Synthesis title:

Cycling Infrastructure

Category: Roads

Other Relevant Topics:

- Pedal Cyclists (Riders)
- Traffic Calming (Roads)

Keywords:

Cycle lane,
Cycle track,
Cycle path,
Shared use

About the Road Safety Observatory

The Road Safety Observatory aims to provide free and easy access to independent road safety research and information for anyone working in road safety and for members of the public. It provides summaries and reviews of research on a wide range of road safety issues, along with links to original road safety research reports.

The Road Safety Observatory was created as consultations with relevant parties uncovered a strong demand for easier access to road safety research and information in a format that can be understood by both the public and professionals. This is important for identifying the casualty reduction benefits of different interventions, covering engineering programmes on infrastructure and vehicles, educational material, enforcement and the development of new policy measures.

The Road Safety Observatory was designed and developed by an Independent Programme Board consisting of key road safety organisations, including:

- Department for Transport
- The Royal Society for the Prevention of Accidents (RoSPA)
- Road Safety GB
- Parliamentary Advisory Council for Transport Safety (PACTS)
- RoadSafe
- RAC Foundation

By bringing together many of the key road safety governmental and non-governmental organisations, the Observatory hopes to provide one coherent view of key road safety evidence.

The Observatory originally existed as a standalone website, but is now an information hub on the RoSPA website which we hope makes it easy for anyone to access comprehensive reviews of road safety topics.

All of the research reviews produced for the original Road Safety Observatory were submitted to an Evidence Review Panel (which was independent of the programme Board), which reviewed and approved all the research material before it was published to ensure that the Key Facts, Summaries and Research Findings truly reflected the messages in underlying research, including where there may have been contradictions. The Panel also ensured that the papers were free from bias and independent of Government policies or the policies of the individual organisations on the Programme Board.

The Programme Board is not liable for the content of these reviews. The reviews are intended to be free from bias and independent of Government policies and the policies of the individual organisations on the Programme Board. Therefore, they may not always represent the views of all the individual organisations that comprise the Programme Board.

Please be aware that the Road Safety Observatory is not currently being updated; the research and information you will read throughout this paper has not been updated since 2017. If you have any enquiries about the Road Safety Observatory or road safety in general, please contact **help@rospa.com** or call **0121 248 2000**.

How do I use this paper?

This paper consists of an extensive evidence review of key research and information around a key road safety topic. The paper is split into sections to make it easy to find the level of detail you require. The sections are as follows:

Key Facts	A small number of bullet points providing the key facts about the topic, extracted from the findings of the full research review.
Summary	A short discussion of the key aspects of the topic to be aware of, research findings from the review, and how any pertinent issues can be tackled.
Methodology	A description of how the review was put together, including the dates during which the research was compiled, the search terms used to find relevant research papers, and the selection criteria used.
Key Statistics	A range of the most important figures surrounding the topic.
Research Findings	A large number of summaries of key research findings, split into relevant subtopics.
References	A list of all the research reports on which the review has been based. It includes the title, author(s), date, methodology, objectives and key findings of each report, plus a hyperlink to the report itself on its external website.

The programme board would like to extend its warm thanks and appreciation to the many people who contributed to the development of the project, including the individuals and organisations who participated in the initial consultations in 2010.

Key facts

- In Great Britain, cycle traffic levels have fluctuated in recent years, but the trend has been generally upward. Cycle traffic increased by 4 per cent between 2013 and 2014.
- The number of pedal cyclist fatalities has remained between 100 and 118 since 2012. The number increased by 2 per cent from 100 in 2015 to 102 in 2016, and has decreased by 13 per cent from the 2012 to 2016 average.

(RRCGB, DfT, 2017)

- Almost two-thirds of cyclists Killed or Seriously Injured (KSI) were at or near junctions, where the risk is greater.

(J. Knowles *et al,* 2009)

- RTIs are primarily the consequence of human behaviour in a context formed by infrastructure, law and culture, and the behaviour of other road users.

(S. Reid and S. Adams, 2010)

- Cyclists themselves have differing and potentially conflicting needs from infrastructure:
    - Cyclists opting for ‘assertion’ want infrastructure that helps to establish their right to be on the road and that clarifies how the road is to be shared; and,
    - Cyclists opting for ‘avoidance’ want infrastructure that gives them more opportunities to avoid traffic.

(S. Christmas *et al,* 2010)

Summary

Cycling infrastructure is infrastructure that is provided for and used by cyclists. This infrastructure can include on-road provision such as cycle lanes or cycle-friendly junction designs, or off-road provision such as cycle tracks and paths. There are many different types of cycling infrastructure; a number of these are discussed in this synthesis.

Overall there has been an upward trend in people using pedal cycles as a mode of transport in recent years in Great Britain, however this varies in different places, with some areas seeing a significant increase in people cycling whilst there have been smaller increases or decreases in other areas. As the number of cyclists on the roads has increased, the number of cyclist casualties has also generally increased.

In London the number of people using pedal cycles has increased. This in part has been attributed to a number of initiatives, such as the Santander Cycle Hire and Cycle Superhighways schemes, as well as a response to congestion and crowding on other modes of transport

The risk for cyclists is greatest at road junctions, and this can be exacerbated by segregation along links if this places cyclists into conflicting positions and turns when cyclists get to junctions and crossings.

When highway infrastructure changes are made for capacity, safety or network reasons, cyclists' needs should be considered from the start of the project so that cyclists' safety and comfort is built into all elements of the design.

Cyclists have differing and potentially conflicting needs from cycling infrastructure. Confident cyclists favouring speed and directness may prefer to cycle in the carriageway with the rest of the traffic. Other cyclists wanting to avoid conflict with motorists prefer separate cycle lanes, or segregated provision such as shared use paths and cycle tracks.

During cycling infrastructure design it is important to consider both 'actual' road safety measured by the number of casualties in an area and the 'perceived' road safety, i.e. how safe do cyclists feel? It is often possible to improve 'perceived' road safety significantly by providing cycling infrastructure, but it is more difficult to prove that cycling infrastructure has reduced casualty numbers.

If people feel safer when cycling they will be more inclined to cycle more often, which leads to safety in numbers and associated health benefits.

Providing dedicated cycling infrastructure might not always be necessary. Depending on traffic flows and speeds, and the primary function of the road or street, measures to manage speeds and encourage safe sharing of the carriageway may be more appropriate than creating separate facilities, which are more necessary where flows and speeds are high and the road's primary function is for movement. In some circumstances off-road paths can provide cyclists with more direct routes, especially in business parks and residential areas where roads can be less direct and may meander. Off-road paths may also provide opportunities for recreational cyclists and as a means to avoid complex or busy junctions or roads for less confident commuter cyclists.

Research has been conducted on a number of different types of cycling infrastructure including cycle lanes, roundabouts, crossing facilities, advanced stop lines, shared used paths and cycle tracks. The research has highlighted the advantages and disadvantages of each type of cycling infrastructure.

There are a number of gaps in the research; evidence on the amount of cycling activity in the UK needs to be improved. Accurate casualty numbers are also required to assist cycling infrastructure designers.

In conclusion, cycling infrastructure has a role to play in improving road safety for cyclists but should not be used in isolation. A range of interventions should be used including marketing, education, legislation and enforcement to improve the culture of road sharing and road user behaviour.

Methodology

A detailed description of the methodology used to produce this review is provided in the Methodology section of the Observatory website http://www.roadsafetyobservatory.com/Introduction/Methods .

This synthesis was originally compiled during August and September 2012, and most recently updated in July 2016.

Note

This review includes statistics from Reported Road Casualties Great Britain 2014, which were the latest available data when the review was written. In December 2017, statistics from Reported Road Casualties Great Britain were updated to Reported Road Casualties Great Britain 2016.

The steps taken to produce this synthesis are outlined below:

- **Identification of relevant research** – searches were carried out on pre-defined research (and data) repositories. As part of the initial search some additional information sources were also consulted, which included www.cyclecraft.co.uk, www.cycling-embassy.org.uk and www.sustrans.org.uk. The search terms and words used, but was not limited to:
    - 'Cycling infrastructure';
    - 'Cycle lanes';
    - 'Cycle tracks';
    - 'Cycle paths';
    - 'Shared use paths';
    - 'Advanced stop lines';
    - 'Safety';
    - 'Behaviour'; and,
    - 'Intervention'.

  A total of 73 pieces of relevant research were identified.

- **Initial review of research** –involved evaluating and ranking the 63 pieces of research, based on key criteria, to ensure that the most relevant and effective pieces of research went forward for inclusion in this synthesis. Key criteria included:
    - Relevance – whether the research has adequate focus on cycling infrastructure and linkages to road safety.
    - Age of research – whether the research has been published within the last 15 years (exceptions made for older but highly topical pieces).
    - Interventions – whether the research proves (or disproves) effective interventions to improve cyclist road safety.

  Following the initial review, 30 pieces of research were taken forward to form the basis for this synthesis, 24 of which were published in the UK.

During an update to this synthesis in 2016, 39 additional pieces of research were used as the basis for this synthesis.

- **Detailed review of research** – key facts, figures and findings were extracted from the identified research to highlight the relevant topic issues.

- **Compilation of synthesis** – the output of the detailed review was analysed for commonality and a synthesis written in the agreed format. Note that the entire process from identifying research to compiling the synthesis was conducted in a time bound manner.
- **Review** – the draft synthesis was subjected to extensive review by a subject matter expert, proof reader and an independent Evidence Review Panel.

Please note that the terms Great Britain and UK have been reproduced in this synthesis as they have been used in the associated references.

Key statistics

This section collates key statistics relating to cycling infrastructure.
The average over the five-year period from 2005 to 2009 is used as a basis for comparison when considering road safety trends over a longer period and used as a baseline for the Outcomes Framework for the DfT Strategic Framework for Road Safety.

Number of cyclist casualties

- Cycle traffic levels have fluctuated in recent years, but the trend has been generally upward. Cycle traffic increased by 4 per cent between 2013 and 2014.
- The number of pedal cyclist fatalities has remained between 104 and 118 since 2008. The number increased by 4 per cent from 109 in 2013 to 113 in 2014, and has decreased by 13 per cent from the 2005 to 2009 average.
- Overall, the number of reported killed or seriously injured (KSI) cyclists increased by 8 per cent from 2013 to 2014.
- Pedal cycle KSI casualties have risen steadily since 2004 as have traffic levels. In 2014 the number was 39 per cent higher than the 2005 to 2009 average; over the same period pedal cycle traffic increased by 17 per cent.
- Between 2013 and 2014 the number of slight casualties increased for pedal cyclists by 10 per cent.
- Overall, the number of all pedal cycle casualties has increased by 29 per cent from the 2005 to 2009 average.

(D. Lloyd *et al*, 2015)

- In London, cycling had a 3 per cent modal share in 2015, however cyclists represented 15 per cent of all casualties, 19 per cent of all serious injuries and 7 per cent of all fatalities in 2015.
- When comparing 2015 against the 2005-2009 baseline, pedal cyclist KSI casualties in London have fallen by 8 per cent, this is in the context of the number of cycle journeys nearly doubling over the same period.
- In 2015, there were nine cyclist fatalities in London (a reduction from 13 in 2014). This is the second lowest level on record.
- 78 per cent of pedal cyclist casualties were male, with men making 73 per cent of cycle journeys in London.

(Transport for London, 2016a)

It is widely acknowledged that the number of RTIs involving cyclists is underreported. The National Travel Survey (NTS) and STATS19 are compared within the Road Casualties Great Britain Annual Report 2014:

- The proportion of road users injured in road accidents that were pedal cyclists in the NTS (2012 to 2014) was 14 per cent compared to 9 per cent in STATS19 (2010 to 2014 average).

(D. Lloyd *et al,* 2015)

Location of Road Traffic Incidents (RTIs) involving cyclists

- In 2014, 72 pedal cyclists were killed on built-up roads, 50 were killed on non built-up roads.
- The top three locations for reported RTIs involving pedal cycles were T or staggered junction (41 per cent), not at or within 20 metres of junction (25 per cent) and at roundabouts (15 per cent).

(D. Lloyd *et al,* 2015)

- In 2009 TRL analysed 92 police files where a cyclist was fatally injured in a RTI. These files were from within the Metropolitan and the City of London Police Force areas and covered the period 2001 to 2006. Specific cycling infrastructure was recorded in 28 police files; 16 RTI sites had a cycle lane on the road, 11 of the sites had a shared bus and cycle lane, and 1 site had a shared pedestrian and cycle path.

(M. Keigan *et al,* 2009)

- STATS19 data from 2005-2007 showed that 97 per cent of RTIs involving cyclists, resulting in a serious injury or fatality, were on the main carriageway. Other data indicated that 2 per cent of RTIs were recorded as being on a cycle lane on the main carriageway and 1 per cent were recorded as being on a cycleway/shared footway. It should be noted that STATS19 include only RTIs that occur on the public highway and which were reported to or attended by the police.

(J. Knowles *et al,* 2009)

- RTIs are generally less common on cycling-specific infrastructure than on infrastructure that is not cycling-specific. However, it is noteworthy that in Denmark injury RTIs are more common on on-road cycle lanes than on roads not marked with cycle lanes – perhaps reflecting exposure.

(OECD, 2012)

- Approximately 75 per cent of reported RTIs involving cyclists in Scotland occurred at or near a road junction.

(Transport Scotland, 2010)

- Almost two-thirds of cyclists Killed or Seriously Injured (KSI) were at or near junctions where the risk is greater.

(J. Knowles *et al,* 2009)

- A fairly high proportion of RTIs occur at junctions, between approximately 20 and 50 per cent for fatal RTIs, and 20 and 60 per cent for injury RTIs across OECD (Organisation for Economic Cooperation and Development) countries. Given that cyclists spend a great deal more of their time cycling at other locations, these percentages suggest the risks posed by junctions are high. There is a need for care when designing junctions, which should be 'readable' by all traffic participants and should also be cycle-friendly.

(OECD, 2012)

- Roundabouts are the safest form of at-grade junction for general traffic, however some 10 per cent of all reported RTIs involving cyclists in Scotland occured at roundabouts. Of these, 11 per cent were either serious or fatal and more than 50 per cent involved a motorist entering a roundabout and colliding with a cyclist using the circulatory carriageway. Cyclist RTI rates at roundabouts are four times that for motor vehicle drivers.

(Transport Scotland, 2010)

Contributory factors

- Of the 21,978 known manoeuvres recorded in reported RTIs involving pedal cycles, 75 per cent of pedal cycles were going ahead, 6 per cent were turning right, 3 per cent were going ahead on a right hand bend and 3 per cent were overtaking on the nearside.
- The main contributory factors for all RTIs, attributed to pedal cyclists, were: failed to look properly (23 per cent), failed to judge the other person's path or speed (10 per cent), careless, reckless or in a hurry (9 per cent), and cyclist entering road from pavement (6 per cent).

(D. Lloyd *et al,* 2015)

- The most recent Transport for London factsheet on cyclist collisions and casualties found that in Greater London in 2010, 74 per cent of cyclist casualties were injured whilst going ahead, with 11 per cent being injured whilst performing an overtaking manoeuvre. 5 per cent of pedal cyclist casualties were turning right and 2 per cent were turning left.
- There were 10 fatal pedal cyclist collisions in Greater London in 2010. Two were the result of the cyclist and the other vehicle turning left together; two were the result of a motor vehicle changing lanes to the left across the path of a cyclist; and two were the result of the cyclist riding off the footway and into the path of a motor vehicle. Two fatal collisions involved a cyclist coming into conflict with an HGV of over 7.5 tonnes and a further two involved collisions with a concrete mixing lorry and a skip lorry.
- Cars were the most common vehicle to be involved in a collision with a cyclist, making up 74 per cent of vehicles. This was followed by good vehicles, buses/coaches and taxis.
- The two most frequently recorded contributory factors in collisions were failing to look properly and failing to judge the other person's path or speed. This applied to both cyclists and motor vehicles involved.

(Transport for London, 2011)

- Miscommunications and incorrect expectations about another road user's behaviour appear to be an important factor in explaining crashes resulting from bike-car interactions.

(N. Chaurand, & P. Delhomme, 2013)

- RTIs are primarily the consequence of human behaviour in a context formed by infrastructure, law and culture and the behaviour of other road users.

(S. Reid and S. Adams, 2010)

Investment in cycling infrastructure

- The National Cycle Network, managed by Sustrans, has over 14,000 miles of walking and cycling routes across the UK which include:
    - Scenic traffic-free paths;
    - Quiet roads and lanes;
    - Signed on-road routes; and,
    - Themed long-distance routes.

(Sustrans, 2016)

- Between 2011 and 2015, £374 million has been allocated to support cycle schemes, with considerable funding being invested in the Cycling City and Towns Programme. Overall, around £5 per person was spent annually.
- In 2013, the Department of Transport launched the Cycle Ambition Cities programme which will see Government funding of £191 million over five year to 2018 to build cycle networks in Birmingham, Bristol, Cambridge, Leeds, Manchester, Newcastle and Oxford. This will involve development of new networks of quiet routes, segregated cycleways, improved lighting and parking facilities and improved cycle links to key services. Spending will equate to £10 per person.
- £50 million will be spent from 2016 to 2020 on the Government's long standing Bikeability programme of cycle-training for school children. 1.7 million children have received training since 2010.
- Highways England has published a Cycling Strategy supporting its aim to invest £100 million between 2015-16 and 2020-21 on cycling.
- There are four other main sources of funding for cycling:
    - Department for Transport local transport programmes
    - Other central Government programmes supporting cycling
    - Local body programmes
    - Initiatives led by business and the third sector.

(Department for Transport, 2016a)

- Investment has been split between capital expenditure (£29.2m on cycle lanes, signing, parking facilities and enhanced junction crossings) and revenue expenditure (£14.2m on training, information, marketing and promotion), reflecting the different barriers to cycling (both structural and relating to skills and attitudes). Revenue expenditure quarter-by-quarter has been relatively constant throughout the programme, whereas capital expenditure was more variable. This reflected the more complex and challenging nature of some infrastructure schemes, and the potential delays that occur in the design, approval and implementation of infrastructure.

(R. Redfern, 2011)

- There has also been investment in cycle parking facilities at rail stations, which has subsequently led to significant increases in cycle use as more people combine cycling and rail on their journeys to work or leisure trips. Cycle-rail journeys have increased by 40 per cent between 2010 and 2016 and the number of cycle spaces at railway stations has gone up from 25,000 to over 64,000 over the same period. This is anticipated to reach 75,000 by 2017.
- The Rail Delivery Group (RDG) has provided £29 million since 2012 to improve cycle facilities at railway stations nationwide and has also invested in 'PlusBike', an information portal specifically for cyclists wanting to use train travel.
- In 2015, the Department for Transport granted a further £14.5 million to improve cycle facilities at railway stations.

(Rail Delivery Group, 2016)

Changes in cycle use

- The number of cycling trips has remained fairly constant over recent years, however the average distance people are cycling has increased (by 26 per cent between 2014 and 1995/97) and average cycle trip length is also further (by 36 per cent).

(N. George & K. Kershaw, 2016)

- In 2013/14, 15 per cent of adults cycled at least once a month and 9 per cent cycled at least once a week. More people cycle for recreational purposes (10.3 per cent) than for utility purposes (6.5 per cent).
- Levels of cycling vary across the country. The areas with the highest levels of cycling (at least once per month) were Cambridge (57 per cent), Oxford (39 per cent), South Cambridgeshire (33 per cent), the Isles of Scilly (33 per cent) and York (32 per cent).
- Between 2012/13 and 2013/14 there were significant increases in cycling rates in 35 local authorities. There were also significant increases in the South West and East Midlands regions, and in Tyne and Wear Metropolitan County. In 14 authorities, there was a decrease in cycling rates.

- In London, the proportion of adult residents who cycle at least once per month, has shown a significant decrease over the 4 years from 2010/11 to 2013/14, from 15.7 per cent to 14.2 per cent. Levels of cycling are much higher in Inner London boroughs than in Outer London boroughs. 10 of the 13 Inner London boroughs show cycling levels above the national average (from 15 per cent-24 per cent), whilst 15 of the 20 Outer London boroughs are below the national average (down to 5 per cent in Harrow).
- On average, 20 per cent of men cycle and 10 per cent of women cycle (for any purpose).

(J. Cummings, 2015)

- In 2014, there was a record number of hires on London's Cycle Hire scheme, with over 10 million journeys being made, an increase of 5 per cent from 2012 (the previous highest year) and 25 per cent from 2013.

(Transport for London, 2015)

- In a YouGov survey, commissioned by the Royal Society for the Prevention of Accidents in February 2015, 58 per cent of people said they never cycle, 18 per cent of people said they cycle less often than once every six months, 23 per cent said they cycle at least once every six months, 14 per cent said they cycle at least once a month and 8 per cent of people said they cycle once a week or more often.
- 36 per cent of respondents said that they would like to cycle more than they currently do, with "concerns around the safety of road cycling" (41 per cent) and "concerns about drivers treating me badly when cycling" (31 per cent) being the main reasons given as to what prevents them from cycling more often were. 39 per cent of people said that they would cycle more often if cycling on the roads was safer.

(YouGov, 2015)

- Increased fitness continues to be the main motivator, with saving time and money also driving interest in (more) cycling. Concern about safety is the most commonly mentioned deterrent to increasing/taking up cycling.
- Amongst those considering taking up cycling, concern about safety is the most deterring factor for 69 per cent, with concern about riding ability (11 per cent) and fitness level (10 per cent) substantially less of an issue.
- Regular cyclists are more likely to feel confident cycling on London's roads than occasional cyclists (83 per cent of regular cyclists reported feeling confident).

(SPA Future Thinking, 2011)

- In London Zone 1 (Central London), during the morning peak period, 32 per cent of vehicles on the roads are now bicycles. On some roads in London, bicycles make up to 70 per cent of vehicles. In 2000, the ratio of motorists to cyclists in the morning peak period was 11 to 1. In 2014, the ratio had fallen to 1.7 to 1 (or 2 to 1 in vehicle terms).
- In 2014, there were 645,000 cycle journeys a day across London, equivalent to one fifth of all tube passenger trips.
- By 2016, five new or upgraded Cycle Superhighways are open in London (compared to two in 2011) and four more are under construction or in the planning stages.
- On the stretch of Superhighway across Vauxhall Bridge, 81% of cyclists are using the track during the day, rising to 93% during evening peak times.

(Transport for London, 2016b)

Research findings

Summaries of key findings from several research reports are given below. Further details of the research reviewed, including methodology and findings, are given in the References section.

Cyclist opinions and needs

No two cyclists are the same; each cyclist has different opinions and needs when it comes to cycling infrastructure. These differences are considered in the following section and an understanding of these differences is needed during cycling infrastructure design.

- The cycle infrastructure close to a person's origin and destination of potential journeys is a key facilitator or potential barrier to encouraging cycling.
- Segregated cycle routes may improve cyclist confidence and thereby levels of cycling; however discontinuous cycle lanes at junctions are an issue that needs to be addressed as there is still the risk of conflict.
- It is important to continually upgrade and maintain cycle infrastructure, particularly surface material as this affects perception of comfort and safety.

(A. Hull & C. O'Holleran, 2014)

- People tend to prefer cycling environments which are either separated completely from motorised traffic or have substantial separation.
- Positive environmental factors for cycling were identified as the presence of dedicated cycle routes, separation of cycle facilities from road traffic, high population density, short trip distances, being located close to a cycle route or green space and school cycling promotion projects.
- Negative environmental factors associated with cycling included dangers from traffic, long trip distances, steep hills and relative distance from cycle route.

(Department for Transport, 2016b)

- Both cyclists and non-cyclists have a strong preference for cycling with higher levels of separation from motorised traffic, such as on routes entirely away from roads, segregated tracks or streets without motorised traffic.
- Reducing traffic speeds are of lesser importance when compared to cycle infrastructure or reducing traffic volumes.

(Transport for London, 2012)

- Cyclists of all abilities agreed that routes which have ‘no facilities’ or ‘bus/cycle lanes’ are the least preferred type of cycle route. A small proportion of very confident cyclists particularly valued short journey times and direct facilities with low cyclist volumes. The type of infrastructure and traffic speeds was not of significance to them.

(B. Caulfield *et al*, 2012)

- A baseline survey revealed cycling infrastructure (or lack thereof) was potentially a key barrier to increasing cycling. Non-cyclists who expressed an interest in starting to cycle and existing occasional cyclists were particularly in favour of cycle routes which were separate from traffic, and also reported concerns about the safety of parking a cycle on the street. Interventions to improve cycling infrastructure (including routes and parking) may well therefore be critical to enabling more people from these groups to start cycling.

(R. Redfern, 2011)

- Novice and intermediate users will favour traffic free routes or roads with low traffic volumes and speeds. Experienced cyclists will be confident sharing space with road traffic. Where a high proportion of the target users are likely to be novice cyclists (for example, younger school children), off-carriageway routes or quiet streets are most effective.
- People with cycle child seats, trailers, trailer cycles, rickshaws, tandems and tricycles, as well as disabled people using hand-cranked cycles all have specialised needs and should be catered for, particularly in situations with high levels of leisure or family cycling. They require wider facilities without sharp bends, pinch points or other features that can require cyclists to dismount.
- Understanding the motivations of the target users is essential to delivering suitable facilities.

(Transport Scotland, 2010)

- Studies have shown that some road cyclists were confident cycling in traffic and are reluctant to see the implementation of segregated cycle infrastructure if this leads to the erosion of cyclists’ right to use the road. This group represented 17 per cent of people questioned in an academic study.
- Off-road cyclists are not always car averse, they often own and drive cars themselves but wish to see more restrictions placed on the use (and cultural symbolism) of cars in urban areas. There is also the desire for segregated cycle tracks which are ‘perceived’ to benefit people travelling on foot (reduced danger/conflict because of pavement cycling) and cyclists (reduced danger/conflict because of motor traffic). This group represented 16 per cent of people questioned in an academic study.

(C. Pooley *et al*, 2011)

- Between 50 per cent and 63 per cent of respondents in each group surveyed during a baseline evaluation of households in the Cycling Cities and Towns (CCTs) programme areas agreed with the statement that safe routes existed for cycling in their area. This indicated that perceptions of safety are not merely related to the availability of routes or paths for cyclists, but also a consequence of other factors which could include an individual's cycling ability, experience and confidence.

  (R. Redfern, 2011)

- Cyclists themselves have differing and potentially conflicting needs from infrastructure:
  - Cyclists opting for 'assertion' want infrastructure that helps to establish their right to be on the road and that clarifies how the road is to be shared; and,
  - Cyclists opting for 'avoidance' want infrastructure that gives them more opportunities to avoid traffic.

  (S. Christmas *et al,* 2010)

- Cyclists should be catered for on the carriageway.
- Cyclists have a preference for direct routes with no barriers, i.e. obstacles that require cyclists to dismount. Where cycle routes do not take into account desire lines and require cyclists to have to stop to give way to traffic, cyclists are less likely to use them.
- Traffic conditions have a significant effect on cyclist behaviour and choices of routes. Where there are high traffic volumes or speeds that would discourage cycling on the road, measures should be put in place to enable safe cycling.

  (CIHT, 2010)

Measuring 'actual' and 'perceived' risk

When evaluating cycling infrastructure it is important to consider the difference between 'actual' road safety and 'perceived' safety. It is often 'perceived' road safety that encourages or discourages people from using cycling infrastructure. This section describes the ways in which researchers have attempted to distinguish between and measure both 'perceived' and 'actual' safety through questionnaires and interviews.

- During an academic study conducted in 2011, questionnaires and interviews identified a number of negative associations with cycling, including the need to negotiate difficult road junctions, cycling being a bad experience using existing roads, and desire for more cycle lanes to feel safer, which together indicate notable safety concerns. Indeed poor safety was one of the key reasons for not cycling, expressed by approximately 80 per cent of respondents.

  (C. Pooley *et al*, 2011)

- A potential cyclist's perception of the safety of cycling in their neighbourhood is the determining factor in their decision to take up cycling.

(A. Hull & C. O'Holleran, 2014)

- Route choices and decisions to cycle are affected by perceptions of safety. A lack of safety is a major deterrent to cycling, mostly related to motorised traffic and weather.
- A discordance between what is safe according to empirical evidence (observed risk) and what is perceived as safe (perceived risk) by cyclists means that even where protective cycle infrastructure is built, people may still choose not to cycle.
- A study from Canada identified major streets with shared lanes as having the greatest perceived risk by cyclists, followed by major streets without bicycle infrastructure.

(M. Winters *et al,* 2012)

- In a French study, when asked to estimate risk of different interactions with motorised traffic, sample of experienced cyclists perceived tailgating as the most risky situation and not signalling at a left turn (equivalent to a right turn in the UK) as the least risky situation.
- Cyclists perceive greater risk when interacting with cars than with other bicycles.
- Experienced cyclists perceived there to be less risk if they were the ones to be carrying out a risky behaviour than if it was the car driver.
- The study found that factors known to influence drivers' perceived risk, also affect cyclists' perceived risk: skill and experience.
- Perceived risk was found to increase with helmet wearing whilst cycling.

(N. Chaurand, & P. Delhomme, 2013)

- A sense of security is the cyclist's perception of what cycling in traffic feels like, whereas safety is the 'actual' recording of RTIs. A sense of security (or insecurity) can be recorded by different types of interviews: focus groups, telephone interviews, street surveys. Safety (or number of RTIs rather) is registered by the police, and categorised according to whether or not the situation involves personal injury. RTI rates can be calculated on the basis of number, density and frequency.
- Indeed, it is rather the cyclist's sense of security, i.e. the cyclist's, of being safe, that actually encourages cycling. For many people perceived safety is a reason for not cycling. An increase in perceived safety is often an explicit objective of infrastructure plans and strategies, but this is generally less clearly formulated than road safety objectives. This is due to the fact that it is more difficult to measure a 'perceived' sense of security (fear of being involved in an RTI).

(T. Andersen *et al*, 2012)

- A person's perception of safety can contribute significantly to their fear of cycling; therefore it is important to address' perceived' safety as much as, or more than, 'actual' safety. On the other hand, 'actual' safety also needs to be addressed, and a balance between choosing infrastructure that is appealing to people interested in cycling, and 'actual' safety, needs to be reached.

(S. Kingham *et al,* 2011)

- Investments in cycle infrastructure generally have a larger impact on the qualitative perception of safety than on measurable quantities. Generally, the 'perceived' improvement of safety is not (fully) reflected by the observed decrease in RTIs.
- Although road safety is considered to be vital by both cycle users and policy makers, there was a remarkable contrast between the impacts of the facilities on the 'actual' and the 'perceived' road safety: road safety data showed no or very minor impacts, whereas the 'perceived' road safety improved substantially. Policy makers were disappointed by the marginal impact of the facilities on the 'actual' road safety figures.

(K. van Goeverden and T. Godefrooij, 2011)

Cycling infrastructure design

It is important that cycling infrastructure is well designed, fit for purpose and takes both 'perceived' and 'actual' safety into account. The following section discusses the requirements for cycling infrastructure and how RTI statistics can be used to pinpoint areas where new cycling infrastructure might be required. It also highlights how cycling infrastructure evaluation is essential to ensure continual improvements are made.

There are numerous guidance documents intended to inform the design of cycling infrastructure in the UK. These include:

- London Cycling Design Standards (Transport for London, 2014)
- Handbook for Cycle-Friendly Design (Sustrans 2014)
- Shared use Routes for Pedestrians and Cyclists (Local Transport Note 1/12) (Department for Transport 2012)
- Cycling by Design (Transport Scotland, 2010)
- Cycle Infrastructure Design (Local Transport Note 2/08) (Department for Transport 2008) (in part superseded by Local Transport Note 1/12)

Although it does not provide design guidance, Traffic signs regulations and general directions (Department for Transport, 2016) defines the types of signs and markings that are permitted on the highway.

- The preferred approach to designing cycle infrastructure and cycle friendly streets is to create conditions on the road that cyclists are comfortable to ride in. This may require speed reduction measures to be put in place or the allocation of cycle facilities away from traffic.

(CIHT, 2010)

- In design, cyclists' needs are represented by five core principles (safety, coherence, directness, comfort and attractiveness) which summarise the desirable requirements for cycling infrastructure. In terms of safety, design should minimise the potential for 'actual' and 'perceived' RTI risk. 'Perceived' risk is a key barrier to cycle use and users should feel safe as well as be safe. It is important to provide consistency of design and avoid ambiguity.

  (Transport Scotland, 2010)

- Safety must always be the top priority, however, utility routes and recreational routes have different priorities in terms of directness, cohesion, comfort and attractiveness.

- The physical design of the infrastructure needs to take into consideration the physical space needs of cycling, including the dimensions of the cyclist and the bicycle and the physical characteristics of the activity of riding a bicycle.

  (D. Dufour 2010)

- Infrastructure should be designed in a way that demonstrates that cyclists are at least as important as motorised traffic on the highway network, with cyclists being given an advantage in terms of directness and priority where possible.

  (Sustrans, 2014)

- In building new infrastructure, it is important to follow desire lines and improve the quality of the surrounding cycle network.

  (Department for Transport, 2016b)

- Cycle facilities must be well designed, constructed and looked after. A variety of potential users should be involved in formulating ideas on where routes and individual links would be useful. There must be official acknowledgment that cyclists are not a homogeneous group, and that different categories of rider require different types of provision in certain circumstances.

- Cycling facilities can also make the road-sharing problem worse if they create additional confusion about where cyclists and drivers are meant to go. The key issues are:

  - Infrastructure that is too complex and needs to be decoded by the user;
  - A failure to communicate to people how to use innovative infrastructure; and,
  - A lack of consistency from one place to the next.

  (S. Christmas *et al,* 2010)

- It has become clear that most national authorities and many regional/municipal authorities simply lack the basis on which to assess both cyclists' safety and the impact of 'safety-improving' policies. At the core of safety assessment is the calculation of RTI incidence rates (typically split into fatal RTIs and others of varying degrees of severity). Schematically, safety (expressed as the RTI incidence rate) is the number of RTIs divided by a measure of exposure or cycle usage. In

many cases both numerator and denominator are inadequately measured or may be missing altogether.

(OECD, 2012)

- RTI data is also an important feature to review. A plot of the whole network can help identify cluster sites, while an investigation of all injury RTIs at a particular site may help to reveal a trend. The data may help to support or suggest a particular engineering solution.

(A. Lord, 2009)

The hierarchy of measures

Until recently, much UK guidance on cycling infrastructure (including DfT's) was based upon the concept of a 'hierarchy of measures'. This sought to prioritise measures to increase safety for cyclists within the carriageway over creating segregated facilities, reflecting a concern that over-emphasising segregation can lead to loss of priority and greater risk of conflict at junctions, as well as conflict with pedestrians. More recent guidance, in particular the London Cycle Design Standards (2014) defines a list of 'core design outcomes' and a classification of road types according to 'Place' and 'Movement' functions in order to define the most appropriate form of provision for cyclists at a particular location.

The following section summarises the hierarchy of measures approach.

- The hierarchy of measures looks to make existing carriageways safe for use by cyclists before considering off-carriageway facilities as an option.

(Transport Scotland, 2010)

- The measures are described below with the top level being the most preferable intervention:
  - Traffic reduction - can traffic volumes be reduced sufficiently to achieve the desired improvements in safety and attractiveness for cyclists?
  - Speed reduction and traffic calming - can vehicle speed be reduced and driver behaviour modified to achieve the desired improvements?
  - Junction treatment and traffic management - can the problems that cyclists encounter, at particularly large roundabouts and RTI locations, be treated by specific junction treatment or other traffic management solutions?
  - Redistribution of the carriageway- can the carriageway be redistributed to give more space for cyclists? Examples of interventions include cycle lanes, cycle lanes on roundabouts, crossing facilities, Advanced Stop Lines (ASLs) and contra flow cycling.
  - Off-road provision - having considered and where possible implemented the above, are any off-carriageway facilities such as cycle tracks necessary?

(Ove Arup & Partners Ltd, 2008)

Core design outcomes

This section summarises the most recent approach used by The London Cycling Design Standards (2014) which specifies at list of six design outcomes, which together describe what good design for cycling should achieve.

The six core design principles are based on international best practice and consensus within London about adopting certain aspects of this practice in the UK:

- Safety - infrastructure should help to make cycling safer and address perceptions of cycling being unsafe, particularly at junctions. Space is an important consideration when considering safety.
- Directness - cycle routes should be as direct as possible, whilst being logical, and avoiding unnecessary obstacles and delays to a journey. Planning routes as part of a network is key.
- Comfort - surfaces which cyclists ride on should be fit for purpose, enable smooth riding and be well constructed and maintained.
- Coherence - infrastructure should be easy to understand and follow for all users.
- Attractiveness – infrastructure should add to the attractiveness of the public realm whilst not contributing to unnecessary street clutter.
- Adaptability – infrastructure should accommodate all types and experiences of cyclist and should be designed taking into account an increase in cyclists in the future.

(Transport for London, 2014)

There is also the principle that the form of cycling infrastructure that is appropriate for a given location will be influenced by the local context and ‘function’ of the road. This is considered as ‘Movement’, i.e. the purpose of getting people and vehicles from one place to another, and ‘Place’, the purpose of a street in providing space where people live, shop, work, meet, view the streetscape etc. Where ‘Movement’ is considered to be the priority then segregated facilities are more likely to be required, whereas if ‘Place’ dominates then spaces are more likely to be shared, and vehicle flows and speeds restricted.

(Transport for London, 2014, CIHT, 2010)

The following sub headings describe the cycling infrastructure associated with each level of measures.

Traffic reduction, speed reduction and traffic calming

In some circumstances it may be possible to create roads which are more suitable for cyclists. This can be achieved by reducing the amount of traffic and reducing traffic speed with signs and traffic calming measures without providing specific infrastructure for cyclists.

- With careful design and traffic management, it is sometimes possible to cater for the needs of pedestrians and cyclists without providing obvious measures such as cycle lanes and subways. This concept is often referred to as 'invisible infrastructure' and its importance should not be underestimated.

  (DfT, 2004)

- Routes do not necessarily have to be segregated cycle facilities or even designated cycle routes – a quiet urban street or country lane may be an excellent cycle 'facility'. The important aspect is the quality (the level of service for cycling) that the infrastructure provides.

  (K. van Goeverden and T. Godefrooij, 2011)

- There is a trend in Europe towards prioritising the needs of pedestrians and cyclists over the needs of car drivers in areas of 'shared space'.

- Cities in the Netherlands, Denmark and Germany have implemented traffic calming measures and 20 mph speed limits in residential area and in some areas restricted traffic routes. From these countries, the evidence suggests that slow speed zones are a key aspect of increasing cycling. In the Netherlands 27 per cent of all trips are by bike, 18 per cent in Denmark and 10 per cent in Germany.

- In 2011, two streets in Bristol were restricted to 20mph speed limits. Other traffic calming measures including street markings, road signs and vehicle activated signs were also used. Within 6 months, there was a 12 per cent increase in cycling and walking.

  (M. Cedaño-Tovar and I. Kilbane Dawe, 2013)

Reducing levels of traffic in general and slowing down traffic can also result in a reduction in both cyclist and pedestrian casualties.

- Evidence from Portsmouth, Barcelona and Brussels suggests that 20 mph zones increase road safety and perceptions of road safety, resulting in higher levels of walking and cycling.

- Crash occurrences involving cyclists and pedestrians are reduced with lower vehicle speeds and this encourages more people to take up these modes of travel.

- The introduction of 20 mph zones in London between 1986 and 2006 was associated with a reduction in the number of road casualties by 42 per cent. Reductions amongst cyclists were by 17 per cent.

(M. Cedaño-Tovar and I. Kilbane Dawe, 2013)

- There are often broader safety and other benefits to be gained by controlling traffic volume and speed rather than providing cycle-specific measures, particularly where there are high levels of pedestrian, cyclist and/or vehicle interactions.

(Transport Scotland, 2010)

- Of all the interventions to increase cycle safety, the strongest evidence is for the benefits resulting from reduction in motorised vehicle speed. Interventions that achieve this are likely to result in casualty reductions for all classes of road user.

(S. Reid and S. Adams, 2010)

More detailed information relating to traffic calming can be found in the Traffic Calming synthesis.

Junction treatment and traffic management

Junctions are one of the most dangerous parts of the road network for cyclists. Research suggests that reducing traffic speeds at junctions is the most beneficial way of reducing RTIs in such locations.

- The available distance over which the cyclist has visibility to potential hazards, approaching traffic or junctions, is a critical design feature.

(Transport Scotland, 2010)

- Mini roundabouts, clearly designated cycle tracks, and motor traffic speed limit reduction are measures which seem to prevent some junction RTIs on roads with cycle lanes.

(T.Andersen *et al*, 2012)

- Reducing speed of traffic through junctions appears to be an effective approach to reducing cycle casualties and physical calming methods are a reliable means of achieving such a reduction. Signalising, or possibly using more restricted geometrics to reduce speed, is likely to reduce risk at large roundabouts.
- Motor vehicle speeds can be reduced through narrowing of traffic lane widths, taking out slip lanes and tightening corner radii.

(S. Reid and S. Adams, 2011)

- In most circumstances, the safety benefits to cyclists of tighter geometry and the reduction in speed of turning motor vehicles outweighs the risk to cyclists that exists in relation to larger vehicles moving out to the centre of the carriageway to make a left turn.

- Marking cycle lanes through priority junctions (such as T-junctions or crossroads) in the direction of the cycle route can increase subjective safety with respect to the potential of other vehicles to turn across cyclists. The lane markings make drivers more aware of the likely presence of cyclists in the nearside lane.

(Transport for London, 2014)

Traffic signals specifically for cyclists at junctions are also considered to have some safety benefits for cyclists:

- More than 80 per cent of cyclists taking part in an off-road trial were in favour of low level cycle signals. Most cyclists used them as an extra source of information, with about half indicating that the junction felt safer than without any low level signals.

(S. Ball *et al*, 2015a)

- When an early release for cyclists was tested, over 80 per cent of road users were positive about it.
- Typically for each second of early release, the average Clearance Time decreased by one second. A higher proportion of cyclists said the junction was ‘safer’ or ‘much safer’ than an ordinary junction in the trial with an early release (about 85 per cent), compared to the trial without an early release (about 50 per cent).
    - (S. Ball *et al*, 2015b)
- In order to support the needs of cyclists in terms of safety, comfort and directness at junctions, signal timings where possible should minimise delays for cyclists, whilst taking into account the needs of other road users and pedestrians. When calculating inter-green timings or advanced starts for cyclists, enough time should be provided to ensure that cyclists can clear the junction safely, taking into account the gradient of the road.

(Transport for London, 2014)

Redistribution of the carriageway

“Reallocation of road space makes an important statement about the relative priority of different transport users, as it not only promotes cycling but can act as a restraint on motor traffic, which is an important aspect of transport and planning policy in congested urban areas”.

(Sustrans, 2014)

Cycle lanes

There is conflicting evidence on the effectiveness of cycle lanes. Mandatory cycle lanes, marked with a solid white line, prevent vehicles from driving or parking in the lane; whilst advisory cycle lanes, marked by a broken white line, allow vehicles to drive and park on the lane unless other restrictions, such as parking controls, are provided.

- The purpose of cycle lanes is to allocate and demarcate space for cyclists within a carriageway in order to:
    - Increase drivers’ awareness of cyclists;
    - Encourage drivers to leave space for cyclists;
    - Give people greater confidence to cycle on the road network;
    - Improve ‘perceived’ and ‘actual’ safety;
    - Assist cyclists to pass queuing traffic;
    - Encourage lane discipline by cyclists and motor vehicle drivers; and,
    - Help to confirm a route for cyclists.

  (Transport Scotland, 2010)

- Cycle lanes result in significant RTI reduction on on-road sections, but may cause safety issues at junctions. Three different studies in Denmark showed a 10 per cent rise in the number of cycling RTIs when cycle lanes were installed in urban areas. The total increase in the number of RTIs covers a major drop on road sections and a major increase at junctions.

  (T. Andersen *et al*, 2012)

- Cycle lanes have become an increasingly common facility aimed at encouraging cycling, through the provision of space for cyclists on the road. Advantages include the opportunity for cyclists to undertake queuing traffic; however disadvantages arise when there is insufficient width to pass vehicles whilst maintaining space from the kerb. No evidence has shown directly that cycle lane presence reduces the perceived risk of cycling.

  (D. Frings *et al,* 2014)

- Although cycle lanes can generally benefit cyclists, lanes that are poorly designed and constructed can make cycling conditions more difficult and there is no legal requirement for the cyclist to use them.

  (Ove Arup & Partners Ltd, 2008)

- Drivers leave less space when overtaking cyclists when there is the presence of a cycle lane on higher speed roads.

  (J. Parkin & C. Meyers, 2010)

- Cycle lanes are often misinterpreted by drivers as defining the space for a cyclist and where roads are narrower this can lead to faster and closer overtaking manoeuvres than if there was no lane present.
- Coloured cycle lanes appeared to reduce overtaking distances slightly, compared to non-coloured lanes, possibly because drivers view cyclists as being in a defined zone in coloured cycle lanes and therefore do not see the need to allow additional space and hence pass closer.

(K. Stewart & A. McHale, 2014)

- Cycle lanes appear to have little impact on road safety targets, but there is clear evidence of safety benefits in continuing lanes across junctions.

(Transport for London, 2005).

- Reid and Adams also highlighted there was inadequate UK evidence which suggested that marked cycle lanes provide a safety benefit. They also found that behavioural indicators such as how much space motorists provided cyclists when overtaking can show deterioration in some circumstances.

(S. Reid and S. Adams, 2010)

- A major drawback of advisory cycle lanes between junctions is that at times of the day when parking and loading is permitted, cyclists using the lane have to pull out round parked vehicles. This can cause resentment with cyclists who feel that “the vehicle is parked on my cycle lane”. Other northern European countries do not use advisory kerbside cycle lanes, primarily for this reason. In situations where kerbside parking or unloading is legally permitted at some times of the day, the use of time-limited mandatory cycle lanes is preferred to advisory cycle lanes.

(Transport for London, 2005)

- From the perspective of Other Road Users (ORUs), the principle benefit of cycle lanes is that they get cyclists out of their way. When cycle lanes are provided, there is an expectation that cyclists should not be on the road.
- There is concern among some ORUs about cycle facilities which make life harder for ORUs, for example by ‘taking away’ some of their space, or allowing cyclists already passed to get back in front again.
- From the cyclist’s perspective, inadequate cycle facilities can diminish the legitimacy of cycles on the road even further without actually providing a viable alternative.

(S. Christmas *et al,* 2010)

- An experiment carried out by TRL looking into cycle lane segregation found that hard margin kerbs were preferred by car drivers and cyclists compared to a solid white line. One metre high marker posts were perceived to offer improved safety and usability over white line separation for road users.

(G. Beard, 2014)

- An alternative to providing cycle lanes is to increase the width of the nearside lane in the main carriageway. This enables drivers to have greater clearance when overtake cyclists and also makes it easier for cyclists to avoid drainage gratings and other hazards commonly found at the edge of the carriageway.
- Cycle lanes are not necessarily suitable for all road designs and can encourage cyclists to take up an inappropriate road position.

(Ove Arup & Partners, 2008)

Two way cycle tracks on one side of the road, as opposed to one way cycle lanes on each side of the road can have practical advantages as they provide a more flexible use of space than one way cycle lanes that are constrained by traffic. However, they are mixed research findings with respect to safety.

- Two way cycle tracks can be advantageous where cycle flows are tidal, i.e. where there are large flows in one direction during peak times. They can be particularly suitable where streets have buildings and active frontages on one side only or where there are not many side roads on one side.

(Transport for London, 2014)

- Research suggests that one way cycle tracks are generally safer than two way tracks at intersections, however when effective intersection safety measures are implemented, crashes are reduced. This is generally because drivers are only looking in one direction for crossing cyclists.

(B. Thomas & M. DeRobertis, 2013)

- Two way cycle lanes can be confusing to motorists, particularly at night time if adequate segregation is not provided. The potential for conflict is increased where these routes cross side roads as drivers may not expect cyclists to be approaching from both directions. Arrangements for pedestrians also become more complicated as pedestrians may not realise the need to look in both directions before crossing.

(DfT, LTN 2/08)

Cycle lanes on roundabouts

Cycle lanes are not often used on roundabouts but where they are provided they must be well designed to ensure they do not introduce additional hazards. Cycle lanes which help cyclists to maintain visibility and help to show other road users where a cyclist is intending to leave the roundabout can be useful.

- The idea of marking cycle lanes on roundabouts may appear, at first glance, to be a relatively simple one, but it is not. Cycle lanes on roundabouts must be very carefully considered. There is little evidence to suggest that they offer any safety benefits to cyclists, and they may introduce additional hazards. Some cycle lanes on roundabouts have been removed because they led to an increase in RTIs.

(Ove Arup & Partners Ltd, 2008)

- Designers should consider how to create conditions that will allow cyclists to adopt a prominent carriageway position to ensure that they are visible to drivers. Cyclists are only likely to adopt a prominent position if conditions are perceived to be safe.
- Cyclists will feel and be safer on roundabouts where:
    - Approach arm traffic speeds are low;
    - Circulatory carriageway speeds are low; and,
    - Cyclists are positioned prominently and are highly visible both on the approach arms and the circulatory carriageway.
- Where this cannot be achieved, cyclists should be provided with an attractive off-carriageway alternative. Off-carriageway cycle facilities offer a safer route through a roundabout, however these may introduce significant additional journey times to the point that they may be unattractive to use. Off-carriageway facilities should be direct, safe and attractive to use.

(Transport Scotland, 2010)

Research by TRL involving off road testing of a Dutch style roundabout reported the following findings:

- There was acceptance from almost all participants that Dutch style roundabout designs such as that trialled would have some safety benefits for cyclists, mainly due to the segregation.
- The majority of cyclists reported that they would be likely to use the orbital cycle track (in preference to the road) when in heavy traffic, although some more confident cyclists did express concern about its narrow width and high kerbs making overtaking more difficult and risky. Confident cyclists were also more likely to choose to use the main vehicle lane, particularly when turning right or going straight on, to minimise the distance travelled.
- A potential risk area was identified for large vehicles leaving the roundabout, where drivers indicated that they found it difficult to see cyclists on the orbital cycle lane.

(I. York *et al,* 2015)

Signalised crossing facilities

Signalised crossing facilities such as Toucan crossings help cyclists cross main roads and will often link cycle tracks and paths. As with all cycling infrastructure, these facilities should be well designed and sited appropriately to ensure maximum benefit. Where signalised crossings are used, short timings for light changes ensure that cyclists do not attempt to cross the road before the lights turn green for the cyclist.

- Selection of the most appropriate location and form of crossing requires careful assessment. The safety of the vulnerable road user is of paramount importance and a site-specific solution should always be sought.

(Transport Scotland, 2010)

- If more walking and cycling is to be encouraged, pedestrians and cyclists must feel that they are as important as motor traffic and not second class users of the road network; crossing timings will need to reflect this.
- Toucan crossings that have a long delay before giving a green to cyclists once a demand has been registered cause frustration and lead to frequent attempts to cross before the green light appears. Where timings can be adjusted to reduce crossing delays the highway authority should be encouraged to do so.
- The operation of the crossing can be further improved by advance cycle detection through the inclusion of loops or above ground detection on the approaches to a Toucan crossing, in addition to the push buttons, positioned such that the lights change as the cyclist arrives there.

(Sustrans, TIN 18)

Other crossing facilities

The type of crossing being implemented for cyclists to cross a road should be based on the traffic conditions of the road, both in terms of motor traffic and cyclist and pedestrian crossing traffic.

Zebra crossings are not signalised. Although cyclists are allowed to use the part of the Zebra crossings on the carriageway these crossings are not often seen as a cyclist crossing facility. In some circumstances cyclists are not permitted to ride on the track/path either side of the Zebra crossing. Research has been conducted to assess whether Zebra crossings can be adapted to allow cyclists to use them as a dedicated crossing facility. Clear signage and permission for cyclists to ride on paths is required. These shared use crossings are often called Tiger crossings and research suggests that these crossings could be widely used.

- Key concerns involve the safety of cyclists being involved in conflict situations with vehicular traffic, other cyclists, and pedestrians (especially mobility impaired people).
- Primary research has investigated these aspects at six different sites around London. The research found that in practice, 88 per cent of cyclists at the observed sites presently ride over some or the whole of a Zebra crossing. In total there were 1,686 cyclists observed, of which 4 were involved in a level of conflict classed as emergency (sudden emergency actions such as hard braking or turning to avoid collision or a near miss); no RTIs were observed.
- Routes which run adjacent to crossings and require cyclists to look behind them before crossing were particularly risky (perhaps due to the difficulty in assessing vehicles coming from behind), as was the blocking of crossings by queuing vehicles which encourage cyclists to weave through them. Vehicles blocking crossings tended to be more prevalent near to junctions and roundabouts.

- Central reservations provided at existing Zebra crossings are often too small to readily accommodate a cycle. Design standards for disabled users at central reservations should also be suitable for cycle users, and the crossings themselves and approaches to crossings for crossing users should be of sufficient size to accommodate shared use. Crossings for cycle use may benefit from designs which allow adequate time for conflict assessment and avoidance, and this is probably dependent upon cyclist visibility splays. It was found that cyclists tend to avoid high kerbs; this may prove useful in discouraging cyclists from certain risky movements.
- Conflict with pedestrians at the observed study sites was generally of a low quantity and level, but increased slightly at crossings with constricted space layouts. Nothing was noted to suggest that existing guidance on shared use areas would prove inadequate. Generally, Zebra crossings were only slightly more risky than Pelican/Toucan/Puffin crossings from analysed STATS19 data.
- Given the present high use of Zebra crossings by cyclists, it might be considered that the formalisation of their use, coupled with modifications to reduce risk concerns, would not result in extra risk.
- The reaction and attitude of other groups are also unknown, this includes pedestrians, mobility impaired people, and motorists. In particular motorists may be unaware of a change which confers priority to cyclists and thus fail to stop.

(S. Greenshields et al, 2006)

A new type of crossing (sometimes referred to as a ‘Tiger’ crossing) has been included in the latest TSRGD (2015) which provides parallel pedestrian and cyclist crossings without the need for signal controls. The crossing consists of a zebra crossing for pedestrians with a route marked by elephants’ footprints next to it within the controlled area of the crossing.

(Transport for London, 2014)

Advanced Stop Lines

Advanced Stop Lines (ASLs) and bike boxes are used at junctions and provide an area in front of stationary traffic for cyclists to wait. ASLs have various benefits and are not deemed to be a safety hazard but they are often not respected by other road users.

- Studies have revealed that ASLs have been shown to be effective in terms of aiding cyclists' positioning, with 44 per cent more cyclists being able to position themselves in front of (and therefore in sight of) waiting motor vehicles at approaches with an ASL as opposed to those without. Cyclists can also derive further benefit from ASLs, namely:
    - Cyclists are given visible and practical priority over other vehicles upon departing the signals;
    - Cyclists can by-pass any queuing traffic on the approach to the signals;
    - Cyclists are afforded somewhere to wait in an area relatively free of exhaust fumes; and,
    - Cyclists can position themselves to turn right more easily, particularly when the traffic lights are red.
- Where it is proposed to install ASLs at an existing signal installation, the signal engineers responsible for the installation should always be consulted. It is essential that the design of any ASL scheme is informed by relevant data and site observations, and that these are considered for each approach to the junction individually.

(A. Lord, 2009)

- ASLs are primarily a measure designed to increase cyclists' safety by allowing cycle users to move away from traffic signals slightly in advance of motorised traffic. ASL facilities provide a second stop line in advance of the regular line.

(D. Allen *et al,* 2005)

- Cycle ASLs are frequently not respected by other road users and show little safety benefit although the research in this area is particularly limited. ASLs may provide a priority for cyclists and may be applicable where there are heavy flows of right-turning cyclists.

(S. Reid and S. Adams, 2010)

- Based on findings from the sites monitored, low levels of reported conflicts suggest that ASLs are not a safety hazard.
- Seventy-eight per cent of cyclists at the ASL site were able to position themselves in front of the traffic when waiting at signals. This was compared with 54 per cent at the control sites.
- The research has identified that ASLs can support less risky behaviour but do not conclusively prevent (or inspire) risk taking by cyclists.
- Thirty-six per cent of all cyclists across all the ASL sites experienced some form of encroachment by vehicles onto the ASL reservoir.

- The proportion of cyclists found to violate a red light was 4 per cent higher at ASL sites compared with control sites. This suggests a slight propensity to violate at ASL sites, but not to a large extent.

(D. Allen *et al,* 2005)

- Based on trials looking at different sizes of bike boxes, larger boxes were associated with a statistically significant but small decrease in compliance by car drivers, although encroachment tended to by only up to 1.25 metres beyond the first stop line.
- When bike boxes were combined with an early release traffic signal for cyclists, car drivers were more likely to start moving in response to the cyclist signals when there were larger bike boxes (7.5 metres or 10 metres deep).
- Drivers generally considered that the size of the reservoir should be based on the location and volume of cyclists using the junction and acknowledged that a balance should be struck between the space for cyclists and space for motor vehicles.

(S. Ball *et al*, 2015c)

Contra flow cycling

Contra flow cycling is used on one-way streets and allows cyclists to travel against the flow of one-way traffic. A one-way street without contra flow access for cyclists can discourage cycling.

- One-way streets in urban road networks can provide less favourable conditions for cyclists for a number of reasons:
    - Reducing the network permeability for cycling;
    - Increasing the distance required to travel between two points; and,
    - Tending to increase traffic speeds.
- There is anecdotal evidence that where one-way streets and one-way accesses make networks sufficiently impermeable, some cyclists will elect to use them illegally, putting themselves and other road users at risk. Where cyclists can be exempted from one-way restrictions, convenience can be increased and travel time can be reduced, which can help make cycling a more attractive travel choice.

(L. Sewell and M. Nicholson, 2010)

There are two types of contra flow cycling system; those that use signs only and those that use dedicated cycle lanes. For those that use signs only, signs permit cyclists to have access to the street whilst other motorists are not permitted. Often cyclists are unsure whether they can use one-way streets and do not understand that a sign prohibiting access to motorised traffic does not apply to them.

There is limited literature that addresses contra-flow entrance points, with most literature and observations being made on European schemes. A review of previous studies showed that in the UK, the ‘No Entry’ sign is considered one of the most abided by signs. Signs prohibiting motorised traffic, similar to Sign 619 ‘Flying Motorcycle’, have been applied at locations in Denmark, Netherlands and Germany, which has shown that the signing is less widely accepted than a No Entry with a specific cycle exemption.

- During the study there was an increase in the number of cyclists travelling in contra-flow following installation of the ‘No Entry Except Cycles’ sign combination, suggesting a greater understanding of the ‘No Entry Except Cycles’ signing regime than that of the ‘Flying Motorcycle’ sign.
- This study has revealed that the ‘No Entry Except Cyclists’ sign combination is more widely respected than the ‘Flying Motorcycle’ sign and has suggested that the combination is more readily understood by cyclists.

(L. Sewell and M. Nicholson, 2010)

Other contra flow systems include dedicated cycle lanes which allow cyclists to ride against the flow of traffic in a redistributed part of the carriageway. These cycle lanes make it much clearer for both cyclists and other road users that cyclists are permitted to ride against the flow of traffic.

- A mandatory contraflow lane provides protected space for cyclists at all times, and highlights to motorists the need to anticipate cyclists travelling in the contraflow direction. Waiting and loading are often restricted to prevent obstruction of a mandatory contraflow lane, and the remaining width for all vehicles (in the with-flow direction) must be sufficient to allow vehicles to proceed without entering the contraflow cycle lane unless stated by a traffic regulation order.

(Ove Arup & Partners, 2008)

- In a study from Belgium, 992 cycle accidents were analysed, with 12.7 per cent involving cyclists using a contraflow in some way. Only 4.7 per cent of all 992 accidents involved a cyclist travelling in the opposite direction to traffic on a contraflow lane.
- Accidents are proportionately no more likely to involve a cyclist travelling against the flow of traffic than with traffic. Evidence even suggests there are less of these accidents. The implementation of contraflow cycling routes has not led to an increase in cycle accidents on the roads concerned.
- Of the accidents involving a cyclist travelling in the direction opposing traffic, 66 per cent took place at an intersection. The proportion of accidents at intersections when looking at cyclists travelling with traffic was 40 per cent. Therefore, based on the evidence, it appears that on roads located that away from intersections, there is more risk of accident for cyclists travelling with the flow of traffic than against; whereas at intersections, cyclists travelling against the flow of traffic are more at risk of accidents.

- It is important that this risk of accident to cyclists travelling with the flow of traffic is not underestimated, and where necessary solutions must be found.

(I. Chalanton & B. Dupriez, 2014)

Off-road provision, cycle paths and tracks

As mentioned previously the hierarchy of measures promotes the use of on-road cycle lanes where possible. As does the core design principles approach. Where this provision is not appropriate cycle tracks that segregate cyclists from motorists and shared use cycle paths may be appropriate.

- *"In general, cyclists need only be removed from the road where there is an overriding safety requirement that cannot be met by on-carriageway improvements, or where providing an off-carriageway cycle route is an end in its own right"*.

(Department for Transport, 2012)

- In a study looking at six segregated cycle tracks in Montreal, the risk of collision per mile was 28 per cent lower than cycling on roads without cycle tracks.

(A.C. Lusk *et al*, 2011)

Within this synthesis cycle tracks are considered as cycling infrastructure provided next to the carriageway, whether as a fully segregated track for cyclists, physically separated from the pedestrian footway, or a shared use path; or a path that is divided into two sections with one side for pedestrians, the other side for cyclists. These cycle tracks will usually cross side roads and other vehicle accesses. Cycle paths are (usually shared use) paths or trails that are provided away from the carriageway, for example in parks.

Both cycle paths and tracks shift cyclists from the road and can eliminate some of the potential hazards associated with cycling on the road. However, it should be noted that some cyclists will choose not to use cycle paths and tracks if they believe these routes are less direct, lose priority increase conflict or are otherwise unsuitable. The issues associated with side road crossings are discussed in the following section.

Side road crossings

A difficulty facing cyclists using cycle tracks adjacent to the carriageway is the way in which they cross side roads. Often it is quicker and more direct to use the main road where the cyclist has priority over the traffic leaving or entering the side road. On the cycle track a cyclist will have to stop at each side road to check in front and behind them for traffic turning into or coming out of the side road. There are a number of solutions to this problem which include introducing marked cycle crossings across side roads that give cyclists priority, or reintroducing cyclists to the main carriageway. In Denmark and the Netherlands, where segregated cycle tracks are commonplace, drivers of vehicles must give priority to cyclists and pedestrians when they are turning across the cycle track. This is not currently the case in the UK.

- Highway authorities have been reluctant to give priority to cyclists on the cycle track over vehicles on the side road, in case drivers fail to observe the priorities and casualties occur.
- A TRL study conducted in 2000 found that cycle tracks with priority for cyclists across minor side roads appeared to work reasonably satisfactorily in some cases, but some hazardous interactions were also observed. Cyclists remaining on the main road had fewer problems crossing the minor road, although the majority of cyclists used the cycle track, particularly less confident cyclists.
- Most problems were observed at ‘straight across’ type crossings mainly due to poor visibility onto the main road. At all sites there was a significant percentage of cyclists who were unsure or did not understand the traffic priorities at the crossing. The research concluded that improvements to cycling conditions on major roads should be considered before changes to the minor road crossing. Where cycle tracks are provided, crossings of minor roads should be ‘bent out’ (the cycle track is coloured red and raised on a road hump) where site conditions allow.

(A. Pedler and D.G. Davies, 2000)

- The side road crossing is a point of potential conflict between cyclists and motorists. This has to be recognised and the situation managed. By installing a cycle track adjacent to the carriageway, designers are putting the burden of responsibility onto the cyclist to slow down and to check for vehicles coming from three directions (one of which is behind the cyclist), through a visibility angle of 270 degrees.
- When designing any shared use scheme adjacent to the carriageway, emphasis needs to be placed on the treatment of side roads to ensure safety and continuity.
- In general Sustrans recommend that designs should include coloured surfacing and cycle logos on the carriageway surface to highlight the crossing both to drivers and to cyclists, and it should preferably be placed on a raised table so as to reduce vehicle speeds. These interventions are not suitable for high speed roads.

(Sustrans, TIN 12, 2011)

- Based on findings, the probability of cyclists being in a collision was lower at intersections that have raised cycle crossings or other speed reduction methods for traffic turning into side roads.

(J.P. Schepers *et al*, 2011)

- By tightening the geometry of a side road, i.e. reducing the turning radius so that vehicles have to cross the path of cyclists close to the perpendicular, vehicle speeds are reduced and cyclists are placed into the direct line of sight of the driver.
- Raised entry treatments can, when implemented in a suitable location, help reduce the speed of vehicles turning into a side road, thereby addressing some of the risks at side road crossings. They can also be used to suggest priority for cyclists and pedestrians by differentiating the crossing from the carriageway road surface.
- Preventing parking and loading close to junctions also helps maintain visibility at the side road crossing.

(Transport for London, 2014)

- Segregated networks may reduce risk to cyclists in general although evidence suggests that the points at which segregated networks intersect with highways offer heightened risk, potentially of sufficient magnitude to offset the safety benefits of removing cyclists from contact with vehicles in other locations.

(S. Reid and S. Adams, 2010)

Conflicts between cyclists and other user groups

When cyclists use shared use cycle paths and tracks there is a potential conflict between cyclists and pedestrians (and other user groups). Whether to segregate users or not should be carefully considered as there are many arguments for and against segregation. Segregation can remove conflicts but unsegregated paths may encourage cooperative use.

- Research has suggested that when off-road/segregated cycle paths/tracks are provided there can be a shift from cyclist-motorist RTIs to cyclist-cyclist RTIs, cyclist-pedestrian RTIs and single cyclist RTIs. The latter types of RTIs are on average of course less serious than the cyclist-motorist RTIs they replaced.
- One-directional cycle paths and tracks are often considered to be safer than two-directional cycle tracks as conflicts between passing cyclists are reduced.

(K. van Goeverden and T. Godefrooij, 2011)

- Sustrans would normally regard unsegregated paths as the default approach, but each situation needs to be considered on a case by case basis.

- Segregation may be appropriate in certain situations such as where there is a high level of use and adequate space can be provided for each user group. Factors that might suggest that segregation would be preferred include:
    - High pedestrian and / or cycle flow;
    - High proportion of utility cyclists (those cycling to work); and,
    - Locations where significant use by vulnerable pedestrians is expected, especially elderly / visually impaired, such as near residential homes.
- Developing the design of a shared use path, including decisions on segregation, should include early consultation with relevant interested parties such as those representing people with disabilities, walkers and cyclists.
- However, constraints may make it undesirable / impracticable to segregate and unsegregated paths tend to encourage improved behaviour by all user groups.

(Sustrans, TIN 19, 2011, Department for Transport, LTN 1/12, 2012)

Bus stops are a significant area of potential conflict between pedestrians and cyclists where pedestrians have to cross a segregated cycle track to get to the bus stop and wait on a bus stop island with limited capacity.

- Findings from a TRL study concluded that a zebra crossing at a bus stop bypass could reduce the probability of interactions between cyclists and pedestrians. It was generally preferred by trial participants in terms of safety perception and understanding of priority at the facility. Those with visual impairments also found it easier to locate. Both pedestrians and cyclists felt safer with the presence of dropped kerbs at a zebra crossing to the bus stop.
- The inclusion of a ramp at a zebra crossing was proved inconclusive, as although it was preferred by users, the number of interaction rates between cyclists and pedestrians was increased. This may be dependent of pedestrian flows.

(I. York & S. Tong, 2014)

- A study looking at a bus stop along a segregated cycle track in Montreal, Canada found that pedestrians tended to adapt their behaviour to the cyclists. Almost all cyclists were observed to maintain their speed and acceleration whereas pedestrians were seen to take evasive action, i.e. either slowing down or speeding up to a run in response to the movement of the approaching cyclists.

(A.P. Afghari *et al*, 2014)

Cyclists also have potential conflicts with left turning motor vehicles when crossing side roads. Current guidance in the UK, following practice in many other countries, is to take segregated cycle tracks across side roads as an advisory cycle lane across the junction, thereby providing continuity between the segregated sections. However, this can increase the risk of conflict between cyclists travelling straight on and vehicles turning into the side road.

- Left turning vehicles cutting across cyclists travelling straight ahead resulted in two out of ten cyclist fatalities in 2010.

(Transport for London, 2011)

- An analysis of accident data in Copenhagen found that following the introduction of cycle tracks adjacent to the carriageway, accidents at the junction increased by 18 per cent, with a 129 per cent increase in accidents involving right turning vehicles (the equivalent of left turning vehicles in the UK) and cyclists travelling straight.

(S. Jensen *et al*, 2006)

One potential way that this might be addressed is through the setting back of segregation from the junction, allowing cyclists to reintroduce themselves back into traffic before the junction.

- Video observations of a trial looking at segregation set back of a cycle lane crossing a side road consistently showed that the segregation set back distance had little impact on the speed and turning path of motor vehicles until it was within 5 metres of the junction. This is explained by the kerb having the effect of tightening the turning radius when it is close to the junction, thereby requiring the driver turning into the side road to slow down. This can also result in the driver taking a position further away from the kerb.
- Within the 5 metre set back trial, left turning drivers were observed to overtake cyclists at a greater lateral distance, crossing the cycle lane at an angle closer to perpendicular. Not only does this demonstrate that drivers give cyclists more space when they are making a tighter turn, but also that the angle of the turn leads to less encroachment into the cycle lane and thus provides drivers with better visibility of approaching cyclists.
- Where traffic speeds are higher and tighter turning geometries are not considered to be appropriate, ending segregation at least 20 metres before the junction may be more suitable, giving cyclists sufficient space to merge back into the traffic flow and giving time for drivers to respond to their presence.
- When asked, HGV drivers preferred to maximise the extent of segregation from cyclists, rather than having cyclists join the main traffic flow early. This made the turning movement easier, rather than for any perceived safety improvement. Setbacks of 15 to 20 metres were found to be a good compromise that maximised segregation but still enabled HGV drivers to easily make the turn.

(I. York *et al*, 2014)

In a number of countries, including the UK, cyclists are permitted to cycle in bus lanes, meaning that they are likely to have interactions with buses, either by overtaking a bus or being overtaken by a bus. This increases the potential for conflict and risk to safety of cyclists.

- An analysis of injury accidents involving a bicyclist in 2010 in London showed that passing a cyclist too close is among the most frequently registered contributory factors of bicycle accidents.

(Transport for London, 2011)

- In a survey, bus drivers and cyclists both indicated that they consider the overtaking of a cyclist by a bus to be an uncomfortable manoeuvre.

(C. Baumann *et al,* 2012)

- Dangerous interactions between buses and cyclists are relatively frequent, irrespective of the width of the bus lane. These interactions include cyclists overtaking buses and buses following cyclists with small time headway.
- Bus following interactions were found to be more likely on narrower bus lanes as overtaking is more difficult.
- Findings showed that cyclists overtaken by buses ride more closely to the kerb than cyclists not interacting with buses.

(T. De Ceunynck *et al*, 2015)

Maintenance and safety inspections of dedicated cycle facilities

The maintenance of dedicated cycling facilities such as cycle paths and tracks is of paramount importance. Deterioration in surface condition on cycle paths and tracks can discourage use and cyclists will use the carriageway instead, where a smoother surface is available. Inspections by those that are cyclists themselves can highlight maintenance and safety issues more effectively.

- The main purpose of safety inspections is to identify any defects that represent an immediate hazard, a potential hazard or where there is a risk of rapid deterioration that would result in a hazardous defect by the next safety inspection.

(Transport Scotland, 2010)

- Routine and safety inspections are best carried out by someone familiar with cycling to help ensure that the inspector has a better understanding of how even small defects can affect cyclists.

(Ove Arup & Partners Ltd 2008)

- Monitoring is important because it enables local authorities and others to measure the impact of individual measures, cycle networks and the overall cycling strategy.

(BRE for Essex County Council, 2006)

- Where segregated facilities are provided the vulnerability of cyclists to poor surfaces suggests that maintenance is important.

(S. Reid and S. Adams, 2010)

- A route that is kept in good condition will be more popular than one of deteriorating quality and given the level of investment in cycle facilities, it is important that routes continue being well used by cyclists.
- Maintenance should be factored in during the design and development stage, as a high level of design and construction can mean reduced need for maintenance in the future. Funding for maintenance should also be secured early in the development stage.
- Both walking and cycling routes should be kept clean and clear, particularly in the autumn and winter when falling leaves and ice may make these routes for hazardous.
- As the majority of cycling happens on the roads, with cyclists typically riding in the 2 metres closest to the kerb, it is important to ensure that this section of the road is well maintained in order to keep cyclists using it. Pot holes, loose drain covers and debris on the edge of the road can cause problems for cyclists and put them off using cycle lanes.
- Signage also requires maintenance as it is susceptible to vandalism and is a key tool for wayfinding.

(Sustrans, 2014)

Making sure cycle routes are well maintained is even more important than general highway maintenance as even minor degradation can cause a cyclist to fall and poor surface quality can impact cyclists' comfort to the extent that it deters cyclists from using the facility.

(Transport for London, 2014)

Range of interventions

Although cycling infrastructure has a role to play in reducing cycle casualties, using a range of interventions which include training and promotion of cycling can help to raise awareness.

- Infrastructure has a role to play in improving the culture of road sharing. The scale of what can be done in practice is constrained; and any serious attempt to change the culture of road sharing would require a range of coordinated interventions, such as marketing, education, legislation and enforcement. However, infrastructure can play a part alongside these other interventions.

(S. Christmas *et al,* 2010)

- One important point is that the evaluated Dutch interventions (cycle tracks and cycle lanes) were implemented in the situation that the cycle was a common mode and a reasonably good cycle infrastructure was already available. In countries that start 'from scratch' with low cycle use and a poor cycle network, interventions that promote cycling may have different (probably larger) impacts.

(K. van Goeverden and T. Godefrooij, 2011)

- In Exeter, Kempston, Stockton, and parts of Nottingham, casualty numbers fell on most of the main roads in the areas served by the cycle routes, but increased on minor roads in some areas. The results of the study suggest that a combination of cycle route provision and area wide safety management should aid the reduction of cyclist casualties overall. Legislation introduced since the implementation of the routes allows a variety of traffic calming features to be installed, which can be effective in developing such a strategy.

  (DfT, 1995)

- If real net gains are to be made in improving cycling as a mode of transport, future policy and practice in the pursuit of this objective must look beyond the provision of a handful of facilities. These facilities are often strung together or make up one or two isolated but often disjointed routes. A more holistic approach which tackles the entire road network on which the majority of cycling takes place is a priority.

  (Transport Policy, 1996)

How effective?

Reallocation of road space, segregated cycle tracks/paths and cycle crossings at signalised junctions have been shown to be effective in improving conditions for cyclists but there is very little robust evaluation of cycling infrastructure safety. The following statements indicate where and how effective safety interventions have been used:

- In 2005 the Department for Transport compiled a number of success stories to encourage more walking and cycling across England. A number of projects have achieved significant results with often modest, but always well-chosen initiatives, which have improved local conditions for walking and cycling and encouraged people to get around on foot and by bike. One such project involved the reallocation of road spaces for cyclists in Hull. On-road cycle lanes were also introduced on a large number of roads in Hull. The cycle lanes were studied for over three years, and before and after comparisons of RTI statistics and cycle flows have highlighted outstanding results. Decreases in RTI numbers and increase in cycle use have been observed. The outcomes of the intervention included a 45 per cent reduction in cycle casualties.

  (DfT, 2005)

- Studies in Denmark have shown that providing segregated cycle tracks or lanes alongside urban roads reduced deaths among cyclists by 35 per cent.

  (WHO, 2004)

- An RTI study of cycle crossings at signalised junctions in Denmark showed that cycle crossing marking has resulted in a 36 per cent drop in the number of cycle RTIs and a 57 per cent drop in the number of serious cyclist casualties. The study further showed that when cycle crossings were established in major junctions, the greatest reduction occurred in RTIs between right turning cars and cyclists going straight ahead (the equivalent of left turning cars and cyclists going straight ahead in the UK). It seems that motorists may move part of their focus from pedestrians to cyclists since there was a rise in pedestrian RTIs. It must be noted that the study took place on roads where vehicles drive on the right hand side of the road

  (T. Andersen *et al*, 2012)

- Annular cycle lanes around the perimeter of roundabouts may offer no benefit or introduce extra hazards for cyclists. However, the re-design of a priority junction in York to a roundabout with a Compact Design, with annular cycle lanes set 1-1.5m into the roundabout, and advanced give-way lines for cyclists contributed to an 80 per cent reduction in RTIs and an increase in cycle use. The Heworth Green Roundabout design encouraged low vehicle speeds and improvements to the visibility of cyclists. Unless leaving at the next exit, the cyclist is positioned within the visibility of drivers on approach arms. Annular cycle lanes should only be considered as part of a broader range of measures to reduce the circulatory carriageway to a single lane and to encourage low speeds.

  (Transport Scotland, 2010)

Gaps in the research

- It is difficult to draw definitive conclusions from the literature because the range of literature on any one type of infrastructure tends to be limited and studies described are often small scale, in a few locations, or were not monitored for long periods of time.
- There was a notable lack of evidence on the amount of cycling activity in the UK and the exposure of cyclists to different forms of infrastructure. This lack represents a serious barrier to more detailed understanding of how to reduce risk to cyclists.
- There are some approaches to improving cycle safety that are used in other European countries but which are rarely used and have not been assessed in the UK; these include general exemptions from one-way restrictions and false one-way streets. More innovation and experimentation, supported by appropriate monitoring, is recommended.
- There are mixed views reported by local authorities as to the effectiveness of the interventions they have adopted with a common reply being insufficient time and/or data to fully assess the scheme's outcome.

(S. Reid and S. Adams, 2010)

- There is a lack of research related to the new cycle hire and cycle superhighways interventions that have been put in place in London. An evaluation of these schemes would highlight whether schemes should be implemented elsewhere.
- Other research gaps include research related to other road users' perception of cyclists, and the difference between such perception in the UK and other European countries.
- There is limited research into how the different priority and liability rules found in countries with the highest levels of cycling affect the perceived and actual levels of safety for cyclists, or their implications for infrastructure design

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References

Department for Transport research and statistics

Title: Reported Road Casualties Great Britain: 2014 Annual Report
Author / organisation: Department for Transport **Date:** 2015 **Format:** Pdf **Link:** https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/463797/rrcgb-2014.pdf **Free / priced:** Free
Objectives: This report reviews the main trends in the number of reported road traffic incident (RTI) casualties in Great Britain in 2014 and compares these with previous years.
Methodology: Statistical analysis of STATS19 figures collected by the police.
Key Findings: • On-road pedal cycle traffic rose by 3.8 per cent to 3.25 billion vehicle miles in 2014. • This represents a rise of 27 per cent since 2007, which is almost equal to the 31 per cent rise in casualties over the same period. • Cycle traffic increased by 3.8 per cent between 2013 and 2014. • Pedal cyclists accounted for 11 per cent of all road casualties in 2014, 6 per cent of road deaths, 15 per cent of serious injuries and 10 per cent of slight injuries. • Pedal cyclist deaths have fallen over the long term, but have fluctuated between roughly 100 and 120 over the last seven years. • In 2014, 113 pedal cyclist were killed, a 4 per cent increase from 2013. • The number of pedal cyclists seriously injured increased by 8 per cent to 3,401. • There were 21,287 pedal cyclist casualties in 2014, up 9.5 per cent from 2013. • Males make up more than 80 per cent of pedal cyclist casualties. Of the 113 pedal cyclist fatalities in 2014, 18 per cent were female and 82 per cent male. • Reporting rates for pedal cyclists are lower than for other road users, and pedal cyclist non-fatal casualties are amongst the most likely to be underreported, especially where the pedal cycle was the only vehicle in the accident. • Trends in pedal cyclist casualties can be partly explained by changes in how much people cycle. • On urban roads pedal cyclists comprise roughly a fifth of casualties, whereas on rural roads they account for around 10 per cent. • Most pedal cyclist killed or seriously injured casualties occur at crossroads and t-staggered junctions. • The main contributory factors for all RTIs, attributed to pedal cyclists were: failed to look properly (23 per cent), failed to judge the other person's path or speed (10 per cent), careless, reckless or in a hurry (9 per cent) and cyclist entering from pavement (6 per cent).
Themes: Cyclist, cycle, casualties.
Comments: This report is based on STATS19 data and provides reliable statistics.

Title: Evaluation of the Cycling City and Towns Programme, Interim Report

Author / organisation: R. Redfern (AECOM for Department for Transport)
Date: 2011
Format: Pdf
Link:http://www.dft.gov.uk/publications/cycling-city-and-towns-programme-interim-report
Free / priced: Free

Objectives: The aims of the evaluation were to:

- Measure the extent to which the anticipated outcomes and wider impacts have been achieved through the Cycling City and Towns (CCT) programme and to assess whether it has provided value for money.
- Assess the effectiveness of individual interventions, including those targeted towards specific population groups and journeys.
- Understand the factors which influence local travel behaviours and how these can be addressed to encourage cycling behaviours.
- Explore the approaches which have been critical to the success of the programme.
- Generate evidence of good practice which can be used to inform the design and delivery of future initiatives aimed at encouraging cycling.

Methodology: This report presents the interim findings of the evaluation of the Cycling City and Towns programme. The aim of the report is to share emerging messages about the factors influencing cycling behaviour, and explore the potential benefits of increasing cycling levels amongst different groups of the population, particularly in terms of health and physical activity, reductions in carbon emissions, and decongestion. An independent programme of monitoring and evaluation has been commissioned to assess robustly the outcomes and longer-term impacts of the CCT programme, as well as to capture lessons about the design and delivery of local cycling schemes. The evaluation is investigating what has changed in the CCTs, why it has changed, and the context for change. The research consisted of:

- A baseline survey of households in the programme areas.
- Interviews with CCT delivery teams.
- Monitoring of expenditure and delivery of interventions.

The subgroups were:

- Group 1 - Non-cyclists who indicated no intention to start cycling (46 per cent of adult respondents to the baseline survey attitudes module);
- Group 2 - Non-cyclists who indicated that there was a possibility they would start cycling in future (11 per cent);
- Group 3 - Cyclists who did not indicate an intention to cycle more frequently (24 per cent);
- Group 4 - Cyclists who indicated that they intended to cycle more frequently in future (4 per cent); and
- Group 5 - Non-cyclists who reported being unable to cycle due to disability or health problems (15 per cent).

Key Findings:

- Between 2008 and 2011, the Department for Transport and the Department of Health will have invested over £43m (plus local match funding) to create the Cycling City and Towns (CCTs): Greater Bristol, Blackpool, Cambridge, Chester, Colchester, Leighton-Linslade, Shrewsbury, Stoke, Southend, Southport.
- Investment has been split between capital expenditure (£29.2m on cycle lanes, signing, parking facilities and enhanced junction crossings) and revenue expenditure (£14.2m on training, information, marketing and promotion), reflecting the different barriers to cycling (both structural and relating to skills and attitudes). Revenue expenditure quarter-by-quarter has been relatively constant throughout programme, whereas capital expenditure was more variable. This reflected the more complex and challenging nature of some infrastructure schemes, and the potential delays that occur in the design, approval and implementation of infrastructure.
- The barriers to cycling identified by the analysis included the 'perceived' safety of cycling on roads with other traffic, which was a concern for the majority of each population sub-group. Furthermore, over 30 per cent of respondents who indicated they might start cycling or cycle more often but felt it would be unsafe to do so in their local neighbourhood. Over three quarters of all respondents therefore supported an increase in the provision of separate cycle routes.
- All other groups had between 52 per cent and 65 per cent of respondents who considered it 'too dangerous' for them to cycle on roads.
- One possible explanation for these 'perceived' safety concerns could have been the levels of provision of cycle routes within each individual neighbourhood. The majority of respondents in each group supported the provision of separate cycle routes and a majority of respondents in group 3, which included the most frequent existing cyclists, supported the further re-allocation of road space to cyclists.
- However, between 50 per cent and 63 per cent of respondents in each group agreed with the statement that safe routes existed for cycling in their area. This indicated that perceptions of safety are not merely related to the availability of routes or paths for cyclists, but also a consequence of other factors which could include an individual's cycling ability, experience and confidence.
- As the baseline survey revealed cycling infrastructure (or lack thereof) was potentially a key barrier to increasing cycling. Non-cyclists who expressed an interest in starting to cycle and existing occasional cyclists were particularly in favour of cycle routes which were separate from traffic, and also reported concerns about the safety of parking a cycle on the street. Interventions to improve cycling infrastructure (including routes and parking) may well therefore be critical to enabling more people from these groups to start cycling.

Themes: Cycling infrastructure, separation from traffic.

Comments: Provides an insight into the opinions of cyclists and potential cyclists.

Title: Infrastructure and cyclist safety (Published Project Report PPR580)

Author / organisation: S. Reid and S. Adams (TRL for Department of Transport)
Date: 2010 **Format:** Pdf
Link: https://trl.co.uk/reports/PPR580
Free / priced: Free

Objectives:

- Summarise an analysis of police recorded cyclist casualties to identify what is known about RTIs and the involvement of infrastructure;
- Present headline conclusions obtained from a Local Authority cycle safety survey; and,
- Summarise evidence from published literature on the extent to which various forms of infrastructure impact on cyclist safety.

Methodology: This review considers the role of infrastructure in the causation and reduction of injuries to cyclist. It was undertaken as part of a wider research programme, Road User Safety and Cycling, being led by TRL on behalf of the Department for Transport. As part of the programme, an international review of literature was undertaken to establish what is already known about casualties involving cyclists. A Local Authority cycle safety survey was also conducted.

Key Findings:

- Drawing a hard distinction between infrastructure and behaviour is problematic. Casualty outcomes are primarily the consequence of human behaviour in a context formed by infrastructure, law and culture and the behaviour of other road users.
- It proved difficult to draw definitive conclusions from the literature because the range of literature on any one type of infrastructure tended to be limited and studies described were small scale, in a few locations or were not monitored for long periods of time.
- There was a notable lack of evidence on the amount of cycling activity in the UK and the exposure of cyclists to different forms of infrastructure. This lack represents a serious barrier to more detailed understanding of how to reduce risk to cyclists.
- Of all the interventions to increase cycle safety, the strongest evidence is for the benefits resulting from reduction in motorised vehicle speed. Interventions that achieve this are likely to result in casualty reductions for all classes of road user.
- Taken as a whole, the most significant infrastructure-related risk factors for cyclists in single vehicle incidents on highways appear to be slippery roads (due to weather) and poor or defective road surfaces. For multi-vehicle RTIs the infrastructure risk factors appear to be speed limits and encounters with other road users at junctions.
- Junctions – reducing speed of traffic through junctions appears to be an effective approach to reducing cycle casualties and physical calming methods are a reliable means of achieving such a reduction. Signalising, or possibly using more restricted geometrics to reduce speed, is likely to reduce risk at large roundabouts.

- Cycle Advanced Stop Lines (ASLs) – are frequently not respected by other road users and show little safety benefit although the research in this areas is particularly limited. ASLs may provide a priority for cyclists and may be applicable where there are heavy flows of right-turning cyclists.
- Cycle lanes on the carriageway – There is little UK evidence that marked cycle lanes provide a safety benefit and behavioural indicators such as passing of motorised vehicles can show deterioration in some circumstances.
- Segregated networks – may reduce risk to cyclists in general although evidence suggests that the points at which segregated networks intersect with highways offer heightened risk, potentially of sufficient magnitude to offset the safety benefits of removing cyclists from contact with vehicles in other locations. Cycling infrastructure away from the highway may reduce the typical severity of casualties however the data collected nationally does not allow this to be determined reliably. Where segregated facilities are provided the vulnerability of cyclists to poor surfaces suggests that maintenance is important.
- There are some approaches to improving cycle safety that are in use in other European countries but which are rarely used and have not been assessed in the UK, these include general exemptions from one-way restrictions and false one-way streets. More innovation and experimentation, supported by appropriate monitoring is recommended.
- Taken as a whole, the inventions used by local authorities represent four broad approaches:
    - Mediating the interaction cyclists and other road users at junctions and other points where cyclists' desire-lines conflict with motor vehicles;
    - Removing cyclists from conflict with motor vehicles by creating alternative routes or network for cycling;
    - Reserving space for cyclists within the carriageway on either an advisory or compulsory basis; and,
    - Measures to reduce traffic speed.

- There are mixed views reported by respondents as to the effectiveness of the interventions they have adopted with a common reply being insufficient time and/or data to fully assess the scheme's outcome.
- Cycling in the UK is more than twice as risky as in Sweden and the Netherlands. This likely to be the consequence of a range of factors, of which infrastructure is only one.

Themes: Junctions, Advanced Stop Lines, cycle lanes, local authority.

Comments: Highlights gaps in research.

Title: Cycling, Safety and Sharing the Road: Qualitative Research with Cyclists and Other Road Users (Road Safety Web Publication No.17 (RSWP 17))

Author / organisation: S. Christmas, S. Helman, S. Buttress, C. Newman and R. Hutchins **Date:** 2010

Format: Pdf

http://webarchive.nationalarchives.gov.uk/20121105134522/http://www.dft.gov.uk/publications/rsrr-theme1-report-17/

Free / priced: Free

Objectives: The purpose of this report is largely 'descriptive', aiming to provide a map of the diversity of safety-relevant motivations, attitudes, perceptions and behaviour among cyclists and Other Road Users (ORUs).

Methodology: This report presents findings from qualitative research carried out with cyclists and other road-users in June 2009.

Key Findings:

- There is evidence of a deeper failure in the culture of road sharing on English roads, which may have important implications for different road-users' interpretations of, and responses to, each other's behaviour and, hence, for road safety.
- Infrastructure has a role to play in improving the culture of road sharing. The scale of what can be done in practice is constrained; and any serious attempt to change the culture of road sharing would require a range of coordinated interventions, such as marketing, education, legislation and enforcement.
- However, infrastructure can play a part alongside these other interventions.
- At the very least, infrastructure should be avoided that creates more confusion about whether, and where, cycles should be.
- From the perspective of ORUs, the principle benefit of cycles lanes is that they get cyclists out of their way. When cycle lanes are provided, there is an expectation that cyclists should not be on the road.
- There is concern among some ORUs about cycle facilities which make life harder for ORUs, for example by 'taking away' some of their space, or allowing cyclists already passed to get back in front again.
- From the cyclist's perspective, inadequate cycle facilities can diminish the legitimacy of cycles on the road even further without actually providing a viable alternative.
- Cycling facilities can also make the road-sharing problem worse if they create additional confusion about where cyclists and drivers are meant to go. The key issues are:
  - Infrastructure that is too complex and needs to be decoded by the user;
  - A failure to communicate to people how to use innovative infrastructure; and,
  - A lack of consistency from one place to the next.
- Cyclists themselves have differing and potentially conflicting needs from infrastructure:
  - Cyclists opting for 'Assertion' want infrastructure that helps to establish their right to be on the road and that clarifies how the road is to be shared; and,
  - Cyclists opting for 'Avoidance' want infrastructure that gives them more opportunities to avoid traffic.

Themes: Cycle infrastructure, road sharing, other road users.

Comments: Makes good points about road sharing and different opinions on this issue.

Title: Cycle Infrastructure Design (Local Transport Note 2/08)

Author / organisation: Ove Arup & Partners Ltd (for Department for Transport)
Date: 2008
Format: Pdf
Link:
https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/3808/ltn-2-08.pdf
Free / priced: Free

Objectives: This design guide brings together and updates guidance previously available in a number of draft Local Transport Notes and other documents. Although its focus is the design of cycle infrastructure, parts of its advice are equally appropriate to improving conditions for pedestrians.

Methodology: Compilation of guidance.

Key Findings:

- The transition from cycle path to carriageway is an important detail for cyclists' safety and comfort.
- Routine and safety inspections are best carried out from a cycle to help ensure that the inspector has a better understanding of how even small defects can affect cyclists.
- The idea of marking cycle lanes on roundabouts may appear, at first glance, to be a relatively simple one, but it is not. Cycle lane on roundabouts must be very carefully considered. There is little evidence to suggest that they offer any safety benefits to cyclists, and they may introduce additional hazards. Some cycle lanes on roundabouts have been removed because they led to deterioration in the RTI rate.
- An innovative roundabout at Heworth Green in York has wide cycle lanes, a reduced circulatory carriageway width, tight geometry and a smaller outside diameter than conventional roundabouts. It has led to a decrease in cycle casualties at the site. The cycle lanes only position a cyclist close to the perimeter when he or she intends leaving at the next exit – otherwise, the cyclist is positioned away from the perimeter. The success of the York design might in part be attributed to the large volume of cycle traffic using the junction, but it illustrates how the intelligent use of cycle lane markings can help guide cyclists away from conflict points.

Themes: Cycle track, carriageway transition, safety inspections, cycle lanes, roundabouts.

Comments: Provides a good example of roundabout design.

Title: Encouraging walking and cycling: Success stories
Author / organisation: Department for Transport **Date:** 2005 **Format:** Pdf **Link:**http://webarchive.nationalarchives.gov.uk/+/http://www.dft.gov.uk/pgr/sustainable/walking/success/uragingwalkingandcycling5798.pdf **Free / priced:** Free
Objectives: Provides guidance.
Methodology: Compilation of good practice. This companion guide contains 50 examples of successful schemes from across England. They have all achieved significant results with often modest, but always well-chosen initiatives, which have improved local conditions for walking and cycling and encouraged people to get around on foot and by cycle. These schemes illustrate clear benefits in terms of reduced congestion, improved public health and enhanced quality of local streets and spaces.
Key Findings: • Case study 14 is specifically related to cycling infrastructure and describes the reallocation of road spaces on major roads for cyclists in Hull. • The project involved the reallocation of road space from motor vehicles to cyclists, by introducing on-road cycle lanes on a large number of roads in Hull. • These schemes were studied over a number years, and before and after comparisons of RTI statistics and cycle flows have highlighted outstanding results. • The outcomes of the intervention included a 45 per cent reduction in cycle casualties.
Themes: Reallocation of road space, reduction in cycle casualties.
Comments: Good example of an effective intervention.

Title: Policy, Planning and Design for Walking and Cycling: Consultation Draft
Author / organisation: Department for Transport **Date:** 2004 **Format:** Pdf **Link:** http://iobi.swan.ac.uk/wp-content/uploads/2012/09/Road-Strategy-2004-Policy-Planning-and-Design.pdf **Free / priced:** Free
Objectives: Provide guidance.
Methodology: Description of common design principles for pedestrian and cycle provision.
Key Findings: • This document sets out the policy context that supports the promotion of pedestrian and cycling facilities. It also describes common design principles for pedestrian and cycle provision. • Delivering increases in walking and cycling while reducing casualty numbers for these modes will require significant action by highway authorities, the police and others with responsibility for rights of way. • With careful design and traffic management, it is sometimes possible to cater for the needs of pedestrians and cyclists without providing obvious measures such as cycle lanes and sub-ways etc. This concept is often referred to as 'invisible infrastructure' and its importance should not be underestimated.
Themes: Cycling, casualty numbers, traffic management, 'invisible infrastructure'.
Comments: Makes an important point about 'invisible infrastructure'.

Title: Transport Local Area Walking and Cycling Statistics: England, 2013/14

Author / organisation: J. Cummings (for Department for Transport)
Date: 2015 **Format:** Pdf
https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/437001/local-area-walking-and-cycling-statistics-england-2013-14.pdf
Free / priced: Free

Objectives: This report reviews the main local area walking and cycling trends in in England in 2013/2014 and compares these with previous years.

Methodology: Statistical analysis of figures from the Active People Survey administered by Sport England.

Key Findings:

- There were significant increases in people cycling once a month in 35 England local authority areas between 2012/3 and 2013/14. The South West and East Midlands regions saw an increase as did the Tyne and Wear Metropolitan county.
- In England, 3 per cent of respondents said that they cycle at least 5 times a week with 9 per cent cycling at least once a week and 15 per cent indicating that they cycle at least once a month. This is significantly lower than the proportion of people who walk.
- 10.3 per cent of people said they cycle for recreation compared to 6.5 per cent who cycle for utility purposes. Most cyclists tended to fall into one of these groups.
- The proportion of the population who cycled at least once a month stayed the same between 2012/13 and 2013/14 (15%).
- 14 local authorities experienced a decrease in cycling rates.
- The proportion of adults cycling at least five times a week varied significantly across the country, from 28 per cent in Cambridge to less than 1 per cent is some areas.
- Cambridge had the highest proportion of adults cycling at least once a month in 2013/14 at 57 per cent.
- In London, for the proportion of adult residents who cycle at least once a month, there has been a decrease in cycling between 2010/11 and 2013/14 from 15.7 per cent to 14.2 per cent. In the same period the proportion cycling at least 5 times a week has not shown a significant change.
- Cycling levels are much higher in inner London boroughs than outer London boroughs. 10 of the 13 inner boroughs experienced levels of cycling above the national average, compared to 15 out of the 20 outer boroughs having below average cycling rates.
- Lower proportions of women (about 10 per cent) tend to cycle compared to men (about 20 per cent). For both men and women, there has been a fall in levels of cycling amongst those aged 25 – 34.
- Cycling for recreational purposes was more prevalent in rural areas and cycling for utility purposes was more prevalent in urban areas.

Themes: Cycling statistics, England.

Comments: This report is based on telephone interviews so there are some limitations to the data.

Title: Cycling and Walking Investment Strategy

Author / organisation: Department for Transport

Date: 2016(a) **Format:** Pdf

Link: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/512895/cycling-and-walking-investment-strategy.pdf

Free / priced: Free

Objectives: This report provides the strategy for cycling and walking investment in England and Wales.

Methodology: Investment figures

Key Findings:

- Between 2011 and 2015, £374 million has been allocated to support cycle schemes, with considerable funding being invested in the Cycling City and Towns Programme. Overall, around £5 per person was spent annually.
- In 2013, the Department of Transport launched the Cycle Ambition Cities programme which will see Government funding of £191 million over five year to 2018 to build cycle networks in Birmingham, Bristol, Cambridge, Leeds, Manchester, Newcastle and Oxford. This will involve development of new networks of quiet routes, segregated cycleways, improved lighting and parking facilities and improved cycle links to key services. Spending will equate to £10 per person.
- £50 million will be spent from 2016 to 2020 on the Government's long standing Bikeability programme of cycle-training for school children. 1.7 million children have received training since 2010.
- Highways England has published a Cycling Strategy supporting its aim to invest £100 million between 2015-16 and 2020-21 on cycling.
- There are four other main sources of funding for cycling:
    - Department for Transport local transport programmes
    - Other central Government programmes supporting cycling
    - Local body programmes
    - Initiatives led by business and the third sector.

Themes: Cycling investment

Comments: Gives figures of investment in measures to promote cycling, including cycling infrastructure as well as soft measures such as education and training.

Title: National Propensity to Cycle Tool Project: Summary Report: Appendix 4 Cycle route infrastructure and cycling uptake- a review

Author / organisation: Department for Transport
Date: 2016(b) **Format:** Pdf
Link:
https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/510268/national-propensity-to-cycle-full-report.pdf
Free / priced: Free

Objectives: A literature review of studies on cycle infrastructure and the uptake of cycling as part of the Department for Transport's National Propensity to Cycle Tool (NPCT) Project.

Methodology: Literature review

Key Findings:

- Studies on behaviour change are not all that prevalent yet but are growing and suggest that high quality infrastructure can increase cycling uptake.
- When building or designing new infrastructure, desire lines of cyclists should be followed where possible and the new infrastructure should contribute to enhancing the quality of the surrounding cycle network.
- People tend to prefer cycling environments which are either separated completely from motorised traffic or have substantial separation.
- Positive environmental factors for cycling were identified as the presence of dedicated cycle routes, separation of cycle facilities from road traffic, high population density, short trip distances, being located close to a cycle route or green space and school cycling promotion projects.
- Negative environmental factors associated with cycling included dangers from traffic, long trip distances, steep hills and relative distance from cycle route.
- There is a need to prioritise routes that meet the demand (or preference) of cyclists, to improve wider network and to ensure that there are good connections between new and existing infrastructure.
- Building small amounts of cycling infrastructure in isolation within a wider network that has generally poor provision for cyclists and low cycling levels may not have much of an effect.

Themes: Cycle infrastructure, cyclist preferences

Comments: Gives some considerations to be taken into account when designing and building cycling infrastructure.

Title: Shared Use Routes for Pedestrians and Cyclists (Local Transport Note 1/12)

Author / organisation: Department for Transport
Date: 2012
Format: Pdf
Link:
https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/9179/shared-use-routes-for-pedestrians-and-cyclists.pdf
Free / priced: Free

Objectives: This design guide brings together and updates guidance previously available in a number of draft Local Transport Notes and other documents. Its focus is on the design of infrastructure that can be used by both cyclists and pedestrians.

Methodology: Compilation of guidance.

Key Findings:

- Shared use paths should accommodate the movement of pedestrians and cyclists. They can be either segregated or unsegregated.
- A poorly designed facility can make conditions worse for both user groups.
- Shared use is generally implemented to improve conditions for cyclists, however it is important to also equally consider the needs of pedestrians, especially where there may be a loss of pedestrian footways.
- Opportunities to improve conditions for pedestrians should also be considered when building new cycling infrastructure.

Themes: Cycle infrastructure, shared use, pedestrians, safety, segregation, design

Comments: Provides good examples of shared use infrastructure.

Other works

Title: Collection of Cycle Concepts 2012

Author / organisation: T. Andersen, F. Bredal, M. Weinreich, N. Jensen, M. Riisgaard-Dam, M. K. Nielsen (Cycling Embassy of Denmark)
Date: 2012
Format: Pdf
Link: http://www.cycling-embassy.org.uk/document/collection-cycle-concepts-2012
Free / priced: Free

Objectives: Provide inspiration and motivation for creating more and safer cycle traffic – in Denmark as well as the rest of the world.

Methodology: Collection of cycle concepts 2012 presents a number of ideas to help generate more cycle traffic and reduce the RTI rate among cyclists.

Key Findings:

- Improving physical conditions for cyclists is a must since citizens need to see favourable material changes to make them want to choose cycling as an alternative to driving. The construction of cycle tracks is essential, but smooth road and cycle track surfaces are required.
- Road modifications are costly but are sometimes the only solution to a specific safety issue. When roads and cycle tracks are being dug up for other reasons, this is an excellent opportunity to change the road's design, making it safer, more comfortable, and more passable.
- It is the cyclist's sense of security, i.e. the cyclist's subjective perception of being safe, that actually encourages cycling. For many people insecurity is a reason for not cycling. A better sense of security is often an explicit objective of infrastructure plans and strategies, but this is generally less clearly formulated than road safety objectives. This is due to the fact that it is more difficult to measure a subjective sense of security.
- A sense of security is the cyclist's subjective perception of what cycling in traffic feels like, whereas safety is the objective registration of RTIs. A sense of security (or insecurity) can be recorded by different types of interviews: focus groups, telephone interviews, street surveys. Safety (or RTIs rather) is registered by the police, categorised according to whether or not the situation involves personal injury. RTI rates can be calculated on the basis of number, density, frequency and risk.
- When cycle lanes are established on-road sections, conflicts can be moved to intersections where they have to be finally confronted. It is crucial that cyclists are highly visible and that the intersection design makes them vigilant to other road users.
- As a supplement to road safety audits the road standards' new instruments for measuring 'perceived' service levels can calculate the level of cyclist satisfaction for the individual road section and intersection as well as for a larger network.
- A coloured surface application that clearly stands out from the surroundings can highlight a circulation area and help render give-way regulations visible. Examples of this are coloured asphalt or blue thermoplastic cycle crossings.

- Wide cycle lanes result in significant RTI reduction on-road sections, but may cause safety issues at intersections. Three different studies show a rise of 10 per cent in the number of cycling RTIs when cycle lanes are installed in urban areas. The total increase in the number of RTIs covers a major drop on-road sections and a major increase at intersections.
- Left-turning cars are a major issue on roads with cycle lanes; the most serious intersection RTIs take place when cyclists turn left. Mini roundabouts, clearly designated cycle lanes, and motor traffic speed limit reduction are measures which seem to prevent some intersection RTIs on roads with cycle lanes.
- An RTI study of cycle crossings in signalized intersections showed that cycle crossing marking has resulted in a 36 per cent drop in the number of cycle RTIs and a significant 57 per cent drop in the number of serious cyclist casualties. The study further showed that when cycle crossings were established in major intersections the greatest reduction occurred in RTIs between left turning cars and cyclists going straight ahead.
- Pilot projects have tested electronic cyclist warning devices in relation to right turning traffic, especially lorries. A project in Aarhus has had positive results, but there is still no definite conclusion as to the traffic safety effect.

Themes: Cycling, infrastructure, cycle lanes, subjective perception of safety.

Comments: Useful information on specific infrastructure types and the associated reduction in casualties. It should be noted that the studies were carried out in Denmark, where vehicles drive on the right hand side of the road.

Title: Cyclling, Health and Safety

Author / organisation: International Transport Forum Working Group on Cycling (OECD)
Date: 2013
Format: Pdf
Link: http://www.keepeek.com/Digital-Asset-Management/oecd/transport/cycling-health-and-safety_9789282105955-en#page1
Free / priced: Free

Objectives: The International Transport Forum at the OECD is an intergovernmental organisation with 54 member countries. It acts as a strategic think tank with the objective of helping shape the transport policy agenda on a global level and ensuring that it contributes to economic growth, environmental protection, social inclusion and the preservation of human life and well-being.

Methodology: Literature review.

Key Findings:

- Road traffic is inherently unsafe. Traffic infrastructure is seldom designed with safety as a starting point and though efforts are made to accommodate the wide range of behaviours displayed by road users, errors and unpredictable or impaired actions often lead to RTIs.
- Crash outcomes are especially severe for vulnerable road users such as pedestrians and cyclists who lack by far the same level of protection mandated for, and offered to, car and other vehicle occupants. Single cycle RTIs are also a source of injuries through falls and RTIs with obstacles and can result in serious injuries, especially for elderly cyclists and those unprotected by helmets.
- Part of the 'built-in' hazard of cycling is that the road system has, with some notable exceptions, not been designed for cyclists.
- It has become clear that most national authorities and many regional/municipal authorities simply lack the basis on which to assess both cyclists' safety and the impact of 'safety-improving' policies. At the core of safety assessment is the calculation of RTI rates (typically split into fatal RTIs and others of varying degrees of severity). Schematically; safety (expressed as the RTI incidence rate) is the quotient of the number of RTIs divided by a measure of exposure or cycle usage. In many cases both numerator and denominator are inadequately measured or may be missing altogether.
- Under-recording of cycle RTIs is an essential problem for cyclist safety analysis. The underlying reason of under-recording is that personal injury RTIs are not systematically registered. Efforts must be made to harmonise definitions of cycle RTI terminology so as to be able to make reliable international comparisons on cyclist safety. National authorities should set standards for, collect or otherwise facilitate the collection of data on non-fatal cycling RTIs based on police reports and, in either a systematic or periodic way, on hospital records.
- Crashes are generally less common on cycling-specific infrastructure than on infrastructure that is not cycling-specific. The most recent UK data shows that 97 per cent of cyclists involved in RTIs resulting in a serious injury or fatality were on the main carriageway and only 2 per cent on a marked cycle

lane on the main carriageway. However, it is noteworthy that in Denmark injury RTIs are more common on on-road cycle lanes than on roads not marked with cycle lanes – perhaps reflecting exposure.

- Safety is central to making cycling irresistible - and by safety, we need to understand that this has two components; 'actual' RTI rates and their severity and, crucially, the 'perceived' safety of users. If citizens don´t feel safe cycling – then they will not ride if there is an alternative they perceive as safer. If on the other hand citizens feel confident about cycling routes and the safety they offer, the more they will take the advantages of the cheap, fast and reliable mobility offered by cycles. Addressing both objective and 'perceived' safety improvements will require slightly different but necessarily coordinated approaches.
- A fairly high proportion of RTIs occur at intersections, between approximately 20 and 50 per cent for fatal RTIs, and 20 and 60 per cent for injury RTIs. In the UK almost two thirds of cyclists killed or seriously injured were at intersections. Given that cyclists spend a great deal more of their time cycling not at an intersection, these percentages suggest the risks posed by intersections. - indicating the risk posed by intersections and the need for care when designing intersections to be 'readable' by all traffic participants and cycling-friendly.
- Adequate infrastructure that matches levels of cycle use is a pre-condition for improving cycle safety in the Safe System approach. Cycle infrastructure (just as any road infrastructure) must meet minimum requirements for sight distances for both cyclists and motorists.
- There is need to deploy further cycling infrastructure that delivers both objective and 'perceived' safety improvements.

Themes: Objective and 'perceived' safety, cycling infrastructure.

Comments: Highlights the need to address both 'perceived' and 'actual' risk.

Title: Attitudes Towards Cycling 2011

Author / organisation: SPA Future Thinking for Transport for London
Date: 2011
Format: Pdf
Link: http://www.Transport for London.gov.uk/cdn/static/cms/documents/attitutudes-towards-cycling-presentation.pdf
Free / priced: Free

Objectives: To assess cycling activity and attitudes amongst Londoners.

Methodology: Survey which comprised 1,066 telephone interviews with adult Londoners. Data are weighted to represent the London population in terms of age, gender, ethnicity, working status and location (inner/outer London).

Key Findings:

- Evidence suggests that the 'year of cycling' continues to have a positive impact on levels of cycling in London. 19 per cent of Londoners now cycle, this is in line with October 2010, and significantly higher than this time last year (when the figure was 16 per cent).
- Scope remains for more Londoners to take up cycling. 40 per cent of Londoners have access to a bicycle in their household and almost nine out of ten know how to ride a cycle. A quarter of Londoners say that they could (but do not currently) commute by cycle.
- Both cyclists and non-cyclists say that if they started cycling, or cycled more, these cycling trips would be instead of bus and car journeys.
- Transport for London has developed a behaviour change model to assess cyclists' and non-cyclists' propensity to increase their level of cycling.
- Current cyclists are most likely to be 'normalised' to cycling more (39 per cent are in this category), meaning they are already 'cycling more, and will continue to do so'. There has been no significant change in this since this time last year.
- Most non-cyclists (61 per cent) are 'pre-primed' to the idea of taking up cycling (meaning they 'would not consider it', 'have never thought about it', or 'have given it thought but are not going to do it').
- Just over a quarter (27 per cent) are 'primed' to take up cycling (meaning they are 'thinking about it', 'have decided to do it' or 'were doing this but couldn't stick to it').
- Amongst both regular and occasional cyclists, trips within the local area are thought to be more appealing than journeys outside the local area and within central London.
- There has been little movement in various attitudes towards cycling since October 2010.
- Many of the attitudes are positive, such as the view that cycling is becoming more popular and that it is a convenient and interesting way to travel. However, the perception that cyclists are vulnerable to other road users and that traffic makes people afraid of cycling is still common.

- Half of those who have used the scheme (or are likely to use it) say they would have been unlikely to cycle had the scheme not been launched.
- The first two Barclays Cycle Superhighways were also opened last year to provide routes for cyclists travelling into central London.
- Since last summer, awareness of the Superhighways has risen substantially. There has however been a slight decline in the proportion aware of the Superhighways since October 2010.
- 3 per cent of Londoners have made use of the routes, with a further 17 per cent of non-users likely to use them in the future.
- Just under half of those who have used/say they will use the Superhighways state they would have been unlikely to cycle had the scheme not been launched.

Themes: Attitudes to cycling, London, Superhighways.

Comments: Research provides information about attitudes to cycling, small section on attitudes to safety available.

Title: Assessment of the type of cycling infrastructure required to attract new cyclists (Research report 449)

Author / organisation: S. Kingham, K. Taylor and G. Koorey (NZ Transport Agency)
Date: 2011
Format: Pdf
http://www.nzta.govt.nz/resources/research/reports/449/
Free / priced: Free

Objectives: The research objectives were to:

- Carry out a comprehensive international literature review on the barriers and motivations associated with cycling, as well as the design of cycling infrastructure and its impact on the use of cycles;
- Identify the biggest barrier for new cyclists when considering cycling as a transport mode;
- Assess the demand for different types of cycle route provision, such as quiet streets, cycle lanes and off-road pathways;
- Identify the impact of cycling infrastructure on the likely uptake of utility cycling by current non-utility cyclists; and,
- Provide recommendations for local and central government on the type of cycle route design required to encourage a growth in cyclist numbers.

Methodology: An international literature review was undertaken to identify the characteristics of people who currently cycle, their motivations and barriers regarding utilitarian cycling, and the types of cycling facilities available. Surveys were then carried out to gain a broad understanding of some of the barriers to utilitarian cycling, and 'potential cyclists' were recruited into focus groups to undertake further research. In the focus groups, all motivations and barriers were discussed to gain an understanding of the key issues for potential cyclists, and to identify the most significant issues. The focus groups also evaluated a range of cycling facilities.

Key Findings:
This research, which was conducted from July 2008 to January 2010, investigated what type of cycling infrastructure (i.e. physical street facilities) would encourage 'new cyclists' to use cycling as their mode of transport for daily activities in New Zealand.

- The research showed that safety was the most significant issue for potential cyclists, particularly in relation to vehicle driver behaviour and traffic volume. Other significant issues included having facilities at the destination for showering and changing, enjoyment, and the perception that car drivers are not courteous.

- The solutions that were most likely to effect a significant change in cyclist numbers related to the nature and consistency of infrastructure, and education for motor vehicle drivers and cyclists on how to best and safely use it.

- The preferred cycling facility was a comprehensive, consistent network of cycle-only paths with separation from motor vehicles, and with dedicated intersection facilities such as hook turns and cycle signals. However, all of the cycling facility options that were presented rated much higher than the 'no provision' options.

- A person's perception of safety can contribute significantly to their fear of cycling; therefore it is important to address 'perceived' safety as much as, or more than, 'actual' safety. On the other hand, 'actual' safety also needs to be addressed, and a balance between choosing infrastructure that is appealing to people interested in cycling, and 'actual' safety, needs to be reached.

Themes: Cycling infrastructure, perception of safety.

Comments: Illustrates the importance of considering a cyclist's perception of safety during cycling infrastructure design.

Title: Side road crossings (Technical Information Note No. 12 (TIN 12))

Author / organisation: Sustrans
Date: 2011
Format: Pdf
Link: http://www.sustrans.org.uk/sites/default/files/images/files/migrated-pdfs/Technical per cent20Note per cent2012 per cent20- per cent20Side per cent20Road per cent20Crossings(1).pdf
Free / priced: Free

Objectives: The purpose of this note is to complement existing information on the design of side road crossings with particular reference to Links to Schools schemes, but the principles apply to other schemes where young or less confident cyclists are expected. This note aims to clarify where cycle priority crossings should be seriously considered and those circumstances where other options are more likely to be appropriate and what those options might be.

Methodology: Description of options for side road crossings.

Key Findings:

- The side road crossing is a point of potential conflict between cyclists and motorists. This has to be recognised and the situation managed. By installing a cycle track adjacent to the carriageway, designers are putting the burden of responsibility onto the cyclist to slow down and to check for vehicles coming from three directions (one of which is behind the cyclist), through a visibility angle of 270 degrees.

- One option is to reintroduce cyclists to the carriageway at the junction (happening increasingly in other European countries), but this requires one-way cycle tracks on both sides of the road, a situation which is uncommon in the UK where cycle tracks are generally two-way.

- When designing any shared use scheme adjacent to the carriageway, emphasis needs to be placed on the treatment of side roads to ensure safety and continuity.

- In general Sustrans recommend that designs should include coloured surfacing and cycle logos on the carriageway surface to highlight the crossing both to drivers and to cyclists, and it should preferably be placed on a raised table so as to reduce vehicle speeds.

- Where there are several side road crossings within a short distance, and cyclists have to give way at these, consideration should be given to whether a shared use footway is the appropriate option.

- Ultimately each scheme should be dealt with on a case-by-case basis having regard to the local circumstances.

Themes: Side road crossings, conflict.

Comments: Indicates how side road crossing can be adapted.

Title: Understanding Walking and Cycling, Summary of Key Findings and Recommendations

Author / organisation: C. Pooley, M. Tight, T. Jones, D. Horton, G. Scheldeman, A. Jopson, C. Mullen, A. Chisholm, E. Strano, S. Constantine.
Date: 2011 **Format:** Pdf
http://www.roadsafetyknowledgecentre.org.uk/issues/cycling/knowledge/631.html
Free / priced: Free

Objectives: The overall aim of the research was to gain a clear understanding of the factors that structure everyday travel in England and, especially, to investigate the reasons why people do and do not undertake short everyday journeys on foot or by bike.

Methodology: A multi-method approach was used making innovative use of a range of quantitative and qualitative research tools. The research was carried out in four study towns. Four principal methods were employed:

- A questionnaire survey probing experience of and attitudes towards walking and cycling across all four study towns;
- Spatial analysis of connectivity and land use in the four study areas;
- Household and mobile interviews (e.g. walking go-alongs) about everyday travel with respondents in the four study towns; and,
- Household ethnographies in selected districts of the four towns.

Key Findings:

- There were a number of negative associations with cycling, including need to negotiate difficult road junctions, cycling being a bad experience using existing roads and desire for more cycle lanes to feel safer, which together indicate notable safety concerns. Indeed poor safety was one of the key reasons for not cycling expressed by approximately 80 per cent of respondents.
- Road cyclists (17 per cent of the variance) were confident cycling in traffic and are reluctant to see the implementation of segregated cycle infrastructure if this leads to the erosion of cyclists' right to use the road.
- Off-road cyclists (16 per cent of the variance) were not car averse – they own and drive cars themselves – but wish to see more restrictions placed on the use (and cultural symbolism) of cars in urban areas. There is also the desire for segregated cycle paths which are 'perceived' to benefit people travelling on foot (reduced danger/conflict because of pavement cycling) and cyclists (reduced danger/conflict because of motor traffic).
- It is essential that the urban environment is made safe for cyclists and pedestrians. This requires the provision of fully segregated cycle routes on all arterial and other busy roads in urban areas. It is clear from the research that most non-cyclists and recreational cyclists will only consider cycling regularly if they are segregated from traffic, and that pedestrians are hostile to pavement cyclists.
- It should be recognized that while physical infrastructure is important, it is not on its own sufficient. There is also need for an integrated policy that embraces social welfare, employment, housing, health, and education amongst other policy areas to create a total environment that is welcoming for cyclists and pedestrians.

Themes: Cycling, infrastructure.

Comments: Useful information on attitudes to cycling and how this should be considered during cycling infrastructure design.

Title: Toucan Crossings (Technical Information Note No. 18 (TIN 18))

Author / organisation: Sustrans
Date: 2011
Format: Pdf
Link: http://www.sustrans.org.uk/sites/default/files/images/files/migrated-pdfs/Technical per cent20Note per cent2018 per cent20Toucans per cent20compressed.pdf
Free / priced: Free

Objectives: This note discusses a number of issues associated with the design of Toucan crossings and in particular the conversion of Pelican and Puffin crossings to Toucan control.

Methodology: Description of options for cyclist crossings

Key Findings:

- If more walking and cycling is to be encouraged, pedestrians and cyclists must feel that they are as important as motor traffic and not second class users of the road network; crossing timings will need to reflect this.
- Toucans that have a long delay before giving a green to cyclists once a demand has been registered cause frustration and lead to frequent attempts to cross before the green light appears. Where timings can be adjusted to reduce crossing delays the highway authority should be encouraged to do so.
- The operation of the crossing can be further improved by advance cycle detection through the inclusion of loops or above ground detection on the approaches to a Toucan, in addition to the push buttons, positioned such that the lights change as the cyclist arrives there.
- Where a new signalled crossing is to be provided at a location on a cycle route that previously had none, a Toucan should be provided.

- Where cyclists are expected to cross at a location that already has a Pelican or Puffin, the default Sustrans position is that the existing crossing should be upgraded to Toucan control.
- In any situation where Pelican / Puffin control might be retained at a crossing on a cycle route it is essential that
    - A cycle track / shared use route is provided up to each side of the crossing; and,
    - Cyclists Dismount signs are not erected.
- Each situation must be assessed on a case by case basis and decided following careful consideration of the operational issues.

Themes: Cyclists, Toucan crossings.

Comments: Provides useful information about cyclist crossings.

Title: Segregation of shared use routes (Technical Information Note No. 19 (TIN 19)

Author / organisation: Sustrans
Date: 2011
Format: Pdf
Link http://www.sustrans.org.uk/sites/default/files/images/files/migrated-pdfs/Technical per cent20Note per cent2019 per cent20- per cent20Segregation per cent20of per cent20shared per cent20use per cent20routes.pdf
Free / priced: Free

Objectives: This note provides technical detail on when to consider segregation between cyclists and pedestrians on a shared use route, whether within the highway or away from it.

Methodology: Sustrans' position draws on emerging findings from the research by DfT and Transport for London together with extensive experience over 30 years in the implementation and management of shared use routes where the width is constrained, such as disused railway lines and towpaths.

Key Findings:

- Sustrans would normally regard unsegregated paths as the default approach, but each situation needs to be considered on a case by case basis.
- Segregation may be appropriate in certain situations such as where there is a high level of use and adequate space can be provided for each user group.
- Factors that might suggest that segregation would be preferred include:
    - High pedestrian and / or cycle flow;
    - High proportion of utility cyclists; and,
    - Locations where significant use by vulnerable pedestrians is expected, especially elderly / visually impaired, such as near residential homes.
- Developing the design of a shared use path, including decisions on segregation, should include early consultation with relevant interested parties such as those representing people with disabilities, walkers and cyclists.
- However, constraints may make it undesirable / impracticable to segregate and unsegregated paths tend to encourage improved behaviour by all user groups.

Themes: Cyclists, segregated routes.

Comments: Highlights the issues to consider when segregating pedestrians and cyclists.

Title: Cycling by Design 2010

Author / organisation: Transport Scotland
Date: 2011 **Format:** Pdf
Link: http://www.transportscotland.gov.uk/strategy-and-research/publications-and-consultations/cycling-by-design
Free / priced: Free

Objectives: The primary focus of the document is the establishment of guidance to ensure consistent and appropriate design. The document was designed to draw together and rationalise existing international cycle design guidelines into a single comprehensive reference document which could be used as a source of sound technical advice.

Methodology: Compilation of good practice and case studies.

Key Findings:

- The two key elements that influence the needs of cyclists in relation to infrastructure are skill level and trip purpose (utility or leisure).
- Novice and intermediate users will favour traffic free paths or roads with low traffic volumes and speeds. Experienced cyclists will be confident sharing space with road traffic. Where a high proportion of the target users are likely to be novice cyclists (for example, younger school children), off-carriageway routes or quiet streets are most effective.
- People with cycle child seats, trailers, trailercycles, rickshaws, tandems and tricycles, as well as disabled people using hand-cranked cycles all have specialised needs and should be catered for. They require wider facilities without sharp bends, pinch points or other features that can require cyclists to dismount.
- Understanding the motivations of the target users is essential to delivering suitable facilities.
- In design, cyclists' needs are represented by five core principles (safety, coherence, directness, comfort and attractiveness) which summarise the desirable requirements for cycling infrastructure. In terms of safety, design should minimise the potential for 'actual' and 'perceived' RTI risk. 'Perceived' risk is a key barrier to cycle use and users should feel safe as well as be safe. It is important to provide consistency of design and avoid ambiguity.
- The hierarchy of measures looks to make existing carriageways safe for use by cyclists before considering off-carriageway facilities as an option.
- The available distance over which the cyclist has visibility to potential hazards, approaching traffic or junctions, is a critical design feature.
- There are often broader safety and other benefits to be gained by controlling traffic volume and speed rather than providing cycle-specific measures, particularly where there are high levels of pedestrian, cyclist and/ or vehicle interactions.
- The purpose of a cycle lane is to allocate and demarcate space for cyclists within a carriageway in order to:
    - Increase drivers' awareness of cyclists;
    - Encourage drivers to leave space for cyclists;
    - Give people greater confidence to cycle on the road network;
    - Improve 'perceived' and 'actual' safety;
    - Assist cyclists to pass queuing traffic;
    - Encourage lane discipline by cyclists and motor vehicle drivers; and,

- Help to confirm a route for cyclists.

- Off-carriageway cycle routes are typically surfaces shared with or adjacent to pedestrians. The potential for cyclist-pedestrian conflict is an important issue to be addressed.
- The cycling side of a segregated cycleway should generally be located between the pedestrian side and the carriageway. This assists pedestrians' perception of safety, and maximises the visibility of cyclists for drivers emerging from side roads and accesses.
- Approximately 75 per cent of reported RTIs involving cyclists occur at or near a road junction.
- When a cycle route crosses a road, selection of the most appropriate location and form of crossing requires careful assessment. The selection process depends on the interaction and resolution of site-specific factors, with the safety of the vulnerable road user being of paramount importance. A site-specific solution should always be sought.
- Roundabouts are the safest form of at-grade junction for general traffic, however some 10 per cent of all reported RTIs involving cyclists occur at roundabouts. Of these, 11per cent are likely to be either serious or fatal and more than 50 per cent involve a motorist entering a roundabout and colliding with a cyclist using the circulatory carriageway. Cyclist RTI rates at roundabouts are four times that for motor vehicle drivers.
- Cyclists will feel and be safer on roundabouts where:
    - Approach arm traffic speeds are low;
    - Circulatory carriageway speeds are low; and,
    - Cyclists are positioned prominently and are highly visible both on the approach arms and the circulatory carriageway.
- Designers should consider how to create conditions that will allow cyclists to adopt a prominent carriageway position to ensure that they are visible to drivers. Cyclists are only likely to adopt a safe position if conditions are perceived to be safe.
- Where this cannot be achieved, cyclists should be provided with an attractive off carriageway alternative. Off-carriageway cycle facilities offer a safer route through a roundabout, however these may introduce significant additional journey times to the point that they may be unattractive to use. Off-carriageway facilities should be direct, safe and attractive to use.
- The quality of surfaces and edge details are particularly important to cyclists, who are more vulnerable to minor defects and poor construction than other road users. It is therefore important to ensure that construction details and materials for the cycle facility are appropriate and that a suitable maintenance regime is established.
- The use of coloured surfacing to identify areas of the carriageway where other vehicles are discouraged from entering is recommended.
- The main purpose of the safety inspections is to identify any defects that represent an immediate hazard, a potential hazard or where there is a risk of rapid deterioration that would result in a hazardous defect by the next safety inspection.

Themes: Cycling, design.

Comments: The combination of good practice and case studies is a useful aid for visualising the improvements and designs that can be used.

Title: Cases of interventions in bicycle infrastructure reviewed in the framework of Bikeability

Author / organisation: K. van Goeverden and T. Godefrooij (Department Transport & Planning, The Dutch Reference Study)
Date: 2011
Format: Pdf
Link: http://www.cycling-embassy.org.uk/document/dutch-reference-study
Free / priced: Free

Objectives: The overall objective of the project was to increase the level of knowledge in relation to cycle based transport and thereby to contribute to more efficient and qualified urban planning and management.

Methodology: The project activities were divided into five interrelated work packages (WPs):

- WP1: Cycling behaviour and its preconditions analysed the determinants for cycling behaviour of individuals, such as motives, lifestyles, opportunities and constraints.
- WP2: Environmental determinants for bike-ability linked GIS data with objective and subjective measures of cycling in relation to the conditions of selected neighbourhoods to develop a validated bike-ability index tailored to the Danish urban context, but applicable in other regions.
- WP3: Choice modelling for simulation of bicyclist behaviour develops an agent based modelling approach to simulate the flow of individual bicyclists in urban areas as a response to changes to the urban environment and the level of and attitude to cycle transport.
- WP4: Interventions to the cycling infrastructure analysed cycle infrastructure cases in the Danish municipalities and the Netherlands; their implementation and significance in terms of contribution to the promotion of cycling, and finally identification of infrastructure and elements of interventions that can help promote cycling significantly.
- WP5: Planning Guidance and Dissemination serves the purpose of presenting the projects methodological advances, tools, and conclusions to policy-makers, planners and traffic engineers, as well as maintaining the dialog and interaction with end-users from the municipalities.

Key Findings:

- Investments in cycle infrastructure have generally a larger impact on the qualitative perception than on measurable quantities. This is valid for both safety and cycle use. Generally, the ‘perceived’ improvement of safety is not (fully) reflected by the observed decrease in RTIs and casualties.
- Two sided one-directional cycle tracks are on average experienced as more safe than one sided two-directional cycle tracks.
- One important point is that the evaluated Dutch interventions were implemented in the situation that the cycle was a common mode and a

reasonably good cycle infrastructure was already available. In countries that start 'from scratch' with low cycle use and a poor cycle network, interventions that promote cycling may have different (probably larger) impacts.

- With regard to road safety the researchers made a distinction between 'objective' road safety which can be measured by the number of personal injury RTIs and fatalities, and the 'perceived' or 'subjective' road safety: how safe do cyclists feel.
- There was a shift from cyclist-motorist RTIs to cyclist-cyclist RTIs, cyclists-pedestrian RTIs and single cyclist RTIs. The latter types of RTIs are on average of course less serious than the cyclist-motorist RTIs they replaced.
- In general the researchers concluded that the demonstration cycle routes had no measurable impact on the number of RTIs with personal injury, and this was a disappointing conclusion.
- Generally users felt safer than before, allowing them to cycle more undisturbed and feeling that they can progress more smoothly.
- Although road safety is considered to be vital by both cycle users and policy makers, there was a remarkable contrast between the impacts of the facilities on the 'actual' and the 'perceived' road safety: road safety data showed no or very minor impacts, whereas the 'perceived' road safety improved substantially. Policy makers were disappointed by the marginal impact of the facilities on the 'objective' road safety figures.
- The research also suggested that one should be careful with applying one-sided two directional cycle tracks: this type of facility can have a negative impact on both 'actual' (objective) and 'perceived' (subjective) road safety of cyclists. Two sided one-directional cycle tracks are on average experienced as more safe than one sided two-directional cycle tracks. Thus one sided two-directional tracks should only be applied if there are clear advantages such as diminishing the need for crossing busy roads.
- In Delft cycle paths, which were already the safest kind of link, strengthened their position as safest facility for cycling, and cycle lanes, which were by far the most unsafe kinds of cycling facility, came close to the safety level of roads with mixed traffic, but remained the most unsafe kind of cycling facility.

Themes: Objective and subjective safety, cycling infrastructure.

Comments: Compares different types of cycling infrastructure with control sites.

Title: Especially Authorised Signing Trial, 'No Entry Except Cycles' Signing Review

Author / organisation: L.Sewell and M. Nicholson, MVA Consultancy for Transport for London (Transport for London) , Cycling England, Department for Transport (DfT)
Date: 2010 **Format:** Pdf
Link: http://www.Transport for London.gov.uk/cdn/static/cms/documents/no-entry-except-cycles-signing-review.pdf
Free / priced: Free

Objectives: The aim of this study is to help inform decisions on the wider application of the proposed new combination of signs: 'No Entry Except Cycles' and generate evidence to respond to safety concerns.

Methodology: Transport for London (Transport for London) commissioned MVA Consultancy to undertake research into the impact of changing the 'Flying Motorcycle' sign 'No Entry Except Cycles' signing combination on user behaviour at especially authorised monitoring sites where cycle contra-flow systems are currently in operation.
The structure of the study has been as follows:

- Literature review of published and unpublished 'grey' literature on how the design of contra-flow streets affects its use and the behaviour of users and a summary of the Royal Borough of Kensington and Chelsea (RBK&C) 'Flying Motorcycle' sign trials.
- STATS 19 review of personal injury collisions database to determine national and London trends for collisions involving cyclists on one-way roads and the severity of these collisions.
- Discussions with Transport for London, Cycling England and the DfT to identify suitable monitoring locations, each formed by a 'trial' site and an 'associated' site, to monitor the effects of changing from the 'Flying Motorcycle' sign to 'No Entry Except Cycles' sign combinations at two sites within London and two sites outside of London.
- STATS 19 collision analysis for the proposed monitoring sites.
- 'Before' and 'after' video surveys at the 'trial' and 'associated' sites to record and analyse volumes and user behaviour, and to undertake a conflict assessment at each monitoring location to establish compliance and understand safety performance.

Key Findings:

- Currently the 'No Entry Except Cycles' signing regime is not permitted by the DfT and therefore required special one-off authorisation by the DfT to monitor the effects of this signing combination at agreed monitoring sites.

- There is limited literature that addresses contra-flow entrance points, with most literature and observations being made on European schemes. A review of previous studies showed that in the UK, the 'No Entry' sign is considered one of the most abided by signs. Signs prohibiting motorised traffic, similar to Sign 619 'Flying Motorcycle' have been applied at locations in Denmark, Netherlands and Germany, which has shown that the signing is less widely accepted than a No Entry with a specific cycle exemption.

- One-way streets in urban road networks can provide less favourable conditions for cyclists for a number of reasons:
    - Reducing the network permeability for cycling;
    - Increasing the distance required to travel between two points; and
    - Tending to increase traffic speeds.
- There is anecdotal evidence that where one-way streets and one-way accesses make networks sufficiently impermeable, some cyclists will elect to use them illegally, putting themselves and other road users at risk. Where cyclists can be exempted from one-way restrictions, convenience can be increased and travel time can be reduced, which can help make cycling a more attractive travel choice.
- There is a greater compliance by motorised vehicles with the 'No Entry Except Cycles' signing combination than the 'Flying Motorcycle' sign, which is in line with the findings of the RBK&C trials.
- There was an increase in the number of cyclists travelling in contra-flow following installation of the 'No Entry Except Cycles' sign combination, suggesting a greater understanding of the 'No Entry Except Cycles' signing regime than that of the 'Flying Motorcycle' sign.
- Few interactions were recorded in both the 'before' and 'after' signing scenarios. There was no significant association between the signing changes and severity of interactions.
- As the cyclists using the network tended to be commuters, they were assumed to be familiar with the signing and road restrictions and showed no hesitation in their contraflow movements.
- Vehicles were less likely to hesitate when presented with the 'No Entry' sign, relative to the 'Flying Motorcycle', suggesting better understanding, although further observations are required to prove significance.
- Contra-flow cyclists behaved and positioned themselves similarly regardless to the signing presented at the one-way streets.
- Cyclists tended to use contra-flow lanes when present, otherwise they utilised (their) left-side of the carriageway.
- Vehicles were more likely to reverse down a one-way street when 'No Entry' signing was present, whereas they were more likely to go in the forward direction (opposite one-way designated direction) with the 'Flying Motorcycle' sign.
- This study has revealed that the 'No Entry Except Cyclists' sign combination is more widely respected than the 'Flying Motorcycle' sign and has suggested that the combination is more readily understood by cyclists.

- There is no evidence that compliance with ‘No Entry’ signs by motorised vehicles is reduced at associated sites, in fact compliance slightly improved. There was a slight increase in violations by cyclists at some associated sites but this was not statistically significant. There was no statistically significant change in conflict between road users at sites with the new combination.

- This analysis indicates that, for the sites studied, the safety concerns raised about the ‘No Entry Except Cyclists’ combination are not supported by the evidence. Indeed, the improved compliance by motorised vehicles is likely to result in a net risk reduction to all users.

- Accordingly there seems no immediately obvious reason not to use this combination of signs. We recommend that the use of this combination be more widely permitted and monitored over a longer period at a wider variety of sites.

Themes: Contraflow cycling, ‘No Entry Except Cyclists’ sign, cyclist behaviour.

Comments: Informative study which has used monitoring of real world situations to make conclusions about the feasibility of changing

Title: Infrastructure toolkit for cycling towns

Author / organisation: A. Lord (Arup for Cycling England)
Date: 2009
Format: Pdf
Link:
http://www.sustrans.org.uk/sites/default/files/documents/infrastructure_toolkit_for_cycle_towns_ce_2009.pdf
Free / priced: Free

Objectives: Provide guidance.

Methodology: Compilation of guidance.

Key Findings:

- The local cycle network should recognise five main design criteria:

    - Coherence: The cycling infrastructure should form a coherent entity, linking all trip origins and destinations; with a continuous level of provision;

    - Directness: Routes should be as direct as possible, based on desire lines, since detours and delays will deter use;

    - Attractiveness: Routes must be attractive to cyclists on subjective as well as objective criteria. Lighting, personal safety, aesthetics, noise and integration with the surrounding area are important;

    - Safety: Designs should minimise the danger for cyclists and other road users; and

    - Comfort: Cycle routes need smooth, well-maintained surfaces, regular sweeping, and gentle gradients. Routes must be convenient to use and avoid complicated manoeuvres and interruptions.

- RTI data is an important feature to review. A plot of the whole network can help identify cluster sites, while an investigation of all injury RTIs at a particular site may help to reveal a trend. The data may help to support or suggest a particular engineering solution.

- Cycle lanes: The decision to provide cycle lanes should be reached by reference to the hierarchy of provision; they should not be seen as a universal solution.

- Where provided, cycle lanes should be a minimum of 1.5m wide, continuous, made conspicuous across side roads at junctions and not abandon cyclists where roads become narrow, for example at right turning lanes. Where cycle lanes are being introduced, the cost of remedial measures to the carriageway surface should be included within the scheme budget.

- Advance stop lines (ASLs) were originally introduced in the UK improve the safety and attractiveness of cycling at signal controlled junctions. ASLs have been shown to be effective in terms of aiding cyclists' positioning, with 44 per cent more cyclists being able to position themselves in front of (and therefore in sight of) waiting motor vehicles at approaches with an ASL as opposed those without. Cyclists can also derive further benefit from ASLs, namely:

    - Cyclists are given visible and practical priority over other vehicles upon departing the signals;

    - Cyclists can by-pass any queuing traffic on the approach to the signals;

    - Cyclists are afforded somewhere to wait in an area relatively free of exhaust fumes; and,

    - Cyclists can position themselves to turn right more easily, particularly in busy situations.

- Where it is proposed to install ASLs at an existing signal installation, the signal engineers responsible for the installation should always be consulted. It is essential that the design of any advance stop line scheme is informed by relevant data and site observations, and that these are considered for each approach to the junction individually.

- Carefully designed contraflow cycle scheme without a cycle lane should not, create safety problems for any road users. If a proposal does give rise to specific safety concerns, then it is recommended that these be addressed by undertaking a risk assessment to identify suitable mitigating measures, including consideration of the risks to cyclists of using alternative routes if contraflow cycling is not permitted.

Themes: Cycle lanes, advanced stop lines, contraflow cycling, design criteria, hierarchy of provision

Comments: Provides useful information about infrastructure types.

Title: Analysis of police collision files for pedal cyclist fatalities in London, 2001-2006 (Published Project Report PPR438)

Author / organisation: M. Keigan, R. Cuerden and A. Wheeler (TRL for Transport for London (Transport for London))
Date: 2009
Format: Pdf
Link: https://trl.co.uk/reports/PPR620
Free / priced: Free

Objectives:

- Analyse cyclist fatalities;
- Identify what factors contributed to RTIs and how the RTis could have been prevented; and,
- Identify what factors contributed to the fatal injuries and how the fatal injuries could have been prevented.

Methodology: This study analysed a total of 92 police fatal files that were available to the researchers, which represented a sample size of 85 per cent. These files were for the period 2001 to 2006, where a cyclist was fatally injured in a RTI, within the Metropolitan and the City of London Police Force areas. The following research questions were considered:

- Primary prevention: What factors contributed to the RTI? How could the RTI have been prevented?

- Secondary and tertiary prevention: What factors contributed to the fatal injury. How could the fatal injury have been prevented?

Key Findings:

- Specific cycling infrastructure was recorded in the file for 28 RTIs, 16 RTI sites had a cycle lane on the road, 11 of the sites had a shared bus and cycle lane, 1 site had a shared pedestrian and cycle path and 59 sites had no cycling infrastructure.

- The most common cause of fatalities occurred when large vehicles were changing into a left-hand lane or turning left.

- Recommendations included a number of interventions:

    - Improving or installing side guards on heavy good vehicles (HGVs);
    - Retrofitting and improving mirrors on HGVs;
    - Raising awareness of cyclists;
    - Driver training;
    - Cyclist training;
    - Improving cyclist conspicuity;
    - Encouraging cycle helmet use; and,
    - Speed management.

Themes: Cyclist fatalities, speed management, cycling infrastructure.

Comments: Identifies fatalities where cycling infrastructure exists.

Title: Collisions involving pedal cyclists on Britain's roads: Establishing the causes (Published Project Report PPR 445)

Author / organisation: J. Knowles, S. Adams, R. Cuerden, T. Savil, S. Reid and M. Tighr (TRL) for RSRSD, DfT, Road safety Research and Statistics Division.
Date: 2009
Format: Pdf
Link: https://trl.co.uk/reports/PPR445
Free / priced: Free

Objectives: To review and report upon the number of RTIs involving cyclists on British roads as well as the contributory factors involved with the RTIs.

Methodology: The Department for Transport commissioned research to assess the causes of RTIs involving cyclists. This report investigates the key causal factors relating to RTIs involving cyclists. The work involved an international literature review and a detailed analysis of cyclist casualties in Great Britain, drawing on both national and in-depth databases of road RTIs and cycling. The main source of the casualty data was the national STATS19 injury RTI data for 1994-2007. Contributory factor data has been recorded nationally as part of the STATS19 system from 2005 and is also reported. The main source of cycling activity data was the National Travel Survey (NTS).

Key Findings:

- STATS19 data from 2005-2007 showed that 97 per cent of RTIs involving cyclists, resulting in a serious injury or fatality were on the main carriageway at the time of the RTIs. Two per cent were coded as being on a cycle lane on the main carriageway and one per cent were coded as being on a cycleway/shared footway. It should be noted that STATS19 include only RTIs that occur on the public highway and which were reported to the police.
- Almost two-thirds of cyclist KSI were at or near junctions where the risk is greater.
- The main RTI configurations involving a cycle and car were the car turning right or left while the cyclist was going straight ahead and the cyclist making as right turn while car was going straight ahead.
- The main contributory factors attributed to the cyclist include: 'cyclist failed to look properly' (43 per cent of serious RTIs) and 'cyclist entering the road from the pavement' (20 per cent of serious RTIs).
- Where contributory factors were assigned to the driver, 'failed to look properly' was by far the most commonly reported factor (56 per cent of serious RTIs).
- Most reported cyclist KSI causalities (83 per cent) in 2005-07 were involved in a RTI with another vehicle, usually a cars or taxi (69 per cent). The cycle was generally hit by the front of the other vehicle. Over a quarter of fatal RTIs involved the front of the vehicle hitting the back of the bike.

Themes: Cyclist RTI rates.

Comments: Gives an indication of why cycling infrastructure might be important in terms of preventing conflict between cyclists and other vehicles.

Title: Shared Zebra Crossing Study

Author / organisation: S. Greenshields, D. Allen, I. York and R. Paradise, TRL, prepared for Transport for London (Transport for London) and Cycling Centre of Excellence (CCE)
Date: 2006
Format: Pdf
Link: http://www.Transport for London.gov.uk/cdn/static/cms/documents/shared-zebra-crossing-study.pdf
Free / priced: Free

Objectives: To assess the impact of this use on cyclists and other road users and allow the CCE to make an informed decision regarding the next steps towards possible expanded and authorised use of shared-use Zebra(Tiger) crossings by pedestrians and cyclists.

Methodology: The methodology involved an assessment of current literature and law, video analysis of six study sites for conflict analysis, and examination of STATS19 data to examine the causes behind RTIs. This allowed the identification of risky behaviours and suggestions as to how these risks could be minimised through engineering in a shared-use Zebra (Tiger) crossing and how this might require legal change.

Key Findings:

- Cyclists are not prohibited from riding on the part of the crossing that consists of part of the carriageway. However, cyclists who do ride across and are involved in a collision risk being challenged in the courts under a charge of riding dangerously. In addition if the footway on either side of the crossing does not allow for cyclist use then they shall be guilty of the offence of using a vehicle on a footway.
- Therefore necessary changes to give cyclists similar rights to pedestrians would be needed to convert the adjacent footways to shared use(and legislation already exists to allow this), and changes to Regulations to give cyclists priority over other vehicles at Zebra crossings.
- In addition, appropriate signing would need to be agreed by DfT. Using existing laws, a shared-use crossing could be implemented however cyclists would not have precedence over other vehicles. The local highway authority may be held liable should the design of a shared-use Zebra (Tiger) crossing lead a cyclist to reasonably conclude that they did have precedence leading to an incident.
- Existing controlled carriageway crossings for cyclists use either Toucan or parallel segregated controlled crossing, both require extensive resources of space and capital, and involve ongoing revenue maintenance over and above Zebra crossings due to the controlled signalling involved.
- Key concerns involve the safety of cyclists being involved in conflict situations with vehicular traffic, other cyclists, and pedestrians (especially mobility impaired people), and the primary research in this report investigated this at six different sites around London.
- The reasons and circumstances behind observed and reported cases of conflict were investigated to identify behaviours (of all involved users) and designs which contribute towards conflict. The elimination of these risky behaviours and designs may help contribute towards a shared-use (Tiger) crossing design which decreases risk to a level similar to that of signalised

crossings.

- The research found that in practice, 88 per cent of cyclists at the observed sites presently ride over some or the whole of a Zebra crossing. In total there were 1,686 cyclists observed, of which 4 were involved in a level of conflict classed as emergency(sudden emergency actions such as hard braking or turning to avoid collision or a near), no RTIs were observed.
- Typical hazards related to riding across the crossing may be reduced by careful designs which limit certain behaviours although this may not be appropriate or viable at some locations.
- Routes which run adjacent to crossings and require cyclists to look behind them before crossing were particularly risky(perhaps due to the difficulty in assessing vehicles coming from behind), as was the blocking of crossings by queuing vehicles which encourage cyclists to weave through them. Vehicles blocking crossings tended to be more prevalent near to junctions and roundabouts.
- Central reservations provided at existing Zebra crossings are often too small to readily accommodate a cycle. Design standards for disabled users at central reservations should also be suitable for cycle users, and the crossings themselves and approaches to crossings for crossing users should be of sufficient size to accommodate shared use. Crossings for cycle use may benefit from designs which allow adequate time for conflict assessment and avoidance, and this is probably dependent upon cyclist visibility splays. It was found that cyclists tend to avoid high kerbs, this may prove useful in discouraging cyclists from certain risky movements.
- Conflict with pedestrians at the observed study sites was generally of a low quantity and level, but increased slightly at crossings with constricted space layouts. Nothing was noted to suggest that existing guidance on shared use areas would prove inadequate. Generally, Zebra crossings were only slightly more risky than Pelican/Toucan/Puffin crossings from analysed STATS19 data.
- Given the present high use of Zebra crossings by cyclists, it might be considered that the formalisation of their use, coupled with modifications to reduce risk concerns, would not result in extra risk.
- However some questions still remain before considering monitored pilot studies. At present it is likely that many cyclists are aware that their actions at Zebra crossings are in breach of the Highway Code and temper their actions accordingly (although it should be noted that this rule in the Highway Code has no statutory backing).
- Similarly the reactions of cyclists to signing requesting them to stop and look before crossing (as suggested by the CCE) are unknown. Conferring priority to cyclists may alter their actions and a test of this is required.
- The reaction and attitude of other groups are also unknown, this includes pedestrians, mobility impaired people, and motorists. In particular motorists may be unaware of a change which confers priority to cyclists and thus fail to stop. It is the suggestion of the CCE that shared-use Zebra (Tiger) crossings would include clear signing for vehicles, with a distinctive marking system for the crossing.

Themes: Zebra crossings, cyclists, shared use.

Comments: Informative study which highlights further research is required.

Title: Designing for cyclists, A guide to good practice

Author / organisation: BRE for Essex County Council
Date: 2006
Format: Pdf
Link:http://products.ihs.com/cis/Doc.aspx?AuthCode=&DocNum=277751
Free / priced: Downloadable from The Construction Information Service (CIS) via subscription.

Objectives: The purpose of this guide is to:

- Summarise current design advice and highlight key points;
- Clarify standards;
- Outline the legal processes necessary to introduce cycling facilities; and,
- Provide sources of more detailed information.

Methodology: Compilation of good practice, the design advice conforms to Department for Transport requirements and standards.

Key Findings:

- Routes do not necessarily have to be segregated cycle facilities or even designated cycle routes – a quiet urban street or country lane may be an excellent cycle 'facility'. The important aspect is the quality (the level of service for cycling) that the infrastructure provides.
- The Institution of Highways and Transportation guidelines summarise the requirements of good cycling infrastructure under the headings below:
    - Coherence: Routes should be continuous, consistent in standard and link all significant trip origins and destinations. Cyclist dismount signs should be avoided where possible.
    - Directness: Routes should be as direct as possible based on desire lines – detours and delays will deter use.
    - Attractiveness - Routes should be attractive to cyclists. Lighting, personal safety and the surrounding area are important.
    - Safety: Designs should minimise 'actual' and 'perceived' danger for cyclists and other road users.
    - Comfort: Cyclists need gentle gradients and smooth, well maintained surfaces that are regularly swept. Routes should be convenient to use and avoid complicated manoeuvres, delays and the need to dismount.
- Planners and designers should use the hierarchy approach:
    - Traffic reduction - Can traffic volumes be reduced sufficiently to achieve the desired improvements in safety and attractiveness for cyclists?

- Speed reduction and traffic calming - Can vehicle speed be reduced and driver behaviour modified to achieve the desired improvements?
- Junction treatment and traffic management - Can the problems that cyclists encounter, particularly large roundabouts and RTI locations, be treated by specific junction treatment or other traffic management solutions?
- Redistribution of the carriageway- Can the carriageway be redistributed to give more space for cyclists?
- Off -road provision - Having considered and where possible implemented the above, are any off carriageway facilities such as cycle tracks necessary?

- Cycle audit should complement safety audit, not duplicate it. All new or amended cycle schemes should be subject to a road safety audit in accordance with local authority procedures.
- Monitoring is important because it enables local authorities and others to measure the impact of individual measures, cycle networks and the overall cycling strategy.

Themes: Civil engineering and public utilities, transport facilities, roads, cycle ways.

Comments: Describes the requirements of good cycling infrastructure and the hierarchy approach.

Title: Behaviour at cycle advanced stop lines (Published Project Report PPR240)

Author / organisation: D. Allen, S. Bygrave and H. Harper (TRL) for Transport for London (Transport for London)
Date: 2005. **Format:** Pdf
Link: https://trl.co.uk/reports/PPR240
Free / priced: Free

Objectives: The objective of the study was to obtain quantitative information on the behaviour of cyclists and other road users where there are Advanced Stop Lines (ASLs).

Methodology: A total of 6,041 cyclists were observed during this study. The research study employed the following methodology:

- The selection of twelve sites with ASLs in the Greater London area, primarily based upon cyclist flows expected and the site/junction arm layout.
- The selection of two control sites without ASLs as a comparator to ASL sites.
- The collection and analysis of video footage of behaviour at the selected sites.
- The compilation of background information regarding the site, particularly traffic flow information.
- The collection and analysis of casualty data at each of the site locations.

Key Findings:

- ASLs are primarily a measure designed to increase cyclists' safety by allowing cycle users to move away from traffic signals slightly in advanced of motorised traffic. ASL facilities provide a second stop line in advance of the regular line.
- Based on finding from the sites monitored, low levels of reported conflicts suggest that ASLs are not a safety hazard.
- Cyclists travelling straight ahead were found to be able to position themselves in front of the traffic this reducing the risk of conflict with left turning vehicles. However at one site a potential conflict was indentified where cyclists were found to be crossing the path of vehicles making a left turn at the junction.
- 78 per cent of cyclists at the ASL site were able to position themselves in front of the traffic when waiting at signals. This was compared with 54 per cent at the control sites.
- The research has identified that ASLs can support less risky behaviour but do not conclusively prevent (or inspire) risk taking by cyclists.
- 36 per cent of all cyclists across all the ASL sites experienced some form of encroachment by vehicles onto the ASL reservoir.
- The proportion of cyclists found to violate a red light was 4 per cent at ASL sites compared with control sites. This suggests a slight propensity to violate at ASL sites, but not to a large extent.

Themes: Advanced Stop Lines, cyclist visibility, reducing risk.

Comments: Provide specific information about advanced stop lines and cyclist and vehicle behaviour seen at this type of cycling infrastructure.

Title: World report on road traffic injury prevention, summary

Author / organisation: World Health Organization (WHO)
Date: 2004. **Format:** Pdf
Link:www.who.int/violence_injury_prevention/publications/road_traffic/world_report/summary_en_rev.pdf
Free / priced: Free

Objectives: The report has three aims.

- To create greater levels of awareness, commitment and informed decision-making at all levels – government, industry, international agencies and nongovernmental organizations – so that strategies scientifically proven to be effective in preventing road injuries can be implemented. Any effective response to the global challenge of reducing road traffic casualties will require all these levels to mobilize great effort.
- To contribute to a change in thinking about the nature of the problem of road traffic injuries and what constitutes successful prevention. The perception that road traffic injury is the price to be paid for achieving mobility and economic development needs to be replaced by a more holistic idea that emphasizes prevention through action at all levels of the road traffic system.
- To help strengthen institutions and to create effective partnerships to deliver safer road traffic systems. Such partnerships should exist horizontally between different sectors of government and vertically between different levels of government, as well as between governments and nongovernmental organizations. At the government level, this means establishing close collaboration between sectors, including public health, transport, finance, law enforcement and other sectors concerned.

Methodology: Compilation of good practice.

Key Findings:

- Road traffic injuries are a huge public health and development problem, killing almost 1.2 million people a year and injuring or disabling between 20 million and 50 million more. Both WHO and World Bank data show that, without appropriate action, these injuries will rise dramatically by the year 2020, particularly in rapidly motorising countries.
- A recent study comparing the risks of travel in the European Union countries by the four main modes and by different means of road travel found that, compared with a person in a car, a person on a cycle 8 times more likely to be killed.
- Providing convenient and affordable public transport, by rail and/or bus and coach, can reduce the distance travelled using higher-risk modes. Trip using public transport usually have a walking or cycling component. Although that component may bear relatively high risk, pedestrians and cyclists pose less risk to other road users than do motor vehicles. National transport policy in many high-income countries now encourages the combination of public transport with improved safety of pedestrian and cycling routes.
- Widespread experience with area-wide road safety management in Europe shows that it can reduce RTIs and injuries by 15 to 80 per cent. The town of Baden, Austria launched a management plan in 1988 that has resulted in about 75 per cent of its road network being restricted to speeds of 20 mph or less and an integrated system of public transport with pedestrian and cycle routes. The rate of road casualties has declined by 60 per cent.

• A study in the Netherlands found that 30 per cent of cycle RTIs occur at night or in twilight and could be avoided if cycle lights were used.
Themes: Reduction in cyclist casualties, segregated cycle tracks.
Comments: Provides one example of a reduction in cyclist casualties.

Title: Cycle track crossings of minor roads (TRL462)
Author / organisation: A. Pedler and D.G. Davies (TRL for DETR) **Date:**2000 **Format:** Pdf **Link:** https://trl.co.uk/reports/TRL462 **Free / priced:** Free
Objectives: To investigate sites where cycle paths cross side roads in order to assess the hazards associated with this feature.
Methodology: TRL used video cameras to monitor 1,512 cyclists at five different cycle track crossings of minor roads. TRL also interviewed 233 cyclists at the sites.
Key Findings: • Cycle paths can help cyclists to avoid sharing busy roads with motor vehicles. • One of the main problems with providing cycle paths however is the design of the crossings of minor roads. This introduces a hazard and the cyclists are usually required to give way. Highway authorities have been reluctant to give priority to cyclists on the cycle path over vehicles on the side road, in case drivers fail to observe the priorities and casualties occur. • The study found that cycle paths with priority for cyclists across minor roads appears to work reasonably satisfactorily in some cases but some hazardous interactions were also observed. • Cyclists remaining on the main road had fewer problems crossing the minor road. • The majority of cyclists used the cycle paths particularly less confident cyclists. • Most problems were observed at ‘straight across’ type crossings mostly due to poor visibility onto the main road. • At all sites there was a significant percentage of cyclists who were unsure or did not understand the traffic priorities at the crossing. • The research concluded that improvements to cycling conditions on major roads should be considered before changes to the minor road crossing. • Where cycle paths are provided crossings of minor roads should be ‘bent out’ (the cycle path is coloured red and raised on a road hump) where site conditions allow.
Themes: Cycle routes, crossing minor roads.
Comments: Illustrates a possible solution to issues related to cycle tracks crossing minor side roads, this is back up with primary research.

Title: Cycle Safety, PACTS policy briefing

Author / organisation: Parliamentary Advisory Council for Transport Safety (PACTS)
Date: Not dated
Format: Pdf
Link:
http://www.roadsafetyknowledgecentre.org.uk/issues/cycling/knowledge/783.html
Free / priced: Free

Objectives: To advise and inform members of the House of Commons and of the House of Lords on cycle safety issues.

Methodology: Summarising recent statistics and research.

Key Findings:

- Kerbed, segregated cycle paths are not wide-spread in the UK, and literature reviews found no evidence in other European countries regarding the safety performance of kerbed cycle paths.

- Other design features not widely used in the UK include cycle lane markings continued across junctions, cycle pre-signals and Trixi mirrors (mounted at traffic lights, giving drivers of heavy vehicles a view of any cyclists to their left), which are now being trialled in London. Further trials and evidence gathering for these features should be carried out in this country.

- Although evidence showing the effectiveness of cycle lanes is limited in the UK, it has been found that many people find cycling a bad experience using existing roads, are put off cycling by having to negotiate difficult road junctions, and have a desire for more cycle lanes.

- More should be done to ensure cycle infrastructure is well-planned, well-maintained, consistent, and legible to all road users.

- Building a better, safer environment for cycling provides a double win: with a safer infrastructure it is hoped that casualty rates will reduce; and also a visibly safer infrastructure may encourage a greater number of people to cycle, assisting achievement of ‘safety in numbers’.

Themes: Cycle, safety, cycle lanes.

Comments: Summary of statistics and research highlighting infrastructure types that aren’t widely used in the UK.

Title: Pedestrian-cyclist interactions at bus stops along segregated bike paths: a case study of Montreal

Author / organisation: A.P. Afghari, K. Ismail, N. Saunier, A. Sharmer & I. Miranda-Moreno
Date: 2014
Format: Pdf
Link:
http://eprints.qut.edu.au/79841/1/Afghari_2014.pdf
Free / priced: Free

Objectives: To identify and characterise interactions between cyclists and pedestrians at bus stops along cycle routes.

Methodology: The study uses video analysis to capture the cyclist and pedestrian interactions. The tracks of cyclists and pedestrians are then automatically extracted using computer vision techniques so that analysis can evaluate cyclists and pedestrians at high risk areas where pedestrians need to cross the cycle track to get to the bus stop. Microscopic behaviour analysis was conducted on speed and acceleration profiles of conflicting users.

Key Findings:

- Pedestrians had large speed differences during the journey indicating that they tended to adapt their behaviour to the cyclists.

- Almost all cyclists were observed to maintain their speed and acceleration, indicating resistance to slow down for pedestrians, whereas pedestrians were seen to take evasive action, i.e. either slowing down or speeding up to a run in response to the movement of the approaching cyclists.

Themes: Bus stops, segregated cycle tracks, pedestrian crossings

Comments: Finds that pedestrians are more likely to give way to cyclists than the other way round.

Title: Low Level Cycle Signals used as repeaters of the main traffic signals. Track trial report (TRL732)

Author / organisation: S. D. Ball, J. Hopkin, V. Chesterton, P. Emmerson, R. Gardner, G. Kandasamy, M. Militzer, P. Knight and I. York
Date: 2015(a) **Format:** Pdf
http://www.trl.co.uk/media/671432/ppr732_ws4_llcs_m14.pdf
Free / priced: Free

Objectives: To investigate how road users respond to low level cycle signals as repeaters of main traffic signals on the same pole.

Methodology: TRL used video cameras and questionnaires to record observations and perceptions of 248 participants (consisting of cyclists, car drivers, motorcyclists, HGV drivers and partially sighted pedestrians) when using a specially constructed typical 'urban' four-arm junction with main traffic signals and low level cycle signals as repeaters. Participants in all road user groups experienced the junction as an individual, with some interaction with other vehicles.

Key Findings:

- Low level cycle signals (LLCS) were generally well understood by all road user groups. Some participants were concerned that the LLCS might be mistaken for pedestrian crossing signals.
- At least 80 per cent of participants considered the LLCS to be of benefit to cyclists. About 80 per cent of cyclists were in favour of the LLCS and 90 per cent of other road users were not negative towards them.
- Participants thought that the LLCS could be bigger or more obvious, and provide an early release. Cyclists considered the height and angle of the LLCS about right.
- The LLCS were used as an extra source of information by most cyclists, particularly while waiting at the junction to turn left. Cyclists typically used the main traffic signals when approaching the junction.
- The LLCS did not have a negative effect on compliance at the junction.
- None of the cyclists said that the junction felt more unsafe than a typical junction and about half said that the junction felt safer.
- Participants felt that LLCS provided clearer information for cyclists at a good height. Some cyclists reported feeling more confident.
- About a quarter of motorcyclists and car drivers thought the LLCS had positive safety implications, indicating that they provided extra information and made them more aware of cyclists.
- Some motorcyclists and car drivers felt that the LLCS could have a negative impact on safety as they were confusing or distracting and there was the potential for road users other than cyclists to use the signals.

Themes: Cycle signals, signalised junctions

Comments: The first of a set of trials testing different configurations of low level cycle signals and junction layouts for TfL.

Title: Low Level Cycle Signals with an early release. Track trial report (TRL733)

Author / organisation: S. D. Ball, J. Hopkin, V. Chesterton, R. Gardner, R. Smith, G. Kandasamy, P. Knight and I. York
Date: 2015(b)
Format: Pdf
http://www.trl.co.uk/media/671438/ppr733_ws4_llcs_m18.pdf
Free / priced: Free

Objectives: To investigate how road users respond to low level cycle signals with an early release ahead of main traffic signals.

Methodology: TRL used video cameras and questionnaires to record observations and perceptions of 200 participants (consisting of cyclists, car drivers and motorcyclists) when using a specially constructed typical 'urban' four-arm junction with main traffic signals and low level cycle signals providing an early release ahead of the main signals. Cyclists, motorcyclists and car drivers experienced the junction as an individual, with some interaction with other vehicles.

Key Findings:

- Over 95 per cent of participants in all road user groups understood that the LLCS were for cyclists. Of small number of cyclists said that it took them a little time to understand the early release.
- All car drivers and 95 per cent of cyclists and motorcyclists reported noticing the early release and over 80 per cent in each road user group felt positively towards it.
- Over 90 per cent of participants thought that the early release would be of benefit to cyclists on the road, with about 90 per cent of cyclists and car drivers and 75 per cent of motorcyclists providing positive comments about the LLCS (more than in the previous trial where there was no early release).
- Cyclists used the LLCS more in this trial than the trial when there was no early release. Most cyclists considered the LLCS to be the most important source of information for them.
- The early release for cyclists did not have any effect on compliance to red lights at the junction.
- A large proportion of cyclists started moving on the red and amber signal (before green).
- Cyclists entered the junction 1.5 – 2 seconds after the LLCS turned green, which would be an average of 3.5 seconds before a car on a 2 second early release; 4.5 seconds before a car on a 3 second early release; 5.5 seconds before a car on a 4 second early release and 6.5 seconds before a car on a 5 second early release.
- Some car drivers and motorcyclists started moving before the main signals changed.

- When there was a longer early release, more cyclists turned right at the junction in front of an oncoming car.
- The junction was perceived to be safer than a normal junction for more cyclists in this trial than in the previous trial without the early release. This is likely an effect of the early release.

Themes: Cycle signals, signalised junctions, early release for cyclists

Comments: The second of a set of trials testing different configurations of low level cycle signals and junction layouts for TfL.

Title: Low Level Cycle Signals with different cycle reservoir depths. Track trial report (TRL735)

Author / organisation: S. D. Ball, J. Hopkin, M. Stonehill, K. Millard, R. Smith, V. Chesterton, R. Gardner, G. Kandasamy, J. Vestey, P. Knight and I. York
Date: 2015(c)
Format: Pdf
http://www.trl.co.uk/media/671450/ppr735_ws4_llcs_m24.pdf
Free / priced: Free

Objectives: To gather evaluation evidence on different sizes of cycle reservoir for groups of cyclists and individual car drivers, specifically when combined with LLCS being mounted on separate poles to the main signals.

Methodology: TRL used video cameras and questionnaires to record observations and perceptions of 1,290 participants (consisting of cyclists, car drivers and motorcyclists) when using a specially constructed typical 'urban' four-arm junction with main traffic signals and low level cycle signals providing an early release ahead of the main signals. Cyclists experienced the junction either in a small group of eight or a large group of 16 cyclists. Car drivers experienced the junction as an individual. with some interaction with other vehicles.

Key Findings:

- 8.0 cyclists could fit into a 5 metre deep cycle reservoir when cycling around in large groups of 16 people. This fell to 6.5 cyclists when cycling around in small groups of 8 people.
- 13.0 cyclists could fit into a 7.5 metre deep cycle reservoir when trialling the large group (all cyclists in the small group could wait inside the reservoir area).
- At least 16 cyclists could comfortably fit in to a 10 metre deep cycle reservoir in almost all instances.
- On a one lane approach to a junction it is suggested that a cycle reservoir of between 5 – 7.5 metres may be considered when there is requirement to provide a waiting area for 8 – 13 cyclists. For a capacity requirement of more than 13 cyclists, a cycle reservoir of over 7.5 metres deep is recommended.

- Observations measures approximately 1.7 cyclists per metre of reservoir depth on a one lane approach scenario.
- About half the cyclists expressed that that had at times found it difficult or impossible to see the LLCS and this was more likely in the larger group scenario. The main reason was that other cyclists were obscuring the signals. In this situation, over 40 per cent of cyclists said that they followed other cyclists, and about 25 per cent indicated that they had had to reposition themselves.
- The longer the early release, the more cyclists turned right across an oncoming car. This was also the case with larger cycle reservoirs, possibly because the approaching car being set further back from the entrance to the junction. The majority of cyclists appeared to make this manoeuvre based on their assessment of having sufficient time to do so safely. Some cyclists suggested that they based their judgement on the behaviour of other cyclists or assumed that they had right of way.
- Car drivers understood the cycle reservoirs and the majority thought that the size was about right; although this should be based on the location of the junction and volume of cyclists using it; with a need to strike a balance between providing space for cyclists and space for other vehicles.
- In the larger reservoir scenarios (10 metres), there was a slight decrease in compliance with car drivers starting to encroach into the reservoir, although typically only up to 1.25 metres past the first stop line.
- In the larger reservoir scenarios, car drivers were more likely to start moving forward on the early release for cyclists than in the smaller reservoir scenarios (5 metres).

Themes: Cycle signals, signalised junctions, early release for cyclists, cycle reservoirs, ASL

Comments: The fourth of a set of trials testing different configurations of low level cycle signals and junction layouts for TfL.

Title: Bike rider and bus driver interaction study - draft report

Author / organisation: C. Baumann, T. Brennan, & M.E. Zeibots (prepared for the City of Sydney)
Date: 2014
Format: Pdf
Link:
https://www.uts.edu.au/sites/default/files/Baumannetal2012bikeandbus.pdf
Free / priced: Free

Objectives: To investigate the experiences of cyclists and bus drivers when interacting with each other on the streets of Sydney and provide recommendation for how interactions could be improved.

Methodology: A social research study undertaken by the Institute for Sustainable Futures at the University of Technology, Sydney. The research involved surveying 405 cyclists and 112 bus drivers.

Key Findings:

- 59 per cent of cyclists reported being slightly uncomfortable or very uncomfortable riding around buses.
- Younger and female cyclists were more likely to feel uncomfortable when interacting with buses.
- Most bike riders indicated they were 'uncomfortable' when being overtaken at very close distance (81 per cent), when a bus is driving very close behind them (just over two thirds) and when buses re-enter the lane right before a bus stop (about two thirds).
- About 40 per cent of bike riders reported trying to make eye contact when approached or overtaken by a bus and slowed down to let the bus overtake (just over a third). By contrast, around a third of cyclists stated that they don't change their behaviour.
- 68 per cent of bus drivers reported being slightly uncomfortable or very uncomfortable driving around cyclists.
- Two thirds of drivers felt at least 'somewhat uncomfortable' with cyclists. Slow, erratic cyclists and those who rode two or more abreast were specific behaviours that made drivers uncomfortable.
- The issue of cyclists riding in bus lanes appears to be particularly problematic for bus drivers as they often commented that there is not enough room in a lane for both a bus and a cyclist.
- Two thirds of bus drivers indicated that they felt uncomfortable when overtaking slow cyclists and again when cyclists do not ride in a straight.
- Over 70 per cent of bus drivers reported slowing down when they approach a cyclist and just over 50 per cent indicated that they change into the car lane.

Themes: Bus- cyclist interactions

Comments: Gives the two perspectives of bus-cyclist interactions.

Title: TfL Cycle Facility Trials: Alternative Separation Methods for Cycle Lanes (TRL704)

Author / organisation: G. Beard
Date: 2014 **Format:** Pdf
Link: http://www.trl.co.uk/media/309316/ppr704_-_alternative_separation_methods_for_cycle_lanes.pdf
Free / priced: Free

Objectives: Examine the impact of different methods of cycle lane separation on the behaviour and safety (perceived and absolute) of road users.

Methodology: TRL used video cameras and questionnaires to record observations and perceptions of participants who experienced different separation methods. The different separation methods tested were:

- A kerb with 365 mm hard margin (full continuous segregation with physical barrier);
- Bolt on delineators (intermittent separation with low profile barriers positioned at 2.5 m intervals; and
- 1 m high marker posts (intermittent separation with high profile barriers positioned at 2 m intervals.

As a baseline, a painted solid white line (mandatory cycle lane, continuous separation with no physical barrier) was also tested.
Each participant experienced the baseline scenario and one of the other test scenarios during the trial.

Key Findings:

- Cyclists, drivers and pedestrians generally rated all of the separation methods highly in terms of perceived usability and perceived safety.
- The bolt on delineators offered the smallest improvement when compared against a painted white line in terms of usability and safety of cyclists and car drivers. They were also perceived by motorcyclists and HGV drivers to be less safe and harder to navigate when compared against the baseline.
- Overall, the hard kerb was the preferred separation method over a white line by car drivers and cyclists, but this was not the case for motorcyclists or pedestrians. In this scenario, motorcyclists rode further away from the separation method and pedestrians found it more difficult to cross.
- The 1 metre high marker posts were the method of separation which offered improvements in perceived safety and usability over the baseline scenario for all road users (except pedestrians where there were no significant differences). Cyclists travelled closer to the marker posts (and therefore closer to road traffic) than the other separation methods, supporting the finding that these were perceived as safer.

Themes: Cycle lanes, segregation, perceived safety

Comments: Compares different methods of separating cycle lanes from motor traffic.

Title: Determining bicycle infrastructure preferences - A case study of Dublin

Author / organisation: B. Caulfield, E. Brick & O.T. McCarthy
Date: 2012 **Format:** Pdf
https://www.researchgate.net/publication/257547642_Determining_bicycle_infrastructure_preferences_-_A_case_study_of_Dublin
Free / priced: Free

Objectives: To examine infrastructure preferences for cyclists in Ireland.

Methodology: A stated preference survey was completed by 2,000 cyclists and non-cyclists to gauge preferences for a range of infrastructure types and route characteristics.

Key Findings:

- Facilities which were segregated from traffic were the most preferred form of cycling infrastructure, regardless of cycling confidence.
- Routes through residential streets and parks were the second most favoured, where no specific infrastructure is provided with the exception of improvements in way-finding.
- Routes which offered no facilities were least favoured and least likely to support a shift to cycling.
- Cyclists of all abilities agreed that routes which have 'no facilities' or 'bus/cycle lanes' are the least preferred type of cycle route. A small proportion of very confident cyclists particularly valued short journey times and direct facilities with low cyclist volumes. The type of infrastructure and traffic speeds was not of significance to them.
- When asked what factors would encourage respondents to begin cycling, 74 per cent said more off road cycle tracks and 56 per cent said more connected on road cycle lanes would encourage them to begin to cycle to work. 69 per cent said that less traffic was unlikely to encourage them to cycle on a regular basis.
- About 9 per cent of respondents said that they thought cycle safety had improved a lot in Dublin over the past three years and about 59 per cent said that it had improved slightly.
- Direct routes with short journey times were the most important variable for existing cyclists and non-cyclists when deciding on a route. This was followed by the type of infrastructure present, the number of junctions along the route and traffic speeds and cyclist volumes.
- A small proportion of very confident cyclists placed high importance on short travel times and direct facilities with low cyclist volumes. The type of infrastructure and traffic speeds were less relevant to them.

Themes: Cycle infrastructure, cyclist preferences

Comments: Discusses what factors, including infrastructure might encourage cyclists to cycle.

Title: Effects of 20mph zones on cycling and walking behaviours in London. Stage 1 – Literature Review

Author / organisation: M. Cedaño-Tovar & I Kilbane Dawe

Date: 2013 **Format:** Pdf

http://static1.squarespace.com/static/5006f1cc84ae2a41e73b7aad/t/5152f637e4b08d37aa3e5388/1364391479536/Effect+of+20mph+zones+on+walking+and+cycling+Stage+1+Report.pdf

Free / priced: Free

Objectives: Reviews the findings of previous studies on the effect of 20 mph zones.

Methodology: Literature review

Key Findings:

- 20 mph zones positively affect safety and perceived safety, two of the key determining factors for modal shift to cycling and walking.
- Crash occurrences involving cyclists and pedestrians are reduced with lower vehicle speeds and this encourages more people to take up these modes of travel.
- Both 'signage only' and mandatory 20 mph zones with physical traffic calming measures encourage modal shift to cycling and walking. However, physical traffic calming measures should be selected based on the specific needs of the area in which they are to be used.
- Traffic calming and speed reductions on residential streets are important to enable people to start their cycle trips as most people begin these trips at home.
- There is a trend in Europe towards prioritising the needs of pedestrians and cyclists over the needs of car drivers in areas of 'shared space'.
- Cities in the Netherlands, Denmark and Germany have implemented traffic calming measures and 20 mph speed limits in residential area and in some areas restricted traffic routes.
- From these countries, the evidence suggests that slow speed zones are a key aspect of increasing cycling. In the Netherlands 27 per cent of all trips are by bike, 18 per cent in Denmark and 10 per cent in Germany.
- Evidence from Portsmouth , Barcelona and Brussels suggests that 20 mph zones increase road safety and perceptions of road safety, resulting in higher levels of walking and cycling.
- The introduction of 20 mph zones in London between 1986 and 2006 was associated with a reduction in the number of road casualties by 42 per cent. Reductions amongst cyclists were reduced by 17 per cent.
- In the Netherland, Denmark and Germany measures such as road narrowing, raised junctions and pavements, traffic circles and extra curves have meant that walking and cycling speeds have increased relative to that of driving, whilst also increasing safety.

Themes: Traffic calming, 20 mph zones, safety, cycling

Comments: A review of evidence from different cities and countries about the impacts of traffic calming and 20 mph zones on cycling.

Title: Safety aspects of contraflow cycling

Author / organisation: I. Chalanton & B. Dupriez
Date: 2014
Format: Pdf
Link: www.mobielbrussel.irisnet.be/static/attachments/partners/na/248/vm-1-sul_ENG_.pdf
Free / priced: Free

Objectives: Provides a detailed analysis of accidents involving cyclists on cyclist contraflows in the Brussels-Capital Region between 2008 and 2010.

Methodology: Statistical analysis of 992 cycle accidents

Key Findings:

- 12.7 per cent of the 992 cycle accidents analysed involved cyclists using a contraflow in some way. Only 4.7 per cent of all 992 accidents involved a cyclist travelling in the opposite direction to traffic on a contraflow lane.
- Accidents are proportionately no more likely to involve a cyclist travelling against the flow of traffic than with traffic. Evidence even suggests there are less of these accidents. The implementation of contraflow cycling routes has not led to an increase in cycle accidents on the roads concerned.
- Of the accidents involving a cyclist travelling in the direction opposing traffic, 66 per cent took place at an intersection. The proportion of accidents at intersections when looking at cyclists travelling with traffic was 40 per cent. Therefore, based on the evidence, it appears that on roads located that away from intersections, there is more risk of accident for cyclists travelling with the flow of traffic than against; whereas at intersections, cyclists travelling against the flow of traffic are more at risk of accidents.
- It is important that this risk of accident to cyclists travelling with the flow of traffic is not underestimated, and where necessary solutions must be found.
- The type of road is a more significant factor in the risk of cycling accidents than whether or not there is a contraflow present. The highest accident risk for cyclists is on the primary road network where it is 15 times more likely than on the local network. On local networks where most contraflows are located, there are less accidents involving cyclists on the sections of road with contraflow than on those without.
- Failure to give way is the most common reason for collisions involving cyclists on contraflow routes against traffic.
- Narrow streets do not appear to be a significant accident factor however; the location of street parking can affect risk to cyclists as it can affect their positioning in the road.

Themes: Contraflow cycling, accidents, statistics

Comments: Comparison of accident rates on contraflow cycling roads against non-contraflow roads.

Title: Cyclists and drivers in road interactions: A comparison of perceived crash risk

Author / organisation: N. Chaurand and P. Delhomme
Date: Accident Analysis and Prevention 50 2013
Format: Pdf
Link:
http://www.academia.edu/8153130/Cyclists_and_drivers_in_road_interactions_A_comparison_of_perceived_crash_risk
Free / priced: Free

Objectives: Investigates actual and perceived crash risk of cyclists interacting with other road users

Methodology: A survey of experienced cyclists and non-cyclist car drivers (living in Paris) to evaluate their personal risk of being involved in a road collision as a cyclist or car driver if they were interacting with a car or bike.

Key Findings:

- When asked to estimate risk of different interactions with motorised traffic, the sample of experienced cyclists perceived tailgating as the most risky situation and not signalling at a left turn (equivalent to a right turn in the UK) as the least risky situation.
- Cyclists perceive greater risk when interacting with cars than with other bicycles.
- Experienced cyclists perceived there to be less risk if they were the ones to be carrying out a risky behaviour than if it was the car driver.
- Factors known to influence drivers' perceived risk, also affect cyclists' perceived risk: skill and experience.
- Perceived risk was found to increase with helmet wearing whilst cycling.
- Miscommunications and incorrect expectations about another road user's behaviour appear to be an important factor in explaining crashes resulting from bike-car interactions.

Themes: Bike-car interactions, collisions, risk, safety

Comments: Investigates actual and perceived risk from a cyclist and car driver perspective.

Title: Manual for Streets 2: Wider Application of the Principles (Chapter 6)

Author / organisation: CIHT
Date: 2010
Format: Pdf
Link: http://www.ciht.org.uk/en/document-summary/index.cfm/docid/055693F6-8DB0-4BBE-AA9FF1B5BC5E9412
Free / priced: Free

Objectives: Adds to Manual for Streets 1, exploring in greater detail how and where the key principles can be applied to busy roads.

Methodology: Compilation of guidance

Key Findings:

- Cyclists should be catered for on the carriageway.
- Cyclists have a preference for direct routes with no barriers, i.e. obstacles that require cyclists to dismount. Where cycle routes do not take into account desire lines and require cyclists to have to stop to give way to traffic, cyclists are less likely to use them.
- Traffic conditions have a significant effect on cyclist behaviour and choices of routes. Where there are high traffic volumes or speeds that would discourage cycling on the road, measures should be put in place to enable safe cycling.
- The preferred approach to designing cycle infrastructure and cycle friendly streets is to create conditions on the road that cyclists are comfortable to ride in. This may require speed reduction measures to be put in place or the allocation of cycle facilities away from traffic.
-

Themes: Cycling, guidance

Comments: Gives guiding principles for implementing cycle facilities and cycle friendly streets.

Title: Sharing is (s)caring? Interactions between buses and bicyclists on bus lanes shared with bicyclists

Author / organisation: T. De Ceunynck, B. Dorleman, S. Daniels, A. Laureshyn, T. Brijs, E. Hermans & G. Wets
Proceedings of the 28th ICTCT conference, Ashdod, Israel, 29-30 October 2015
Date: 2015 **Format:** Pdf
https://uhdspace.uhasselt.be/dspace/bitstream/1942/20377/1/151214De%20Ceunynck%20et%20al%20sharing%20is%20scaring_ICTCT.pdf
Free / priced: Free

Objectives: An observation study of the interactions between cyclists and buses on shared bus lanes in Belgium.

Methodology: Straight sections of two bus lanes shared with cyclists in Belgium were observed for two weeks with all interactions between the two road users being recorded. The lateral position and riding speed of the cyclists at the time of the interaction with the buses was compared against a control group. One bus lane was located in Kortrijk and had a width of 3.1 metres as specified in the road design guidelines, the other was located in Ghent and had a width of 4.2 metres (too wide according the guidelines).

Key Findings:

- Dangerous interactions between cyclists and buses were found to be relatively frequent at both analysed bus lanes.
- Dangerous overtaking manoeuvres, such as a bus overtaking a cyclist with very little lateral distance as well as dangerous cyclists-following situations, where a bus drive very closely behind a cyclist, were quite common at both analysed bus lanes.
- The hypothesis that a sufficiently narrow bus lane is safer than the wider bus lane could not be confirmed based on the analysis.
- Slightly more unsafe and dangerous overtaking manoeuvres seemed to take place at the narrow bus lane, but the difference was not statistically significant.
- More cyclist-following situations took place at the narrower bus lane because overtaking was more difficult. The results showed that buses often follow cyclists at distances that are unsafe in these situations.
- The presence of a bus was found to affect cyclist behaviour.
- Cyclists that get overtaken by a bus, tended to ride more closely to the edge than cyclists that were not interacting with a bus.
- The observations showed that cyclists take up a position of less than 1 metre from the edge of the road while being overtaken; however the road design guidelines assume that cyclists take up a width of 1 metre from the edge on bus lanes shared with cyclists. The presence of a bus does not have a significant influence on the lateral stability of the cyclist.
- There were also some indications that cyclists who involved in an interaction with a bus were riding faster than cyclists who were not interacting with a bus.

Themes: Bus-car interactions, risk, overtaking, bus lane

Comments: Investigates bus and cyclist interactions in bus lanes.

Title: PRESTO Cycling Policy Guide: Cycling Infrastructure

Author / organisation: D. Dufour, Ligtermoet & Partners, the Netherlands
EU's Intelligent Energy – Europe Programme
Date: 2010
Format: Pdf
Link: https://ec.europa.eu/energy/intelligent/projects/sites/iee-projects/files/projects/documents/presto_policy_guide_cycling_infrastructure_en.pdf
Free / priced: Free

Objectives: This guide brings together guidance from state of the art European knowledge and experience on urban cycling policy. It outlines the overall principles, critical issues and decision making factors.

Methodology: A compilation of guidance

Key Findings:

- Safety must always be the top priority, however, utility routes and recreational routes have different priorities in terms of directness, cohesion, comfort and attractiveness.
- The physical design of the infrastructure needs to take into consideration the physical space needs of cycling, including the dimensions of the cyclist and the bicycle and the physical characteristics of the activity of riding a bicycle.
- In a hierarchical network approach, the guiding principle should be that mixing of cyclists with other traffic should be implemented where possible and segregation should be implemented if necessary if safety requires it, for example in areas of high motor traffic volumes or speeds.

Themes: Cycle infrastructure, policy, hierarchy of measures

Comments: Guidance on how to implement successful cycle infrastructure based on European examples.

Title: The effects of cycle lanes, vehicle to kerb distance and vehicle type on cyclists attention allocation during junction negotiation

Author / organisation: D. Frings, J. Parkin & A. Ridley
University of the West of England
Date: 2014
Format: Pdf
Link:
http://eprints.uwe.ac.uk/24358/3/Frings%20Parkin%20and%20Ridley%20AAP%20Paper.pdf
Free / priced: Free

Objectives: Investigates cycle behaviour when interacting with other vehicles in different road set ups.

Methodology: Involved analysis of video observations of a cyclist's perspective cycling on busy roads in central London. The eye tracking aspect of the research involved 26 trials of participants looking at clips on a screen from the perspective of a cyclist. Risk perception and behaviour choice were records.

Key Findings:

- Cyclists focused the majority of their attention on the nearside closest to the kerb. Offside passing was perceived as most risky. Cyclists tended to wait behind traffic.
- Cycle lanes did not affect behaviour however nearside passing was seen as less risky when one was present.
- Perceived risk of passing increased for larger vehicles with cyclists more likely to remain behind.
- Wider kerb distances increased the likelihood of nearside passing as the perceived risk was lower.
- Cycle lanes have become an increasingly common facility aimed at encouraging cycling, through the provision of space for cyclists on the road. Advantages include the opportunity for cyclists to undertake queuing traffic; however disadvantages arise when there is insufficient width to pass vehicles whilst maintaining space from the kerb. No evidence has shown directly that cycle lane presence reduces the perceived risk of cycling.

Themes: Risk, attention, interactions with other vehicles

Comments: Describes cyclist behaviour during interactions with other road users and how they perceive risk in different situations.

Title: Road Use Statistics Great Britain 2016
Author / organisation: N. George and K. Kershaw (for Department for Transport) Date: 2016 **Format:** Pdf **Link:** https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/514912/road-use-statistics.pdf **Free / priced:** Free
Objectives: This report provides an overview of statistics on roads and how they are used.
Methodology: Statistical analysis of transport, travel and traffic figures.
Key Findings: • Overall 2 per cent of personal trips were cycled, • The number of cycling trips has remained broadly constant over recent years, however the average distance cycled per person has risen by 26 per cent since 1995/97. Average cycle trip length has increased by 36 per cent.
Themes: Cycling statistics, Great Britain
Comments: This report is based on DfT data

Title: Bicycling infrastructure: can good design encourage cycling?
Author / organisation: A. Hull & C. O'Holleran Urban, Planning and Transport Research, Volume 2, Issue 1, 2014 **Date:** 2014 **Format:** Pdf **Link:** http://www.tandfonline.com/doi/abs/10.1080/21650020.2014.955210 **Free / priced:** Free
Objectives: Discusses whether good design of cycle infrastructure in a city will encourage more people to cycle.
Methodology: Literature review
Key Findings: • The cycle infrastructure close to a person's origin and destination of potential journeys is a key facilitator or potential barrier to encouraging cycling. • Segregated cycle routes may improve cyclist confidence and thereby levels of cycling; however discontinuous cycle lanes at junctions are an issue that needs to be addressed as there is still the risk of conflict. • It is important to continually upgrade and maintain cycle infrastructure, particularly surface material as this affects perception of comfort and safety. • A potential cyclist's perception of the safety of cycling in their neighbourhood is the determining factor in their decision to take up cycling.
Themes: Cycling, infrastructure, propensity to cycle
Comments: Explores the factors that affect people's decision to take up cycling.

Title: Road safety and perceived risk of cycle facilities in Copenhagen

Author / organisation: S. Jensen, S. Rosenkilde & N. Jensen
Date: 2006 **Format:** Pdf
Link: http://www.vehicularcyclist.com/copenhagen1.pdf
Free / priced: Free

Objectives: Investigates the effect of cycle infrastructure on rad safety in Copenhagen.

Methodology: A before and after study looking at the effect of constructing one way cycle tracks and cycle lanes, blue cycle crossings and raised exits, in terms of road safety and cyclists' perceived risk. The study involved investigating accidents and traffic counts before and after the various facilities were constructed to establish the effects on road safety and traffic volumes. Interviews of cyclists were carried out to understand perceived risk.

Key Findings:

- There was a slight reduction in the total number of accidents (10 per cent) and injuries (4 per cent) on the road sections between junctions after the cycle tracks had been built.
- Following the introduction of cycle tracks adjacent to the carriageway, accidents at the junction increased by 18 per cent, with a 129 per cent increase in accidents involving right turning vehicles (the equivalent of left turning vehicles in the UK) and cyclists travelling straight.
- Injuries to women increased by 18 per cent compared to just 1 per cent for men.
- There were three safety gains from the construction of the cycle tracks:
    - Fewer accidents involving cars hitting cyclists from behind;
    - Fewer accidents involving cyclists turning left (equivalent to turning right in the UK); and
    - Fewer accidents involving cyclists hitting parked car.
- However, these were outweighed by new safety problems:
    - More accidents involving cyclists hitting other cyclists, mostly when trying to overtake;
    - More accidents involving cars turning right (equivalent to turning left in the UK);
    - More accidents involving left turning cars (equivalent to right turning in the UK) hitting cyclists; and
    - More accidents involving cyclists and pedestrians entering or existing a bus stop.
    - Fewer accidents involving cars hitting cyclists from behind;
- Prohibited parking was one of the main reasons why introducing cycle tracks led to an increase in accidents and injuries. This is because it results in cars parking on side streets, which then leads to an increase in turning traffic and associated accidents.
- At signalised junctions, the number of accidents with traffic from entry lanes with a shortened cycle track fell by 30 per cent but injuries increased by 19 per cent. Safety improved for car drivers but deteriorated for cyclists and pedestrians.

• Construction of cycle lanes resulted in an increase in accidents of 5 per cent and an increase in injuries of 15 per cent, but these are not statistically significant. • Building cycle lanes resulted in a 5-7 per cent increase in cycle traffic. • Cyclists felt more secure on cycle tracks and less secure in mixed traffic, cycle lanes are a compromise of the two.
Themes: Cycle infrastructure, before and after, cycle tracks, cycle lanes, safety
Comments: Highlights the need for careful safety considerations when designing and implementing new cycling infrastructure.

Title: Risk of injury for bicycling on cycle tracks versus in the street
Author / organisation: A.C. Lusk, P. Furth, P. Morency & J.T. Dennerlein Injury Prevention 17(2):131-5 · February 2011 **Date:** 2011 **Format:** Pdf **Link:** http://injuryprevention.bmj.com/content/early/2011/02/02/ip.2010.028696.full **Free / priced:** Free
Objectives: To compare cyclist injury rates on cycle tracks against injury rates on the street in Montreal, Canada.
Methodology: Vehicle/cyclist collisions and health record injury counts were obtained for six cycle tracks and comparable reference streets. For these, use counts were conducted and the relative risk of injury was calculated for cycle tracks and compared against the reference streets.
Key Findings: • 2.5 times as many cyclists used the cycle tracks compared with the streets used as a comparison in the study. • There were 8.5 injuries and 10.5 crashes per million kilometres cycled. • Injury risk on cycle tracks was found to 28 per cent lower than on the road.
Themes: Safety, relative risk, injuries
Comments: Compares risk of cycling on cycle tracks with cycling on the road.

Title: The effect of cycle lanes on the proximity between motor traffic and cycle traffic

Author / organisation: J. Parkin & C. Meyers
Accident Analysis & Prevention Volume 42, Issue 1, January 2010
Date: 2010
Format: Pdf
Link: http://www.sciencedirect.com/science/article/pii/S0001457509001997
Free / priced: Priced

Objectives: To add to previous research on motor traffic overtaking cyclists on roads.

Methodology: The experiment collected proximity data of motorised traffic overtaking cyclists on roads with and without cycle lanes using an instrumented bicycle.

Key Findings:

- Drivers passed at significantly wider distances when there was no 1.45 metre cycle lane (on 40-50 mph roads with a 9.5 metre carriageway). This was not replicated for a similar width road where the speed limit is 30 mph and there was a 1.3 metre cycle lane.
- When there is a cycle lane, drivers may drive within the lane width marked for them with less recognition that cyclists may still need a more comfortable, wider passing distance.

Themes: Cycle lanes, overtaking

Comments: Considers the effect of cycle lanes on motor vehicle overtaking distances.

Title: Rail promotes pedal power as cycle-rail journeys soar to 50M a year

Author / organisation: Rail Delivery Group
Date: 2016
Format: Webpage
Link: http://www.raildeliverygroup.com/media-centre/press-releases/2016/469762600-2016-05-19.html
Free / priced: Free

Objectives: Provides a summary of cycle rail journeys and investment in cycle facilities at stations.

Methodology: Figures on cycle rail journeys and investment in cycle facilities at stations.

Key Findings:

- There has also been investment in cycle parking facilities at rail stations, which has subsequently led to significant increases in cycle use as more people combine cycling and rail on their journeys to work or leisure trips. Cycle-rail journeys have increased by 40 per cent between 2010 and 2016 and the number of cycle spaces at railway stations has gone up from 25,000 to over 64,000 over the same period. This is anticipated to reach 75,000 by 2017.

- The Rail Delivery Group (RDG) has provided £29 million since 2012 to improve cycle facilities at railway stations nationwide and has also invested in 'PlusBike', an information portal specifically for cyclists wanting to use train travel.

- In 2015, the Department for Transport granted a further £14.5 million to improve cycle facilities at railway stations.

Themes: Cycling, rail, investment

Comments: A summary of investment in cycle-rail facilities and the impact on cycle rail journeys.

Title: Road factors and bicycle-motor vehicle crashes at unsignalised priority intersections

Author / organisation: J.P. Schepers, P.A. Kroeze, W. Sweers & J.C. Wüst
Accident Analysis & Prevention Volume 43, Issue 3, May 2011
Date: 2011
Format: Pdf
Link: http://www.sciencedirect.com/science/article/pii/S0001457510003350
Free / priced: Free

Objectives: To investigate the safety of cyclists at unsignalised priority junctions within built up areas in the Netherlands. The study focuses on the link between junction design and collisions involving cyclists and motor vehicles.

Methodology: A correlational study of data collected by the police across 540 junctions/intersections. The data consists of 339 failure to yield collisions in four years, classified into one of two types of movement:
Type 1 - through bicycle related collisions where the cyclist has right of way (i.e. bicycle on the priority road); and
Type 2 - through motor vehicle related collisions where the motorist has right of way (i.e. motorist on the priority road).
This data was then compared against the design characteristics of the interchanges.

Key Findings:

- Of the 540 junctions, 490 were susceptible to Type 1 crashes and 524 to Type 2 crashes.
- Type 1 collisions occurred more at junctions where there was the presence of well marked, reddish brown coloured two way cycle tracks.
- Type 1 collisions were reduced at intersections that had raised cycle crossings or other speed reduction methods for traffic turning into side roads.
- Probability of collision was also lower at junctions where the approach of a track is deflected 2 – 5 metres away from the main carriageway.
- There were no significant relationships between Type 2 crashes and road factors such as the presence of a raised crossing.

Themes: Cyclists, safety, junctions, cycle crossings

Comments: Looks at the relationship between intersection/junction design and collisions involving cyclists and motor vehicles.

Title: Cycle lanes: their effect on driver passing distances in urban areas

Author / organisation: K. Stewart and A. McHale
Transport Special Issue on Travel Demand Management, Volume 29(3),
Date: 2014
Format: Pdf
Link: http://admin.indiaenvironmentportal.org.in/files/file/cycle%20lanes.pdf
Free / priced: Free

Objectives: To understand the effects of cycle lanes on driver passing distances.

Methodology: The study involved using an instrumented bicycle to collect information on the passing distance of drivers when overtaking a cyclist within the urban (30 mph/40 mph) environment. A statistical analysis of this data was then conducted.

Key Findings:

- When a driver encounters a cyclist on road not at a junction, there are more significant variables than the presence of a cycle lane that determines the overtaking distance. The three most significant factors were absolute road width, the presence of parked vehicles on that side of the road and the presence of an opposing vehicle at the time of overtaking.
- Coloured cycle lanes appeared to reduce overtaking distances slightly, compared to non-coloured lanes, possibly because drivers view cyclists as being in a defined zone in coloured cycle lanes and therefore do not see the need to allow additional space and hence pass closer.
- The analysis considers the driver as an unknown variable who will vary by area, site, time of day and mood, making them difficult to quantify.

Themes: Cycling, lane widths, lane markings, overtaking

Comments: Compares risk of cycling on cycle tracks with cycling on the road.

Title: Sustrans Design Manual: Handbook for cycle-friendly design

Author / organisation: Sustrans

Date: 2014 **Format:** Pdf

http://www.sustrans.org.uk/sites/default/files/file_content_type/sustrans_handbook_for_cycle-friendly_design_11_04_14.pdf

Free / priced: Free

Objectives: The purpose of this manual is to complement existing information on the design of cycle infrastructure

Methodology: Description of options for different types of cycle infrastructure and other measures that may be implemented to encourage cycling.

Key Findings:

In general, Sustrans finds:

- Design of any infrastructure or introduction of any cycle measures should be user focused, meaning it important to recognise that cyclists are important and consider their experiences and who is being targeted.
- Cycle infrastructure needs to be linked to the wider network to provide continuity.
- Infrastructure should be designed in a way that demonstrates that cyclists are at least as important as motorised traffic on the highway network, with cyclists being given an advantage in terms of directness and priority where possible.
- Reallocation of road space makes an important statement about the relative priority of different transport users, as it not only promotes cycling but can act as a restraint on motor traffic, which is an important aspect of transport and planning policy in congested urban areas.

In terms of maintenance:

- A route that is kept in good condition will be more popular than one of deteriorating quality and given the level of investment in cycle facilities, it is important that routes continue being well used by cyclists.
- Maintenance should be factored in during the design and development stage, as a high level of design and construction can mean reduced need for maintenance in the future. Funding for maintenance should also be secured early in the development stage.
- Both walking and cycling routes should be kept clean and clear, particularly in the autumn and winter when falling leaves and ice may make these routes for hazardous.
- As the majority of cycling happens on the roads, with cyclists typically riding in the 2 metres closest to the kerb, it is important to ensure that this section of the road is well maintained in order to keep cyclists using it. Pot holes, loose drain covers and debris on the edge of the road can cause problems for cyclists and put them off using cycle lanes.
- Signage also requires maintenance as it is susceptible to vandalism and is a key tool for wayfinding.

Themes: Cycling, guidance, infrastructure, maintenance

Comments: Indicates how different measures to encourage and support cycling can be implemented in different settings.

Title: Factsheet - Casualties in Greater London during 2015

Author / organisation: Transport for London
Date: 2016
Format: Pdf
Link: http://content.tfl.gov.uk/casualties-in-greater-london-2015.pdf
Free / priced: Free

Objectives: This factsheet reports the main trends in the number of reported road traffic collisions and casualties in Greater London in 2015 and compares these with previous years.

Methodology: Statistical analysis of figures collected by the police in accordance with the STATS 19 reporting system.

Key Findings:

- Overall, 25,913 road traffic collisions involving personal injury were reported to the police in London during 2015, a 3 per cent reduction compared to 2014.
- These collisions resulted in 30,172 casualties, of which 136 were fatal injuries, 1,956 were serious injuries and 28,090 were slight injuries.
- In 2015, pedal cyclists accounted for 15 per cent of all casualties, 19 per cent of all serious injuries and 7 per cent of all fatalities. Cycling had a 3 per cent modal share in 2015.
- When comparing 2015 against the 2005-2009 baseline, pedal cyclist fatalities have fallen by 46 per cent and KSI casualties have fallen by 8 per cent, despite there being a considerate increase in the number cyclists over the last few years.
- The number of cycle journeys in London has almost doubled between 2005 and 2015 to about 645,000 journeys per day.
- Pedal cyclist fatalities have decreased from 13 in 2014 to 9 in 2015 (the second lowest level on record) and KSI casualties have fallen by 10 percent over the same period.
- Between 2014 and 2015, pedal cyclist casualties fell by 13 per cent.
- 78 per cent of pedal cyclist casualties were males, with 73 per cent of cycle journeys being made by men.
- 11 per cent of young adult (16-24 years) casualties were pedal cyclists, and for adults aged 25-59, 18 per cent of casualties were cyclists.
- 8 per cent of child casualties (under 16 years) were pedal cyclists.
- Pedal cyclist casualties feel by 14 per cent in inner London boroughs and by 12 per cent in outer London boroughs between 2014 and 2015.

Themes: Cyclist, cycle, casualties, London

Comments: This report is based on STATS19 data and provides reliable statistics.

Title: Human Streets: The Mayor's Vision for Cycling Three Years On

Author / organisation: Transport for London
Date: 2016
Format: Pdf
Link: https://www.london.gov.uk/sites/default/files/human_streets_0.pdf
Free / priced: Free

Objectives: This report reviews progress made so far on the Mayor's Vision for Cycling and looks ahead to priority tasks for the future.

Methodology: Progress report on the Mayor's Vision for Cycling.

Key Findings:

- Cycling has risen on TfL controlled main roads by 63 per cent in the period 2008 – 2014. Cycling on all roads in London has risen by 33 per cent over the same period.
- In 2014, in the morning peak period, there are two cars for every bike on the road, compared to 11 cars to every bike in 2000.
- In zone 1 in London, during the morning peak period, 32 per cent of all vehicles on the road were bicycles in 2014. On some main roads, up to 70 per cent of vehicles are bicycles.
- Across London, by 2014 there were 645,000 cycle journeys per day.
- Although the number of women cycling has increased, the proportion of women cycling has stayed relatively unchanged.
- In 2015 there were around 270 million cycle journeys made in London, with nine fatalities. This is an improvement compared to 1989 (the worst year on record) when there were 90 million cycle journeys made in London and 33 fatalities.
- There were 432 serious injuries and fatalities in 2014, an all time low per journey time. The number of fatalities (nine) in 2015 was the second lowest on record in terms of absolute values, but the lowest on record when taking into account the number of cycle journeys.
- Following the opening of Cycle Superhighway 5 at Vauxhall Bridge, there has been a 73 per cent increase in the number of cyclists using the bridge. Over 80 per cent of cyclists crossing the bridge are using the segregated cycle track (Cycle Superhighway) in 2016.
- The East-West and North-South Superhighways received 84 per cent support during consultation. In a YouGov survey, 64 per cent of respondents indicated support for the proposed Cycle Superhighways despite being made aware of the delay to traffic that might result. 71 per cent were in support of segregated cycle routes.
- TfL has increased the ten year budget for cycling from £273 million to £913 million, with plans to spend around £145 million in 2015/2016, equivalent to £18 per head.
- Five new or upgraded Cycle Superhighways are open.

- Of the 33 worst junctions in terms of cyclist and pedestrian injuries and deaths, 11 will have been finished by the end of 2016 (Tower, Blackfriars, Parliament Square, Elephant & Castle, Spur Road, Lancaster Gate, Aldgate, Apex (Shoreditch), Oval, Vauxhall and Stockwell). Six more junctions are at the consultation or construction stage (Hammersmith, Highbury Corner, Westminster Bridge South, Swiss Cottage, Archway and Old Street). There are plans to roll out improvements to the remaining 16 junctions in the coming years.
- £90 million has been awarded to three outer London boroughs (Waltham Forest, Enfield and Kingston) to transform them into 'mini-Hollands'.
- The Safer Lorry Scheme requires all lorries in London to fit special mirrors and sideguards to protect cyclists with about 97% compliance to date. TfL are proposing the requirement to retrofit an extra cab window to lorries to enable drivers to see cyclists.
- Two Quietways should be completed this year, one running from Waterloo to Greenwich and the other running from Bloomsbury to Walthamstow through Islington and Hackney.
- Operation Safeway is helping improve cyclists' and other road users' behaviour towards each other.
- TfL is building cycle superhubs at major railway stations, including one for several thousand bikes at Waterloo. Bikes are now permitted on the Docklands Light Railway.
- £17 million has been invested in soft cycling measures, including teaching 75,000 children to cycle; residential, on-street and station cycle parking; and Safer Urban Driving courses for large vehicle drivers.
- Priorities for the future include:
    - Protecting the cycling budget;
    - Improving the Quietways;
    - More Superhighways;
    - Town centre projects to remove or address barriers to cycling;
    - More cycling infrastructure such as safer bridges for cyclists;
    - Developing electric bikes;
    - Reducing traffic in central London.

Themes: Cycling, infrastructure, safety, casualties, London

Comments: A summary of key achievements in the Mayor's Vision for Cycling and priorities for the future.

Title: Cycling in London now highest since records began

Author / organisation: Transport for London
Date: 2015
Format: Webpage
Link: https://tfl.gov.uk/info-for/media/press-releases/2015/february/cycling-in-london-now-highest-since-records-began
Free / priced: Free

Objectives: A summary of cycling use statistics in London

Methodology: Statistics on cycling in London

Key Findings:

- Cycling increased by 10 per cent in 2014 and was forecast to grow by 12 per cent over the financial year 2014/15.
- On main roads in London in TfL's road network, cycling levels in Quarter 3 of 2014/15 were 10 per cent higher on the previous year. Cycling levels were the highest since records began in 2000.
- In 2014, 10,023,987 journeys were made on London's Cycle Hire scheme bikes, an increase of 5 per cent on 2012 (the previous highest year) and 25 per cent on 2013.
- Hires at Waterloo had increased by 12% in the year 2014 compared to 2013. There are now more than 10,000 bikes available over 700 docking stations (in 2014) an increase from 6,600 bikes across 400 docking stations in 2010.
- In 2014, 170,000 cycle journeys were made in the London Congestion Charge zone.

Themes: Cycling, London, Cycle hire scheme

Comments: A summary report on the increase in cycling up to 2014. Provides an update on number of cycle hire journeys.

Title: London Cycling Design Standards

Author / organisation: Transport for London

Date: 2014 **Format:** Pdf

https://tfl.gov.uk/corporate/publications-and-reports/streets-toolkit#on-this-page-1

Free / priced: Free

Objectives: This manual sets out the requirements and advice for cycle network planning and for the design of dedicated cycle infrastructure, cycle friendly streets and cycle parking in London.

Methodology: Description of options for different ways to design cycle infrastructure and cycle friendly streets as well as other cycling facilities.

Some Key Findings:

- The six core design principles are based on international best practice and consensus within London about adopting certain aspects of this practice in the UK:
    - Safety - infrastructure should help to make cycling safer and address perceptions of cycling being unsafe, particularly at junctions. Space is an important consideration when considering safety.
    - Directness - cycle routes should be as direct as possible, whilst being logical, and avoiding unnecessary obstacles and delays to a journey. Planning routes as part of a network is key.
    - Comfort - surfaces which cyclists ride on should be fit for purpose, enable smooth riding and be well constructed and maintained.
    - Coherence - infrastructure should be easy to understand and follow for all users.
    - Attractiveness – infrastructure should add to the attractiveness of the public realm whilst not contributing to unnecessary street clutter.
    - Adaptability – infrastructure should accommodate all types and experiences of cyclist and should be designed taking into account an increase in cyclists in the future.
- Transport for London's guidance also reflects the principle that the form of cycling infrastructure that is appropriate for a given location will be influenced by the local context and 'function' of the road. This is considered as 'Movement', i.e. the purpose of getting people and vehicles from one place to another, and 'Place', the purpose of a street in providing space where people live, shop, work, meet, view the streetscape etc. Where 'Movement' is considered to be the priority then segregated facilities are more likely to be required, whereas if 'Place' dominates then spaces are more likely to be shared, and vehicle flows and speeds restricted.
- In most circumstances, the safety benefits to cyclists of tighter geometry and the reduction in speed of turning motor vehicles outweighs the risk to cyclists that exists in relation to larger vehicles moving out to the centre of the carriageway to make a left turn.

- Marking cycle lanes through priority junctions (such as T-junctions or crossroads) in the direction of the cycle route can increase subjective safety with respect to the potential of other vehicles to turn across cyclists. The lane markings make drivers more aware of the likely presence of cyclists in the nearside lane.
- In order to support the needs of cyclists in terms of safety, comfort and directness at junctions, signal timings where possible should minimise delays for cyclists, whilst taking into account the needs of other road users and pedestrians. When calculating inter-green timings or advanced starts for cyclists, enough time should be provided to ensure that cyclists can clear the junction safely, taking into account the gradient of the road.
- Two way cycle tracks can be advantageous where cycle flows are tidal, i.e. where there are large flows in one direction during peak times. They can be particularly suitable where streets have buildings and active frontages on one side only or where there are not many side roads on one side.
- A new type of crossing (sometimes referred to as a 'Tiger' crossing) has been included in the latest TSRGD (2015) which provides parallel pedestrian and cyclist crossings without the need for signal controls. The crossing consists of a zebra crossing for pedestrians with a route marked by elephants' footprints next to it within the controlled area of the crossing.
- By tightening the geometry of a side road, i.e. reducing the turning radius so that vehicles have to cross the path of cyclists close to the perpendicular, vehicle speeds are reduced and cyclists are placed into the direct line of sight of the driver.
- Raised entry treatments can, when implemented in a suitable location, help reduce the speed of vehicles turning into a side road, thereby addressing some of the risks at side road crossings. They can also be used to suggest priority for cyclists and pedestrians by differentiating the crossing from the carriageway road surface.
- Preventing parking and loading close to junctions also helps maintain visibility at the side road crossing.
- Making sure cycle routes are well maintained is even more important than general highway maintenance as even minor degradation can cause a cyclist to fall and poor surface quality can impact cyclists' comfort to the extent that it deters cyclists from using the facility.

Themes: Cycling, guidance, infrastructure, London, design, requirements

Comments: Advice and requirements of how cycle infrastructure should be laid out to suit different surrounding environments.

Title: Cycle route choice: Final survey and model report

Author / organisation: Steer Davies Gleave (prepared for Transport for London)
Date: 2012
Format: Pdf
Link: http://content.tfl.gov.uk/understanding-cycle-route-choice.pdf
Free / priced: Free

Objectives: To investigate the decisions cyclists in London make when deciding which route to take and the different factors that affect their decision, such as route features. It also explores more general preferences and attitudes amongst cyclists.

Methodology: A survey was completed by 100 participants in a pilot and a further 2,307 cyclists during the main survey phase.

Key Findings:

- The most important considerations for participants when deciding on a route to cycle were using the safest route, avoiding traffic (so using roads with low traffic flows or segregated cycle tracks).
- There was high agreement with the statement: "I would prefer cycling in a cycle lane even if it meant a longer journey".
- Cyclists indicated that they do not always choose the most direct route.
- Female cyclists and cyclists with less than 2 years of experience were much more likely to prefer using safer routes away from other traffic and complex junctions.
- About half of the cyclists surveyed indicated that they would alter their route if there was the opportunity to travel through green spaces and parks. This was more prevalent amongst older cyclists (over 55s). 15 per cent of all cyclists indicated that they would be prepared to take a much longer route.
- 40 per cent of respondents said that they would change their route to use a cycle superhighway, with 8 per cent happy to take a much longer route to do so. This was lower than for green spaces.
- 51 per cent indicated that they would change their route if it meant they could use a dedicated on road cycle lane. 12 per cent indicated they would be willing to take a noticeably longer route to do so.
- Turning left at a junction was perceived to be the safest manoeuvre with travelling straight across a minor junction being perceived as fairly safe as well. Cyclists perceived the least safe manoeuvres to be turning right at a two lane roundabout and a right turn from a minor road on to a major road. On average, cyclists were willing to extend their journey by 7.5 minutes to avoid these kind of junction manoeuvres.
- Female cyclists were more likely to rate junctions as less safe than males, as was the case for older cyclists compared to younger cyclists. The most regular cyclists felt safer at most junctions than those who cycle less frequently.

• Participants were generally prepared to consider a change in their route under the right conditions. Frequent cyclists and those travelling for a work based tripe were more likely to choose the fastest route. • The extent of cycle lane provision was more significant than the type of road being used, whilst the presence of an off road route was also highly valued. • Generally speaking, the lower an individual's cycling frequency, the less sensitive they are to time constraints.
Themes: Cycling patterns, cycle lanes, attitudes, junctions, safety London
Comments: This report provides an insight into what cyclists value most when deciding on a cycle route.

Title: Factsheet – Pedal cyclist collisions and casualties in Greater London

Author / organisation: Transport for London
Date: 2011 **Format:** Pdf
Link: http://content.tfl.gov.uk/pedal-cyclist-collisions-and-casualities-in-greater-london-sep-2011.pdf
Free / priced: Free

Objectives: This factsheet reports the main trends in the number of reported road traffic collisions and casualties in Greater London in 2010 and compares these with previous years.

Methodology: Statistical analysis of figures collected by the police in accordance with the STATS 19 reporting system.

Key Findings:

- 17 per cent of all collisions in Greater London in 2010 resulted in injury to pedal cyclists. Cyclists represented 14 per cent of all casualties.
- Pedal cyclist casualties made up 16 per cent of all KSI casualties in London in 2010.
- Between 1994-98 and 2010, there has been a decrease in pedal cyclist KSIs of 18 per cent. There has been a decrease of 9 per cent in all casualties over the same period.
- 78 per cent of cyclist casualties in 2010 were male.
- Half of casualties whose age was known were aged 25-39 years old.
- In 2010, 65 per cent of cyclist casualties were injured in London's inner boroughs.
- London's main road network has seen an increase in cycling of over 150 per cent between 2010 and 2010.
- Pedal cyclist casualties have fluctuated between 1986 and 2010, reaching a peak in 1989 and falling to a low in 2005. Numbers have been increasing between 2005 and 2010.
- In Greater London in 2010, 74 per cent of cyclist casualties were injured whilst going ahead, with 11 per cent being injured whilst performing an overtaking manoeuvre. 5 per cent of pedal cyclist casualties were turning right and 2 per cent were turning left.
- There were 10 fatal pedal cyclist collisions in Greater London in 2010. Two were the result of the cyclist and the other vehicle turning left together; two were the result of a motor vehicle changing lanes to the left across the path of a cyclist; and two were the result of the cyclist riding off the footway and into the path of a motor vehicle. Two fatal collisions involved a cyclist coming into conflict with an HGV of over 7.5 tonnes and a further two involved collisions with a concrete mixing lorry and a skip lorry.
- Cars were the most common vehicle to be involved in a collision with a cyclist, making up 74 per cent of vehicles. This was followed by good vehicles, buses/coaches and taxis.
- The two most frequently recorded contributory factors in collisions were failing to look properly and failing to judge the other person's path or speed. This applied to both cyclists and motor vehicles involved.

Themes: Cyclist, cycle, casualties, London

Comments: This report is based on STATS19 data and provides reliable statistics.

Title: The safety of urban cycle tracks: A review of the literature

Author / organisation: B. Thomas & M. DeRobertis
Accident Analysis & Prevention Volume 52, 28 March 2013, 2013
Date: 2013
Format: Pdf
Link: http://www.sciencedirect.com/science/article/pii/S0001457512004393
Free / priced: Free

Objectives: To examine studies of cycle tracks from different countries in order to identify the safety of these facilities relative to cycling on roads.

Methodology: A literature review of 22 papers from Northern Europe and one from Canada, all dating from 1987.

Key Findings:

- One way cycle tracks are generally safer at intersections than two way cycle tracks.
- When effective intersection treatments are employed, constructing cycle tracks on busy roads can reduce collisions and injuries.
- When there is a control of exposure and all collision types are included, one way cycle tracks reduce the severity of injuries even if no intersection treatments are implemented.
- Intersection treatments that appear to be effective in improving safety are:
  - Having the cycle track closer to the adjacent road traffic on the approach to the intersection to increase the visibility of cyclists to motorists;
  - Having advance stop lines for motorised traffic at least 20m back from the entrance of the junction;
  - At side road crossings and locations where cyclists might be travelling straight with vehicles turning across the path of a cycle track, cycle crossings should be raised, effectively providing a speed bump that reduces vehicle turning speeds and therefore lowers the severity of potential injuries to cyclists;
  - Having cycle signals to formally separate the movements of cyclists going straight ahead and motor vehicles turning.
- The safety benefit of coloured cycle crossings is less conclusive. Some studies suggested that they improve safety, but only when used on one arm of a four arm intersection. When used on multiple arms they become less prominent to drivers.
- The literature reviewed failed to address injury severity and also take account of how exposure affects risk.

Themes: Cycle infrastructure, safety, cycle tracks, intersections, junctions

Comments: A review of studies looking at the safety of different intersection treatments.

Title: Safe Cycling: How Do Risk Perceptions Compare with Observed Risk?
Author / organisation: M Winters, S. Babul, H.J.E.H. Becker, J.R. Brubacher, M. Chipman, P. Cripton, M.D. Cusimano, S.M. Friedman, M.A. Harris, G.Hunte, M. Monro, C.C.O Reynolds, H. Shen & K. Teschke Canadian Public Health Association, 2012 **Date:** 2012 **Format:** Pdf **Link:** http://journal.cpha.ca/index.php/cjph/article/viewFile/3200/2668 **Free / priced:** Free
Objectives: To report the relationship between perceived and observed injury risk.
Methodology: The paper looks at the Bicyclists' Injuries and the Cycling Environment (BICE) study which is a case-crossover study that involved 690 participants, consisting of injured adult cyclists who visited hospitals in Toronto and Vancouver in Canada. They calculated the observed risk by comparing route types at injury sites with control sites, and measured perceived risk of non-injury sites though participant questionnaires.
Key Findings: • Major streets with shared lane and no parked cars had the highest perceived risk rating, followed by major streets without cycle infrastructure. • The routes perceived as safest were paved multi-use paths, standard residential streets and residential streets marked as cycle routes with traffic calming. • Most of the routes that cyclists perceived to be more risky were also found to be more risky in terms of observed risk in the injury study. • Cycle tracks were perceived as less safe than they were observed to be and multi-use paths were perceived as safer than they were observed to be.
Themes: Safety, injury, perception
Comments: Compares how perceived risk and observed risk compare and whether they are aligned with one another.

Title: Trials of segregation set-back at side roads: Overview report and recommendations (TRL703)

Author / organisation: Dr I. York, V. Chesterton & M. Benton
Date: 2014
Format: Pdf
Link: http://www.trl.co.uk/media/309301/ppr703_-_trials_of_segregation_set-back_at_side_roads_overview_report_and_recommendations.pdf
Free / priced: Free

Objectives: Provides an overview of a set of four trials investigating the effects of different set back distances of a kerb segregated cycle track from a side road junction. The objectives of the trials were to investigate what distance of set back minimises the risk of conflict between all road users and what distance is most preferred by different road user groups.
The three track trials used video observations to measure speed, in lane position and stopping position. Questionnaire were used to understand user perceptions.

Methodology: Three of the trials were based at a specially designed (off road) side road junction setting with a one lane approach, with the fourth using a driving simulator of a similar scenario with a two lane approach. The two set back distances were 5 metres and 20 metres. Drivers were approaching the junction at 30 mph.

Key Findings:

- Video observations of the track trials demonstrated that car drivers' speed and turning path was largely unaffected by the segregation set back distance until it was within 5 metres of the junction.
- At 5 metres from the junction, the kerb is sufficiently close to result in a tightening of the turning radius, making it necessary for drivers turning left into the side road to slow down. This can result in the car having a position further away from the kerb.
- The driving simulator trial found that in a two lane approach scenario, there was no difference in speed and position of car drivers in the 5 metre and 20 metre scenarios. This suggests that segregation in this setting would need to be brought even closer to the junction in order to have an effect, as there are other aspects such as the width of lanes contributing to a larger turning radius for drivers.
- The driver simulator trial showed that the presence of a cyclist at a conflict point resulted in drivers reducing their speed. When a conflicting cyclists was present, drivers not only slowed at the junction, but also on approach to the junction, waiting for the cyclist to go straight ahead before turning left into the side road.
- The track trial observations showed that on in a 5 metre set back situation, left turning drivers who overtook cyclists on the approach to the junction, allowed more lateral space between them and the cyclist.

• Tighter geometry at the junction was found to result in less encroachment into the cycle lane and improved driver visibility of approaching cyclists. • Drivers preferred a greater set back distance from the junction. • Cyclists were split between preferring a shorter or longer set back distance. This was related to variations in cyclist views on the benefits of segregation. Some cyclists expressed concern about being able to take a good road position when passing the junction and that drivers would not give way when turning left across the cyclists' path.
Themes: Cycle tracks, segregation, junction, left turn, conflict with other users
Comments: Compares how different set back distances of a kerb segregated cycle track affect safety at a side road junction.

Title: Off street trials of a Dutch-style roundabout (TRL751)

Author / organisation: Dr I. York, Dr S. Helman & P. Vermaat

Date: 2015 **Format:** Pdf

Link: http://www.trl.co.uk/media/839260/ppr751_dutch_roundabout_safety_v1.pdf

Free / priced: Free

Objectives: To present the safety findings of a series of off-street trials of a Dutch style roundabout with an orbital cycle track. The objective of the trial was to investigate the safety implication of this for cyclists

Methodology: Cyclists and car drivers were required to enter the Dutch style roundabout as an individual in early trials and in later trials in small groups. Interactions between cyclists and car drivers were recorded on video and participants also completed questionnaires on their perceptions and understanding of the roundabout. The roundabout tested had four arms each with a different approach, crossing and exit configuration.

Key Findings:

- All road user types generally found the roundabout easy to use and considered it to be safe, although some participants expressed concern about not knowing who had priority.
- Almost all participants thought that the roundabout design would have safety benefits for cyclists, mainly as a result of the segregation. Around half of the participants also thought that pedestrians and drivers would also benefit.
- Participants mentioned a need for education and information campaigns if this type of roundabout design was introduced on to real roads.
- Participants reported back that it was not clear of who had priority when exiting the roundabout and re-joining the carriageway. Despite this, most car drivers gave way to cyclists.
- Most cyclists indicated that they would be likely to use the orbital cycle track rather than the road when in heavy traffic, although confident cyclists were more likely to use the road instead, particularly if turning left or going straight ahead, as this reduced the distance travelled.
- Some more confident cyclists expressed concern about the narrow width of the cycle lane and high kerbs making overtaking more difficult.
- Drivers reported finding it difficult to see cyclists on the orbital cycle lane, which raises a potential risk area for large vehicles leaving the roundabout.
- Car drivers were observed to be far less likely to recognise the priority of cyclists on the orbital cycle track when entering the roundabout than when they were exiting the roundabout, even though UK drivers should be giving way to traffic circulating the roundabout and would not be expecting to give way on the exit of a roundabout.
- The arm of the roundabout which had a sharp turn at the entry into the orbital cycle track and the arm where cyclists exited directly into the path of exiting cars were rated as the least favourable and least safe by cyclists.

Themes: Roundabout, cycle lane, segregation

Comments: An investigation into an innovative roundabout design in the UK, commonly used in Europe and whether it would be understood in the UK.

Title: Off street trials of a Bus Stop Bypass: An assessment of user perceptions, safety, capacity and accessibility (TRL730)

Author / organisation: Dr I. York & S. Tong
Date: 2014
Format: Pdf
Link:
http://www.trl.co.uk/media/573524/ppr730_bus_stop_bypass_main_report_v1.pdf
Free / priced: Free

Objectives: To evaluate the concept of a Bus Stop Bypass and assess pedestrian crossing options with varying pedestrian and cycle flows.

Methodology: Three trials were conducted at a facility at the TRL test track.
The first involved able bodied cyclist and pedestrian participants using the Bus Stop Bypass (BSB) at the same time, under different flow conditions (of both cyclists and pedestrians). Four different pedestrian crossing types were used: zebra crossing with a ramp, zebra crossing without a ramp, but with dropped kerbs, no zebra crossing with a ramp, and no zebra crossing and no ramp, but dropped kerbs, Video observations of behaviour were recorded and automatic tube counters measured cyclist speeds. A sample of both participant groups was asked to complete questionnaires for feedback.
The second trial involved pedestrian participants with different disabilities using the BSB facility. These participants completed a questionnaire and took part in a focus group to provide feedback on their experiences of using the BSB.
The third trial looked at the pedestrian capacity of the bus stop island, where participants wait for a bus after crossing the cycle track. The trial involved 97 participants, split into two groups, with one group starting upstream from the bus stop and the other starting downstream of the bus stop. Participants were released in different group sizes and asked to wait on the bus stop island. Measurements of how pedestrians queued, their distribution at the bus stop and the maximum number of pedestrians able to wait on the Bus Stop Island, were recorded via video observations.

Key Findings:

- Formalised queuing stopped after 33 – 47 pedestrians were waiting on the bus stop island.
- Zebra crossings reduced the interactions between cyclists and pedestrians and had the highest score for perceived safety. This type of crossing was easier for participants with impaired vision to locate. Participants generally understood priorities at the crossing and elsewhere.
- Dropped kerbs were preferred by most at the zebra crossing with the exception of in high pedestrian flows. Both pedestrians and cyclists felt safer in the set ups with a dropped kerb.

- Ramps generally increased the probability of interactions, although slightly decreased the number of serious interactions. When there was a high pedestrian flow, a ramp decreased the number of interactions.
- Pedestrians with impaired mobility preferred the zebra crossing with ramp crossing, although others in the accessibility trial slightly preferred there to be no ramp.
- Up to half of the cyclist participants said that they would be more likely to cycle in town with BSB facilities being available. This was more likely under higher traffic flows.
- Cyclists considered the designated crossing point to be safer when it was at cycle track level (i.e. no ramp).
- Cyclists were generally travelling faster when there was no zebra crossing, particularly when cyclist flows were high. This may have been related to the increase in ambiguity over priorities and cyclists therefore not giving way to pedestrians and being able to maintain higher average speeds.
- The zebra crossing was easy for participant to identify and made it clear who have priority, thereby reducing the number of interactions between the cyclists and pedestrians.
- Further on street trials are required before more definitive design recommendations can be made.

Themes: Bus stop bypass, cycle track, pedestrian crossing

Comments: An investigation into the capacity and understanding of a Bus Stop Bypass facility.

Title: Safer Cycling Survey

Author / organisation: YouGov (commissioned by RoSPA)
Date: 2015
Format: Webpage
Link: http://www.rospa.com/media-centre/press-office/press-releases/detail/?id=1360
Free / priced: Free

Objectives: This article summarises the key findings of the Safer Cycling Survey 2015.

Methodology: Survey answered by 2,169 people.

Key Findings:

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

- 36 per cent of respondents said that they would like to cycle more than they currently do, with “concerns around the safety of road cycling” (41 per cent) and “concerns about drivers treating me badly when cycling” (31 per cent) being the main reasons given as to what prevents them from cycling more often were. 39 per cent of people said that they would cycle more often if cycling on the roads was safer.

Themes: Cycling frequency, perceived safety

Comments: The results reveal that more still needs to be done to encourage more people to cycle, primarily by making the roads in the UK feel safer.

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