TRL Report PPR 580

FINDINGS

Department for Transport

Infrastructure and Cyclist Safety

Abstract

The Department for Transport commissioned TRL to conduct a literature review to consider the role of infrastructure in relation to the safety of cyclists and their interaction with other road users. It was undertaken as part of the wider research programme, Road User Safety and Cycling, being led by TRL.

Overall, it proved problematic to draw firm conclusions from the literature. 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 collisions, the main infrastructure risk factors appear to be posted speed limits and encounters with other road users at junctions.

Main findings

- Of all interventions to increase cycle safety, the greatest benefits come from reducing motor vehicle speeds. Interventions that achieve this are also likely to result in casualty reductions for all classes of road user. This may be achieved by a variety of methods, including physical traffic calming; urban design that changes the appearance and pedestrian use of a street; and, possibly, the wider use of 20 mph speed limits.
- Most cyclist injuries in multi-vehicle collisions take place at junctions. Reducing the 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.
- Providing segregated networks may reduce risks to cyclists, although evidence suggests that the points at which segregated networks intersect with highways can be relatively high-risk, sometimes of sufficient magnitude to offset any safety benefits of removing cyclists from the carriageway.
- A number of infrastructure interventions that are not widely used in the UK have been implemented on the continent to increase safety at junctions. Particular examples include cycle lane markings continued across junctions, cycle pre-signals and Trixi mirrors (mounted below signal heads to allow drivers of heavy vehicles to see cyclists at their nearside). The literature suggests that, appropriately applied, the former two approaches can have a beneficial effect on cycle casualties.

Background

This integrated research programme has assessed a range of road user safety topics in relation to cycling, including:

- analysis of cycling activity and collision data;
- qualitative research with cyclists and other road users;
- review of infrastructure provision; and
- review of the effectiveness of cycle helmets in reducing injuries.

Research findings

Junctions

As with all classes of road user, cyclist injuries are particularly associated with junctions. In order to reduce the total number of cycle casualties, interventions at junctions should be a relatively high priority, particularly in urban areas, where the majority of collisions involving cyclists take place.

Reducing the speed of traffic through junctions appears to be an effective approach to reducing cycle casualties. This can be achieved by side entry treatments, raised cycle track crossings and signalisation of large roundabouts, for all of which there is evidence of a casualty reduction benefit for cyclists. Traffic calming in general, including features that reduce traffic speed through junctions, such as raised tables, is likely to be of benefit to cyclists, although care should be taken with some features, such as road narrowings and the placement of speed cushions, that they do not increase conflict between cyclists and other road users.

Other methods that achieve lower speeds through junctions appear likely to be beneficial, although specific UK evidence is not available. Foremost among these are the restricted geometries of 'continental' style roundabouts where the width of circulating carriageways is lower and the deflection of vehicles away from their path is greater than typical of UK designs and, hence, the speed at which motorised vehicles can circulate is reduced, as is the potential for the cyclist to be in the periphery, rather than the centre, of a driver's vision.

With regard to junction form, there is a convincing body of evidence that larger and multi-lane roundabouts are a particularly risky junction type for cyclists and that the speed of motorised traffic through roundabouts is a good proxy for risk.

A study for Transport for London found that the signalisation of roundabouts significantly reduced cyclist casualties, but this approach might not be universally applicable.

Continuing a cycle lane, particularly if it is emphasised by a coloured surface, through a junction appears also to reduce cycle casualties, although evidence suggests that this effect is only achieved when a single lane is so marked. This would suggest that such an approach is only likely to be practical where there is a particularly strong cycle desire line through a junction.

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

Although speed reduction may provide benefits, cyclist injuries involving heavy goods vehicles (HGVs) at junctions were often found to take place at low speed. This suggests that relative positioning and visibility of the cyclist may be a key factor in these incidents.

A number of infrastructure interventions that are not widely used in the UK have been implemented on the continent to increase safety at junctions. Particular examples include cycle lane markings continued across junctions, cycle pre-signals and Trixi mirrors (mounted below signal heads to allow drivers of heavy vehicles to see cyclists at their nearside). The literature suggests that, appropriately applied, the former two approaches can have a beneficial effect on cycle casualties. The latter is currently (2010/11) being trialled by Transport for London. Wider experimentation with these approaches in the UK is recommended.

Cycle lanes

There is little evidence in the UK that marked cycle lanes provide a safety benefit, although they may achieve other objectives. This lack of evident benefit may, however, represent a lack of quality and continuity in implementation. There is also extremely limited experimentation with, and no reported studies of, kerbed cycle lanes in the UK.

Providing segregated networks may reduce risk to cyclists in general, although evidence suggests that the points at which segregated networks intersect with highways can be relatively high-risk, sometimes of sufficient magnitude to offset any

safety benefits of removing cyclists from the carriageway. This may be particularly the case if segregated networks remove cyclists from relatively low-risk links but then increase their exposure at junctions. There is nevertheless a potential application for this approach and it is likely to be attractive to some users. It may be of value in rural settings, where the frequency of junctions is relatively low and where required quality can be achieved and cyclists can be protected at junctions.

Systemic approaches

The evidence is strong that reducing the general speed of motorised traffic confers a safety benefit for cyclists. This may be achieved through placemaking methods, physical traffic calming and, possibly, the wider use of 20 mph speed limits.

In western Europe, network-wide segregated facilities supported by traffic calming on the highway network appear to offer an effective system-wide approach. Piecemeal implementation of such an approach, however, is unlikely to be satisfactory, and careful consideration needs to be given as to the best sequence in which to introduce measures.

Achieving a functional network for cyclists in urban areas based on these continental principles would require:

- sustained investment over decades;
- a willingness to prioritise cycle traffic;
- a multi-faceted approach seeking to increase cycle safety and cycle use together; and
- a focus on achieving high-quality outcomes.

In addition to design, different legal conventions, particularly governing priority at junctions, may influence casualty outcomes in continental countries as opposed to the UK. Notwithstanding this, it is acknowledged in nations such as the Netherlands, where this form of facility is common, that managing conflict between cyclists and motorised vehicles at intersections is safety-critical. Separate facilities that do not frequently intersect the general highway network will not suffer from the same drawback. However, they are only likely to be achievable in rural settings.

It should be noted that most of the evidence presented has been gathered from urban studies. Cycle safety benefits might also be realised from motor vehicle speed reductions in rural settings. However, the options to achieve those speed reductions might be substantially more limited on rural roads. Localised exceptions to this could be spot treatments in specific locations such as villages.

In some situations, the type of infrastructure selected for a given site may not meet cyclists' needs. Where infrastructure does not meet the needs of cyclists, they might behave in ways that could increase their risk, such as illegally using footways not designed for cycling (Gibbard, 2004). This failure is sufficiently widespread that methodologies such as *Cycle Audit and Cycle Review* (Institution of Highways & Transportation, 1996) and *Non-motorised User Audits* (Highways Agency, 2005) have been devised. These prompt designers of highway schemes to thoroughly consider the requirements of cyclists. The requirements for such procedures are underlined by Christmas et al.'s (2010) finding from qualitative research with cyclists, who commented that there were instances of cycle facilities that:

- ended suddenly, leaving the cyclist having to rejoin traffic;
- were punctuated by drains and manhole covers, or poorly maintained;
- required the cyclist to stop frequently, e.g. a pavement cycle track crossing side roads; and
- were impinged on by traffic, or used to park cars.

Conclusions

Of all interventions to increase cycle safety, the strongest evidence is for the benefits resulting from reduction in the general speed of motorised traffic. The review identifies the potential benefits of segregated networks for cyclists but notes evidence that cyclists may be exposed to heightened risk where cycle networks intersect the general highway network.

The review also identifies a number of techniques to improve cyclist safety that are in use in overseas but which have not been commonly applied in the UK. There is 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 represents a barrier to better understanding how to reduce risk to cyclists.

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 collisions the infrastructure risk factors appear to be:

- posted speed limits; and
- encounters with other road users at junctions.

About the project

As part of this programme, an international review of literature was undertaken to establish what is already known about casualties involving cyclists. This report specifically covers literature relating to the influence of infrastructure on cycle casualties, focusing on the context in which injuries to cyclists happen and can be reduced.

Further information

The full report, **Infrastructure and Cyclist Safety** by the Transport Research Laboratory, is published by TRL (PPR 580).

To download a free copy of the report, go to www.trl.co.uk/online_store/reports_publications/free_reports/

These Findings can also be downloaded free of charge from www.dft.gov.uk/topics/road-safety/research

Although this research was commissioned by the Department for Transport, the findings and recommendations are those of the authors and do not necessarily represent the views of the DfT.