



Raising the bar

Review of Cycling Safety Policies in the European Union

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BIKE PAL receives financial support from the European Commission, the German Road Safety Council (DVR) and Fundación MAPFRE.

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FUNDACIÓN MAPFRE

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Review of Cycling Safety Policies in the European Union

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Brussels, 2012



BIKE PAL Project

BIKE PAL is a pan European project that aims to offer cyclists a package of information, resources, and awareness raising experiences to help them significantly improve their safety on the roads, thus effectively becoming cyclists' best friend. The project also aims at mobilising students to run a project to improve the safety of cyclists, for example a local cycling safety campaign or the treatment of a high risk site for cyclists.

BIKE PAL also aims to reach policy-makers and other groups of stakeholders who can increase cyclist safety. The first part of the project consists of three new publications presenting the state of play regarding cycling safety. A comparison of the performance of the 27 European Union Member States in reducing the number of deaths among cyclists has been published.¹ This paper compiles and reviews examples of good practice in improving the safety of cyclists with the help of a purposely assembled group of high-level experts. It aims to serve as a reference document for policy-makers and other interested stakeholders who can either act or influence policies related to cycling. A cycling safety manual, which will provide cyclists with essential information and recommendations to act safely on the roads, has also been published.² The manual will be distributed primarily to university students during an EU-wide lecture tour.

During the second part of the BIKE PAL project, ETSC is organising a university lecture tour to spread the accumulated knowledge to students across the continent. Apart from their awareness-raising function, the lectures will also be the occasion to invite students to enter the BIKE PAL competition. To participate in the competition, groups of two students each must submit an initial project proposal aimed at improving the safety of cyclists in their local community.

The groups of students with the best project proposals will be invited for a one-week training course organised by ETSC in Brussels. Following this training camp, ETSC will monitor and support the students while they liaise with local authorities as well as external partners to implement their projects. The three groups of students with the best implemented projects, as decided by a jury of experts, will be invited to Brussels to receive an award at a special ceremony.

The European Transport Safety Council

The European Transport Safety Council (ETSC) is an international non-governmental organisation which was formed in 1993 in response to the persistent and unacceptably high European road casualty toll and public concern about individual transport tragedies. It brings together experts of international reputation and representatives of 48 national and international organisations concerned with transport safety from across Europe to exchange experience and knowledge and to identify and promote research-based contributions to transport safety. ETSC provides an impartial source of advice on transport safety matters to the European Commission, the European Parliament and to national governments and organisations concerned with safety throughout Europe.

1 ETSC (2012) Pedalling Towards Safety http://www.etsc.eu/documents/BIKE_PAL_Safety_Ranking.pdf

2 ETSC (2012) Have a safe ride! http://www.etsc.eu/documents/Bike_Pal_cycling_manual_web.pdf

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1. Introduction

Cycling is a mode of transport that has become more popular in the last years. Cycling offers a whole range of benefits: it provides mobility irrespective of age and income, it is conducive to health, cost-effective, environmentally friendly, it reduces the amount of noise and it requires comparatively less space than private motorised transport options. An attractive range of cycling options contributes to improving tourist locations, particularly in structurally weak rural areas. Moreover, promoting cycling secures jobs in the cycle industry, in the retail trade and in the numerous cycle-related service areas, and thus helps to promote small and medium-sized businesses.

The Eurobarometer Survey from October 2010 revealed that around 7% of all EU citizens use bicycles as the main mode of transport:³

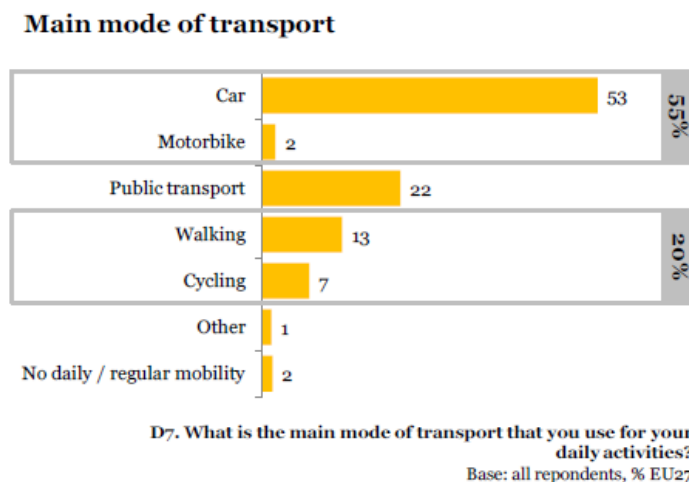


Fig. 1 Main mode of transport used in daily activities. Source: Eurobarometer.

The proportion of cyclists differs from country to country, from 31% in the Netherlands to close to 0% in Cyprus.

Bicycles are also used for leisure and for sportive purposes and cyclists are interacting with other road transport modes. Cyclists are considered as vulnerable road users, because they are unprotected in case of a collision, regardless of the one who is responsible for the collision.

From a historical perspective, until the 1940s, cycling was seen as the first 'mass' means of individual transportation, due to the prohibitive high costs of personal motorised cars. Cycling was picked up as a means of personal emancipation and seen as a way of enjoying the surrounding and of experiencing the world. The uptake in cycling was reversed at the middle of the 20th century as cars became more affordable, more reliable and infrastructure was purposely built for car use. However, cycling as a means of transport still retains the benefit of providing users with a fun aspect not encountered by driving. One of the benefits of cycling, particularly in the context of cycling in urban environments, refers to the ability of the cyclists to discover the surrounding area, given the relatively long distance that can be covered in comparison to walking. In the UK, Transport for London created a series of cycling videos which reveal several of the benefits of using a bicycle as a means of transport.⁴ One of the fact sheets funded by the German Federal Ministry for Transport, Building and Urban Development to promote the 2002-2012 German cycling plan also looks at the

³ Flash-Eurobarometer 312, Future of Transport, published March 2011.

⁴ The videos can be viewed at <http://cyclestories.tfl.gov.uk/>

relation between bicycle use as a mode of transport and social class – the population is divided into ‘milieus’ according to occupation, income, etc. – and recommends lifestyle-specific promotion of cycling.⁵

In terms of social or collective benefits, several studies have looked at the effects of regularly using a bicycle, particularly in terms of public health benefits, environmental benefits, improving social inclusion and improving the overall quality of (urban) life. A large part of the literature looks at cycling as a means of tackling the unwanted consequences of other transport choices, thus in a way creating a dichotomy between cycling and other transport modes.

From a public policy perspective, cycling as a transport mode has been most often linked with a reduction of CO₂ emissions resulting from transport. According to a report by the European Cyclists’ Federation, emissions of greenhouse gases coming from cycling stand at approximately 16g of CO₂ equivalent per passenger kilometre⁶, while the production costs of the bicycle, distributed over its life-cycle stand at 5g CO₂ equivalent per kilometre, a total of 21g CO₂e per kilometre⁷. For passenger cars, the fleet average CO₂ emission requirements for 2012 stand at 130 g/km, with a long-term target of 95g/km to be reached by 2020⁸. According to the European Cyclists’ Federation, the CO₂e emissions linked with the production and operation of buses amount to 101g CO₂e per passenger-kilometre⁹.

To link cycling’s CO₂ offset potential and health effect benefit, Woodcock et. al conducted a study in London, UK, and Delhi, India, whereby the authors ascertained the health effect of shifting trips from motor vehicles to active modes of travel – walking and cycling.¹⁰ The study looked at methods of reducing greenhouse gases emissions from inner-city travel and identified active travel options – i.e. walking and cycling – as having the potential for a sizeable contribution towards reducing the amount of GHGs coming from urban transport. For the same total distance travelled, Woodcock et. al. found that a better GHG emission reduction can be achieved by shifting trips to active travel modes than by solely focusing on lower-carbon-emission motor vehicles. The most promising scenario for reducing GHG emissions identified by the researchers - combining an increase in active travel with a focus on lower emission motor vehicles - found a 60% GHG emission reduction by 2030, compared with the Business As Usual (BAU) prediction. The authors then analysed the health benefits of the scenarios to reduce GHG emissions. The proxy used for measuring health benefits was the number of Disability Adjusted Life Years (DALYs). As presented in Murray (1994)¹¹, DALY represents an indicator of the time lived with a disability and the time lost due to premature mortality.

The scenario yielding the best return in terms of GHG emission reduction unsurprisingly also yielded the most significant health benefits. For the 2010-2030 scenarios assuming an increase in active travel coupled with lower-carbon motor vehicles, Woodcock et.al. found benefits of 7,439 DALYs per million inhabitants in the case of London and 12,995 DALYs per million inhabitants in the case of Delhi.

5 Cycling Expertise (2012) Lifestyle and Cycling CyE Analysis factsheet CyE a-5 <http://www.nationaler-radverkehrsplan.de/en/transferstelle/downloads/cye-a-05.pdf>

6 http://www.ecf.com/wp-content/uploads/ECF_BROCHURE_EN_planche.pdf

7 TNO (2010) <http://www.tno.nl/downloads/Fietsen%20is%20groen,%20gezond%20en%20voordelig.pdf>

8 http://ec.europa.eu/clima/policies/transport/vehicles/cars/index_en.htm

9 http://www.ecf.com/wp-content/uploads/ECF_BROCHURE_EN_planche.pdf

10 Woodcock, J., Edwards, P. et.al. (2009) Public health benefits of strategies to reduce greenhouse-gas emissions: urban land transport, *The Lancet* 374: 1930-1943.

11 Murray. C.J.L. (1994) World Health Organisation OMS. Vol. 72 1994 <http://www.ncbi.nlm.nih.gov/pmc/articles/PMC2486718/pdf/bullwho00414-0105.pdf>

In terms of individual benefits, individual health and an increase in the number of active life years (ALY) are an often-quoted benefit of cycling. The “Valuing the benefits of cycling” report, written by SQW and commissioned by Cycling England, highlights three elements in terms of the health benefits of cycling.¹² The report approaches cycling as an activity increasing the level of physical activity. The elements considered are:

- the value of the lost lives – deaths which could be prevented as a result of cycling;
- National Health Service savings – reducing the costs relating to the treatment of illnesses resulting from physical inactivity;
- productivity gains – reducing absenteeism relating to illness which is preventable through increased activity, such as cycling.

The SQW report approaches cycling as a unique travel mode which balances societal needs to reduce traffic congestion, reduce pollution and deliver health benefits (SQW 2007). Based on the available literature, it provides a monetary value to the various benefits, where possible. Where the comparison was possible, the SQW report concluded that the positive effects of normal bicycle use outweigh the loss of life due to collisions by a factor of 20:1.

In terms of health benefits, the SQW study identified fighting obesity as one of the health conditions which can be tackled due to the increased physical exercise achieved through cycling. A report by the British House of Commons’ Health Committee addressed, among other issues, the effect of cycling on reducing obesity:

A significant increase in the rate of cycling “might achieve more in the fight against obesity than any individual measure we recommend within this report.”¹³

The SQW study quotes epidemiological studies which closely link three disease groups – Coronary Heart Disease (CHD), stroke and colon cancer – to physical inactivity. The study then finds higher benefit values for older people who take up cycling to increase their level of physical activity, than for young people.

Moreover, one of the fact sheets published in the framework of the German Cycling Plan also looks at the public health and cycling and lists a wide list of benefits that can be derived from regular cycling. Reduction of problems related to obesity, the reduction of psychological stress, of CHD diseases, spinal and musco-skeletal problems, enhanced joint protection and improved metabolic processes are listed among the benefits of regular cycling.¹⁴

In terms of assessing the health economic benefits of cycling, several studies have attempted to monetise the value of increased rates of active travel, particularly walking and cycling. To this end, in 2011, the World Health Organisation published a methodology and user guide for appraising the health economic effects of walking and cycling.¹⁵ This tool is meant to quantify the health effects of cycling, answering the question ‘If x people cycle or walk y distance on most days, what is the economic value of mortality rate improvements?’ As statistical input, the HEAT tool must be supplied with data relating to:

- an estimate of the number of people cycling in the given geographical unit (company, municipality, region, country);

¹² SQW (2007) “Valuing the benefits of cycling. A Report to Cycling England” <http://www.teespublichealth.nhs.uk/Download/Public/1012/DOCUMENT/5803/Valuing%20the%20benefits%20of%20cycling.pdf>

¹³ Conclusion 46 from the House of Commons Health Committee: Obesity, Third Report of Session 2003–04, Volume I, May 2004 in SQW. The set target, which was not reached, was to treble cycling between 2000 and 2010.

¹⁴ Cycling Expertise (2012) Public Health CyE Analysis factsheet CyE a-10 <http://www.nationaler-radverkehrsplan.de/en/transferstelle/downloads/cye-a-10.pdf>

¹⁵ WHO (2011).

- an average of the duration and length of the trips taken;
- an estimate of the number of cycling trips made yearly by one person;
- an estimate of the number of daily steps (on footpaths or sidewalks) taken by one person.

The economic value derived using the HEAT tool can be used in cost-benefit analyses performed to decide on the implementation of measures, e.g. providing an estimated benefit to be derived from building a new cycle lane or path. Additionally, the promotion of cycling should take into consideration not only the increase of the number of cyclists, but also the increase of the safety of cyclists.

Moreover, given that over 50% of the trips undertaken in the EU are shorter than 5 kilometres¹⁶, cycling as a transport mode is well-placed to provide a substitute for car trips, if it is perceived as a safe and convenient activity.

Data collected in the BIKE PAL project show that, while a relation exists between relative cycling safety and the number of cyclists, this is not a perfect correlation and dedicated actions and policies for the safety of cyclists need to be put in place.

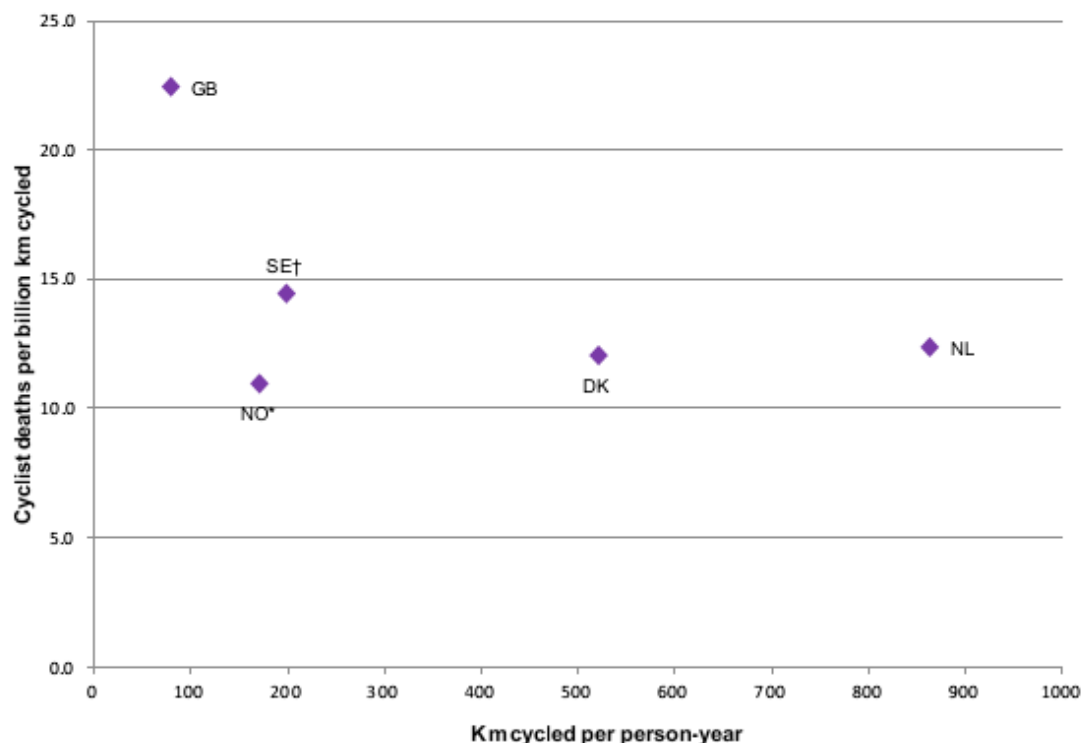


Fig. 2 Number of cyclist deaths per billion km ridden (vertical axis) plotted against the rate of cycling per person (horizontal axis).¹⁷

Around 2,100 cyclists were recorded as killed in traffic collisions in 2010 in the 24 EU countries where the data are available, representing 7.2% of the total number of road deaths recorded in those countries. Over the 2001-2010 decade the number of cyclist deaths was reduced by just 39%, compared to the 43% reduction in the overall number of road deaths observed in the same countries. EU-wide, 2009 and 2010 saw slower progress in reducing the number of cyclists killed on the roads than the corresponding reduction in deaths for non-cyclists.¹⁸

¹⁶ European Cyclists' Federation (2012) Action Plan on Urban Mobility.

¹⁷ ETSC (2012) Pedalling Towards Safety http://www.etsc.eu/documents/BIKE_PAL_Safety_Ranking.pdf

¹⁸ Ibid.

Across the EU countries, the majority of cyclist road deaths are males and there is also a large proportion of elderly cyclists who die in cycling collisions. Elderly cyclists, who constitute an increasingly large proportion of all cyclists, are often more seriously injured than younger cyclists because of the frailties associated with old age. Moreover, cyclists who inappropriately make use of the roads are exposed to particularly high risks. Quite often, the reason behind such behaviour is the cyclists' unwillingness to take the long way around, the difficulty of crossing roads and the desire to have a direct, simple connection. It is frequently the case that infringements of the rules reflect the fact that the cycling facilities are not properly designed for the users. Most of the accidents involving cyclists occur in urban areas, which lend themselves more to cycling due to the relatively shorter trip distances where most of the people use to cycle.

2. EU Policy on Cycling

The European Union has, albeit in a limited fashion, taken account of cycling as a mode of transport and have noted the need to improve the safety of cycling, most often in the context of improving the safety of vulnerable road users in general.

The European Commission's Road Safety Policy Orientations 2011-2020 look, under Objective 7, at the protection of vulnerable road users – riders of powered two-wheel vehicles, pedestrians and cyclists. The European Commission notes that potential or perceived road safety risks remain a decisive obstacle for potential cyclists. While the European Commission acknowledged the significant environmental, climate, congestion and public health benefits of cycling, it identifies the Action Plan on Urban Mobility as the main instrument that can be used to improve the safety of cyclists. However, the Commission limits itself to "making appropriate proposals with a view to...increasing the safety of cycling and other vulnerable road users, e.g. by encouraging the establishment of adequate infrastructures." In its reply to the Commission's document, ETSC regretted that so little was proposed to protect pedestrians and cyclists on EU roads, particularly given the higher risks per distance travelled faced by these road users. ETSC noted that trips by public transport, including walking and cycling to and from access points, i.e. combined trips, are collectively safer than car trips and as such must be promoted by the EU.¹⁹

In 2010, the EU Transport Ministers, in response to the Policy Orientations, acknowledged that certain categories of road users, including cyclists, remained particularly vulnerable despite positive general results in reducing road casualties. The ministers also considered the establishment of adequate infrastructure as important and noted that in some cases Member States may be in the best position to make decisions, based on their existing infrastructure, enforcement and legislative frameworks.

In 2011, the European Parliament adopted an own-initiative response to the European Commission's Road Safety Policy Orientations. Known as the Koch report – the rapporteur for the dossier was MEP Dieter Lebrecht Koch, EPP DE – the Parliament's response proposed several measures to improve the safety of cyclists. The EP calls for the protection of vulnerable road users, including cyclists, to be an integral part of road safety and recommends, among other measures, the introduction of special lanes reserved for VRUs. The EP also calls on the Commission and the EU Member States to support walking and cycling and to treat them as integral parts of all transport systems. In terms of protection and conspicuity, the EP recommends that cyclists, particularly at night and outside built up areas, wear helmets and wear gear that improves visibility. Moreover, the Commission is asked to propose minimum requirements for lights and reflective devices that bicycle manufacturers must respect.

The White Paper on Transport, published by the European Commission in 2011, recognised the potential of walking and cycling to substitute passenger car trips which are shorter

¹⁹ ETSC (2003) Transport Safety Performance in the EU: a Statistical Overview.

than 5km and also noted the benefits of walking and cycling in reducing greenhouse gas emissions, improving health, lowering air pollution and noise emissions, as well as the modes' reduced need for space and lower energy use. The Commission went on noting that "facilitating walking and cycling should become an integral part of urban mobility and infrastructure design." In its reply, ETSC noted that the reduction in the number of cyclist deaths was slower than for all road users between 2001 and 2010 – 39% and 43% respectively²⁰ –and that the severity of injuries suffered by vulnerable road users was higher than for car occupants.²¹ ETSC also pointed out that the safety of walking and cycling must be prioritised because, while they account for a relatively small percentage of the distance travelled, they account for a larger proportion of the number of trips taken as well as the time spent using the roads. ETSC supported the development and utilisation of technologies to facilitate the protection of vulnerable road users.

The White Paper also included Urban Mobility Plans within its list of initiatives. This was followed up by a public consultation process on the European Union's future Urban Mobility Policy launched in September 2012. An urban mobility package is planned for mid 2013 and a number of the initiatives announced in the Transport White Paper are expected to be of relevance to cycling. These include:

- Establish procedures and financial support mechanisms at European level for preparing Urban Mobility Audits, as well as Urban Mobility Plans, and set up a European Urban Mobility Scoreboard based on common targets. Examine the possibility of a mandatory approach for cities of a certain size, according to national standards based on EU guidelines.
- Link regional development and cohesion funds to cities and regions that have submitted a current, and independently validated Urban Mobility Performance and Sustainability Audit certificate.

(EC Communication List of Initiatives 2011:26).

Transport safety should be considered as an essential component of sustainable mobility and mobility planning. In attempting to secure change in urban mobility patterns, road safety can be regarded as a critical challenge, largely because of the social and economic cost of road collisions. As such, safety should be tackled at all levels of mobility planning. Real and perceived safety can have a profound effect on modal choice especially in terms of the most sustainable modes of travel - walking and cycling and ability to access public transport. Safety should be integrated not only into the development of Urban Mobility Plans but also into proposed Urban Mobility Audits and Guidelines and be reflected in common targets.

Plans should adopt a clear hierarchy of transport users, with pedestrians, cyclists and public transport users at the top of the hierarchy. As a general principle, these users should have their safety and convenience needs considered first. It is most important that the hierarchy is applied where a large share of travel is (or could be) made by walking, cycling and public transport.

The White Paper also stressed that "*Demand management and land-use planning can lower traffic volumes. Facilitating walking and cycling should become an integral part of urban mobility and infrastructure design.*" The White Paper signalled a change of approach to dealing with transport issues – from the traditional single pronged approach of building more and more transport infrastructure to a more multi-faceted approach that also seeks

²⁰ More information in the BIKE PAL Cycling Safety Ranking http://www.etsc.eu/documents/BIKE_PAL_Safety_Ranking.pdf and the 5th Road Safety PIN Report http://www.etsc.eu/documents/ETSC_2011_PIN_Report.PDF

²¹ More information in the ETSC Response to the European Commission White Paper <http://www.etsc.eu/documents/ETSC%20Response%20to%20the%20White%20Paper%20on%20Transport%206%20June%202011.pdf>

to manage travel demand and make better and more efficient use of existing resources and new technologies.

Despite the benefits that cycling brings through its individual and societal benefits, safety considerations pose a hurdle to the number of people who choose it as a travel mode^{22,23}. In response certain policy options have been considered, and in several cases also adopted, to increase the level of safety for cyclists. These measures fall into three broad categories depending on the component of the transport system which is addressed. They refer to road infrastructure, vehicles and road users and will be presented and analysed in turn in the following chapters of this paper.

3. Infrastructure

Road infrastructure is an important element which influences both the safety of cyclists and the individual choices of whether to cycle or not. While inappropriate behaviour in traffic by cyclists should not be ignored, a lack of compliance with traffic rules, sometimes even leading to collisions with other road users, could signal deficits in the road infrastructure or in the road management. Confusing road design can lead vehicle drivers to overlook cyclists, especially on road junctions in urban areas. Furthermore, if vehicles are parked on cycle paths, cyclists will tend to use the road surface or the opposite side of the cycle path increasing road risk.

In-depth analysis of collisions involving cyclists should be performed whenever possible to determine whether the road infrastructure should be adapted so as to become more conducive to correct road user behaviour.

While in line with the Sustainable Safety principles developed in the Netherlands at the beginning of the 1990s, the characteristics of roads determine to a significant extent the type of road users who travel on them. However, infrastructure by itself can only have a limited impact on the safety of cyclists, or of any other road user for that matter. In this respect, policy-makers must thus keep in mind that infrastructure is not a 'silver bullet' to solve all problems. It must be used in conjunction with developments in other areas related to the traffic system, i.e. vehicle technologies (see Part 4 below) and road user behaviour (see Part 5 below), in order to deliver its maximum road safety benefits.

In accordance with the Dutch Sustainable Safety principles²⁴, the first step in deciding how to maximise the level of cyclist safety on the road network should be the categorisation of the roads according to the traffic function (below) they must fulfil. Overlooking this necessary first step in measures aimed at improving the safety of cyclists could lead policy-makers to adopting infrastructural measures which put cyclists at more risk, rather than decrease it. The principle of monofunctionality of roads must be applied when such a categorisation is made.

22 British Medical Association (2012), Healthy Transport = Healthy Lives. <http://bma.org.uk/transport>

23 SWOV (2006) Advancing Sustainable Safety. National Road Safety Outlook for 2005-2020. SWOV, Leidscham, 2006. http://www.swov.nl/rapport/dmdv/Advancing_sustainable_safety.pdf

24 Ibid.

Sustainable Safety principle	Description
Functionality of roads	Monofunctionality of roads as either through roads, distributor roads, or access roads, in a hierarchically structured road network
Homogeneity of mass and/or speed and direction	Equality in speed, direction, and mass at medium and high speeds
Predictability of road course and road user behaviour by a recognizable road design	Road environment and road user behaviour that support road user expectations through consistency and continuity in road design
Forgivingness of the environment and of road users	Injury limitation through a forgiving road environment and anticipation of road user behaviour
State awareness by the road user	Ability to assess one's task capability to handle the driving task

Table 1: the Sustainable Safety principles. Source: SWOV

The three primary road functions are described as following:

- Through roads facilitate traffic flow;
- Access roads provide access to destinations;
- Distributor roads provide a transition between these two categories.²⁵

The theoretical categorisation presented above needed a slight adjustment in order to be applied to the Dutch road network. As such, the implementation of the original 1996 Sustainable Safety vision required a further categorisation which takes into account the location of the different road sections. A distinction between outside and inside urban areas was made for distributor and access roads.

The functional purposes served by each road will then influence the type of road users travelling along the given road section. As such, **the speed management regime for each road should be adapted to the needs of the users and the specific characteristics of the traffic mix.** This recommendation follows from the principle of homogeneity, as presented above. In particular, when there is a mixture of motorised traffic and vulnerable road users on the same road section, as is the case particularly on sections fulfilling the access function, the goal is to ensure that when collisions do occur, their consequences do not result in serious injury or deaths. Speed is the factor most quoted as a cause in traffic collisions resulting in deaths, and as such it plays an important role in diminishing or increasing the severity of collisions.²⁶ The probabilities of a collision resulting in death are presented in the figure below.

²⁵ Ibid.

²⁶ ETSC (2010) 4th Road Safety Performance Index Report. Chapter 3: Tackling the Three Main Killers on the Roads. <http://www.etsc.eu/documents/ETSC%20PIN%20Report%202010.pdf>

Risk of death in frontal collision

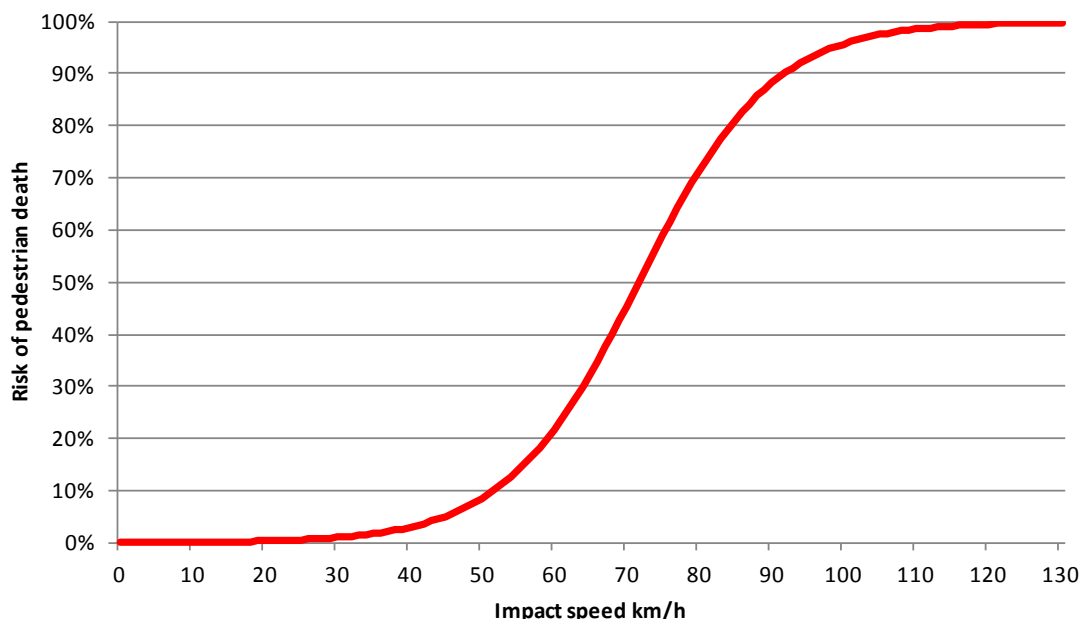


Fig. 3 Risk of a pedestrian being killed in a frontal collision with a passenger car

The curve above shows the rapid increase in risk of death as the speed increases. The table below, detailing the safe travelling speeds on different roads according to the types of road users travelling on them, was developed in the framework of the Sustainable Safety vision.²⁷

Road types combined with allowed road users	Safe speed (km/h)
Roads with possible conflicts between cars and unprotected road users	30
Intersections with possible transverse conflicts between cars	50
Roads with possible frontal conflicts between cars	70
Roads with no possible frontal or transverse conflicts between road users	≥100

Table 2: Safe travelling speeds according to possible conflicts between road users travelling on the roads. Source: SWOV, *Advancing Sustainable Safety* p.14

To minimise the risk of death and serious injury, the maximum speed limit should be set at 30km/h on roads used by cyclists and pedestrians.

The German Guidelines for Cycling Facilities (ERA 2010), published in 2010 use a function based on traffic speed and traffic volume when recommending whether bicycle-specific infrastructure must be built for the protection of cyclists.

²⁷ SWOV (2006) *Advancing Sustainable Safety*. National Road Safety Outlook for 2005-2020. SWOV, Leidscham, 2006. http://www.swov.nl/rapport/dmd/Advancing_sustainable_safety.pdf

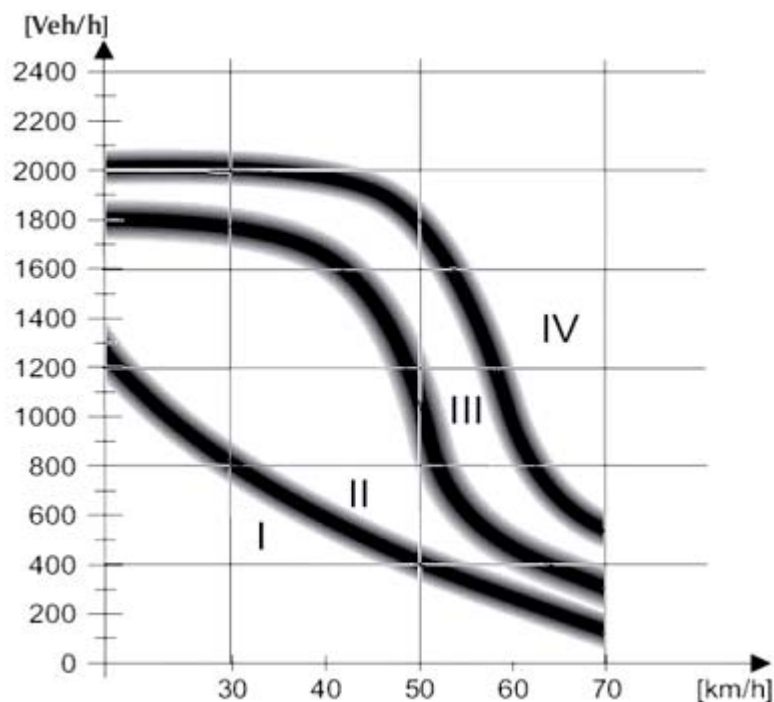


Fig. 4 Choice of cycling facility type (integration/separation) by car traffic volumes and speed (ERA 2010).

The ERA 2010 guidelines recommend that cyclist and motorised traffic is mixed only in cases of relatively low speed and low traffic volume i.e. below the first dark bar in the figure above, with some form of physical separation for all other situations.²⁸ 'Soft' separation through cycle lanes is recommended for the area marked II in the figure above. In Germany, the main guiding principles applied when planning and implementing dedicated cycling infrastructure are:

1. Allow sight!
2. Create additional safety areas!
3. Enough width!
4. Don't neglect problem-areas!

These are supplemented by minimum width requirements for each type of infrastructural solution, the choice of which being made in line with figure 4 above: 2 metres for one way cycle paths; 3 metres for two-way cycle paths; 1.85 metres for cycle lanes; 1.5 metres for cycle protection lanes and 4 metres for shared cyclist-pedestrian paths.²⁹ Generally, cycle lanes are the standard for intra-urban infrastructure because of the relatively small amount of space needed for their implementation and because they allow for a good level of visibility between cyclists and motorised traffic. Moreover, it is recommended that the minimum dimensions are avoided where possible.³⁰

For intra-urban cycling in France, the Certu Scientific and Technical Network recommends the following degrees of separation between cycle and motorised traffic:

- In shared space areas and 30km/h zones no separation is needed, except for contra-

28 Cycling Expertise (2010) State of the Art Design for Cycling Facilities CyE Infrastructure factsheet CyE i-1 <http://www.nationaler-radverkehrsplan.de/en/transferstelle/downloads/cye-i-01.pdf>

29 Ibid.

30 Cycling Expertise (2010) Cycling in Urban Main Streets CyE Infrastructure factsheet CyE i-2 <http://www.nationaler-radverkehrsplan.de/en/transferstelle/downloads/cye-i-02.pdf>

flow streets (see below). It is also mentioned that according to the decree of 30 July 2008, all roads in such areas should be open to two-way cycle traffic;

- On roads with speed limits of up to 50 km/h separation to be made preferably through the use of cycle lanes;
- On roads with speed limits higher than 50 km/h separation to be made preferably through the use of cycle tracks.

The Certu also uses the scheme below, which takes into account both traffic speed and volume for recommending the degree of separation between cycle and motorised traffic.³¹

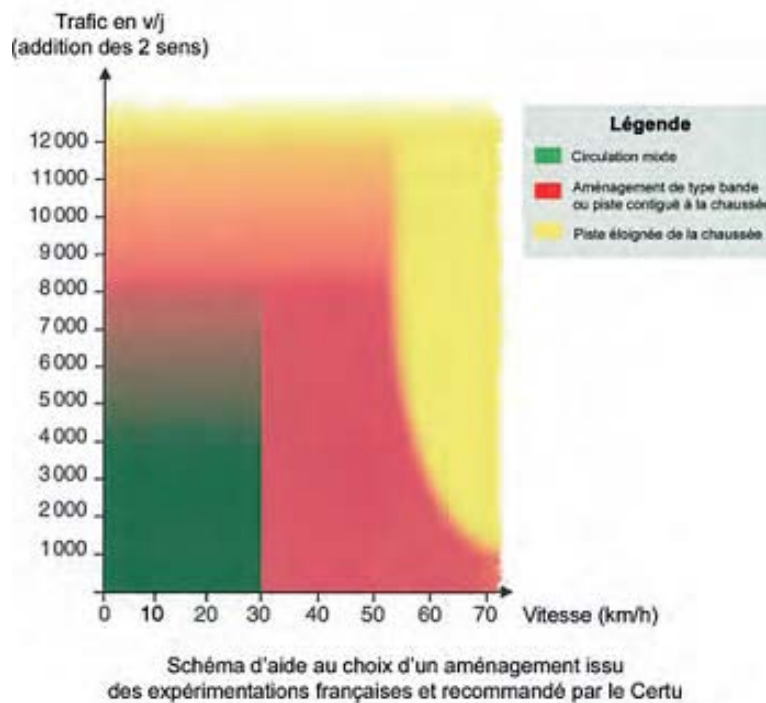


Fig. 5 Choice of cycling facility type by car traffic volumes and speed. Green: mixed traffic; red: separation through cycle lane or roadside cycle track; yellow: cycle track separated from the road. Source Certu.

3.1 Cycling on access roads

For cycling to be safely integrated into the national and local transport networks and plans, the sections of the road where cyclists mix freely with traffic would have to be primarily located on access roads. These roads should be made clearly recognisable through signing and road users – both motorised and cyclists – be informed and trained on how to act within these areas (see also section on road users below). Allowing a free mix of motorised and unprotected road users on roads under a speed regime which does not guarantee their safety is likely to result in increased risks for cyclists and depress the number of cyclists (see above). Road users should also be trained so as to be able to predict the behaviour of the other traffic participants in these areas. Moreover, the road infrastructure in areas where cyclists and motorised traffic share the road should reinforce the speed limit. Road signs announcing the speed limit can be supplemented by traffic calming measures, such as chicanes or speed humps, which oblige road users to obey the posted speed limits.

³¹ Certu (2008) Savoirs de base en sécurité routière. Les cyclistes Fiche no. 7.



Fig. 6 Speed hump in urban areas. Source: Presto factsheet on traffic calming. Image source D. Dufour.³²

Cyclists can mix freely with motorised traffic where the travel speed, volume and mass of motorised traffic do not pose a significant risk to the unprotected road users.

Within the implementation phase of Sustainable Safety in the Netherlands, 30km/h areas were built following the categorisation of the relevant road sections. In 2006 approximately 30,000 kilometres of roads were 30km/h streets. These areas were signposted according to the guidelines made by the Dutch information and technology platform for infrastructure, traffic, transport and public space (CROW), an example of which is available below. However, these 30 km/h road sections were built as low cost rather than what was considered as optimum design and the next phase of Sustainable Safety is expected to also focus on adapting these areas. The two design methods are described as follows:

- “Low-cost: gate construction (see e.g. figure below) at the transition boundary of speed limit zones, combined with speed reducing measures such as speed humps at intersections” and;
- “Optimum: such a road design, and physical speed reducing measures that are placed so close to each other that driving too fast becomes less self-evident.”

³² Presto-give cycling a push (2010). Factsheet on traffic calming and cycling <http://www.presto-cycling.eu/images/factsheets/presto%20infrastructure%20fact%20sheet%20on%20traffic%20calming%20and%20cycling.pdf>

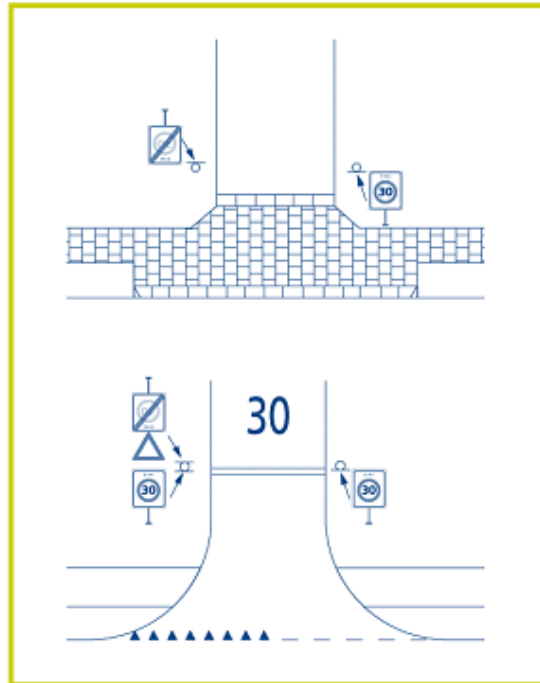


Fig. 7 Two examples of a gate construction of a 30km/h zone entrance. Source CROW, reproduced in SWOV(2006).³³

Different colour road markings and surfaces have also been used in Dutch cities to mark areas where traffic is mixed and motorised traffic shares the space with cyclists.



Fig. 8 Cycle path in Germany. Source: Planungsgemeinschaft Verkehr (PGV) and German Road Safety Council (DVR).

³³ SWOV (2006) Advancing Sustainable Safety. National Road Safety Outlook for 2005-2020. SWOV, Leidscham, 2006. http://www.swov.nl/rapport/dmdv/Advancing_sustainable_safety.pdf

Another example from Utrecht, the Netherlands, shows the various road designs that are in use for residential, i.e. access roads.

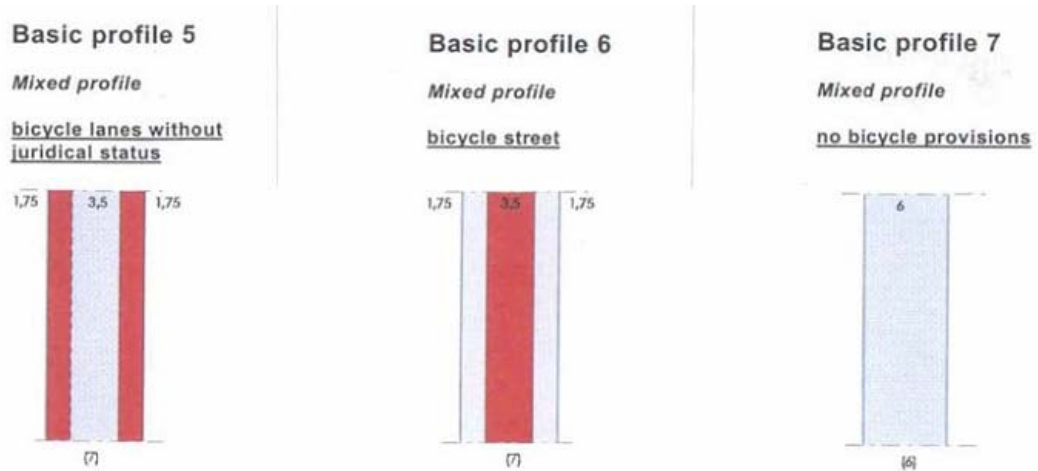


Fig. 9 Above: road designs in residential areas in Utrecht, the Netherlands. The red lines show the cycle lanes, areas of the road for bicycle traffic. Below: bicycle route in a residential area (30km/h) with road calming measures.³⁴



Certain measures which facilitate cycling by providing direct routes to destinations are suitable for implementation on access roads where the speed of motorised vehicles is sufficiently low so that the probability of death in the event of a collision is also low. Allowing contra-flow cycling is such a measure. Contra-flow cycling refers to sections of (access) roads where motorised traffic is only allowed to travel in one direction, but cyclists are allowed to travel in both directions.³⁵ However, implementing such a measure on roads or streets where the speed of motorised traffic is too high is likely to result in an unacceptably high level of risk for cyclists.

In France, all streets within 30km/h speed limits can be set up to allow contra-flow cycling,

³⁴ <http://www.fietsberaad.nl/library/repository/bestanden/document000114.pdf>

³⁵ Presto-give cycling a push (2010). Factsheet on contra-flow cycling <http://www.presto-cycling.eu/images/factsheets/presto%20infrastructure%20fact%20sheet%20on%20contra-flow%20cycling.pdf>

following decree 2008-754. However, before contra-flow cycling is allowed, a permit has to be given by the local authorities.³⁶

The layout and signing of streets that allow contra-flow cycling can vary from country to country and from town to town, as the two examples below prove, but, in line with the sustainable safety predictability principle, road users should know what to expect on the given road section.



Fig. 10 Contra-flow cycling signs in Brussels, Belgium, (left) and Rennes, France (right). Source: Presto factsheet on contra-flow cycling.³⁷

The junctions and the end of contra-flow cycling streets present particular challenges in order to ensure the safety of cyclists. Depending on the road layout, cyclists can either have priority when exiting the contra-flow street or they have to yield to incoming traffic from the left (driving on the right-hand side). Where cyclists have priority over incoming traffic, car drivers are alerted of having to yield through signs such as the one below.

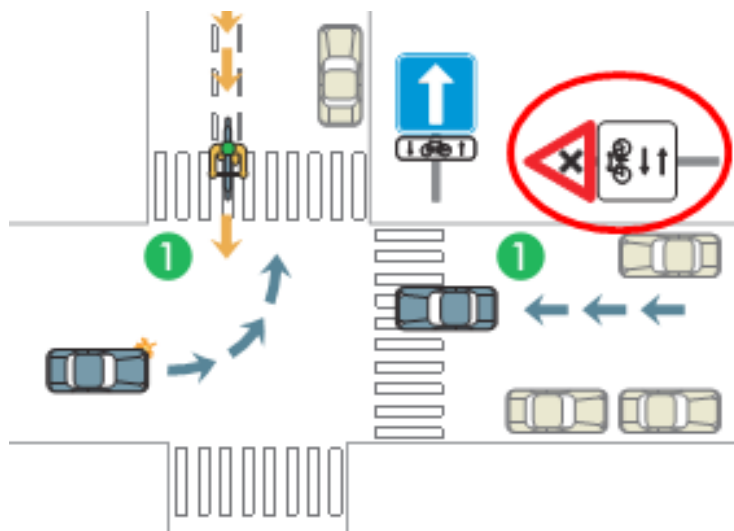


Fig. 11 Traffic sign alerting drivers that they have to yield to cyclists coming from the right, who are exiting a contra-flow area. Source: IBSR³⁸

36 Certu (2009) Les double-sens cyclables Fiche no. 6.

37 Presto-give cycling a push (2010). Factsheet on contra-flow cycling <http://www.presto-cycling.eu/images/factsheets/presto%20infrastructure%20fact%20sheet%20on%20contra-flow%20cycling.pdf>

38 IBSR (2009) Le SUL Cyclistes à contresens dans les sens unique. Conseils aux usagers <http://webshop.ibsr.be/frontend/files/products/pdf/0e6a5500c746b36d654415c9425074fd/le-sul-cyclistes-a-contresens-dans-les-sens-uniquesconseils-aux-usagers-depliant-2004.pdf>

Alternatively, cyclists can yield to incoming traffic when they exit a contra-flow street, as shown in the example below.

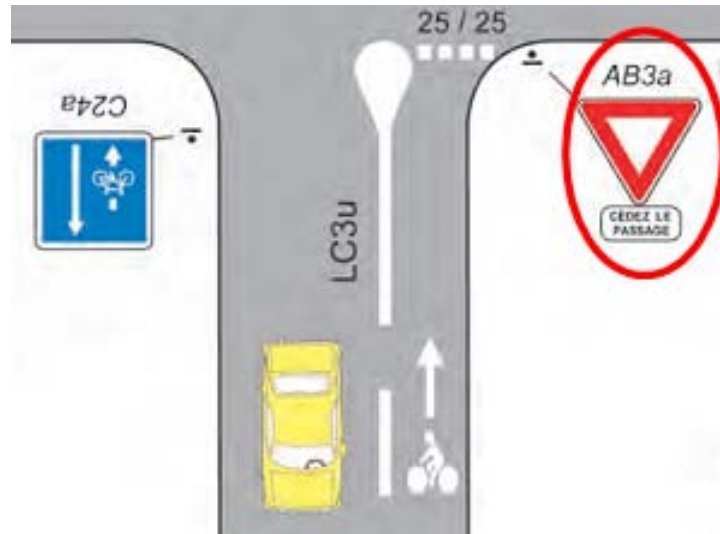


Fig. 12 Traffic sign alerting cyclists that they have to yield when exiting a contra-flow street. Source Certu.³⁹

Moreover, road users must also be trained on safe behaviour within this type of roads. Below is a snapshot of a training video produced by Gracq, a Belgian cycling association.⁴⁰

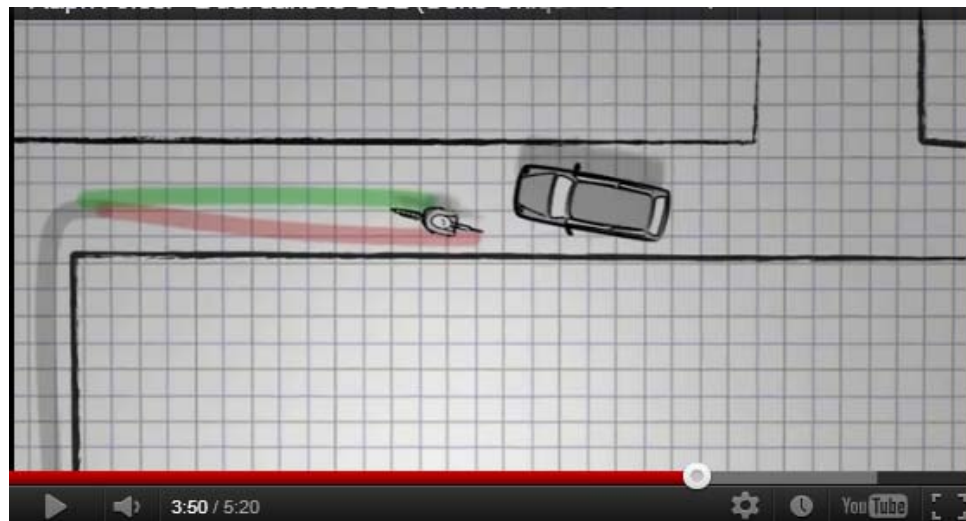


Fig. 13 Trajectories of cyclist and car driver on contra-flow street.

In Denmark, cycling infrastructure at the local level is planned from a network perspective, whereby a network of bicycle routes is overlaid on the city plan with priority being given to providing access by bicycle to the city centre and other points of interest. These latter areas are treated to mix cycle and motorised traffic at low speeds, as seen below.⁴¹

³⁹ Certu (2008) Savoirs de base en sécurité routière. Les cyclistes Fiche no. 7.

⁴⁰ <http://www.gracq.be/CAPSULES/SUL>

⁴¹ Cycling Embassy of Denmark (2012). Collection of Cycle Concepts. More information on specific policies available through the Danish Cycling Embassy, <http://www.cycling-embassy.dk/2012/05/10/cycle-concepts2012/>

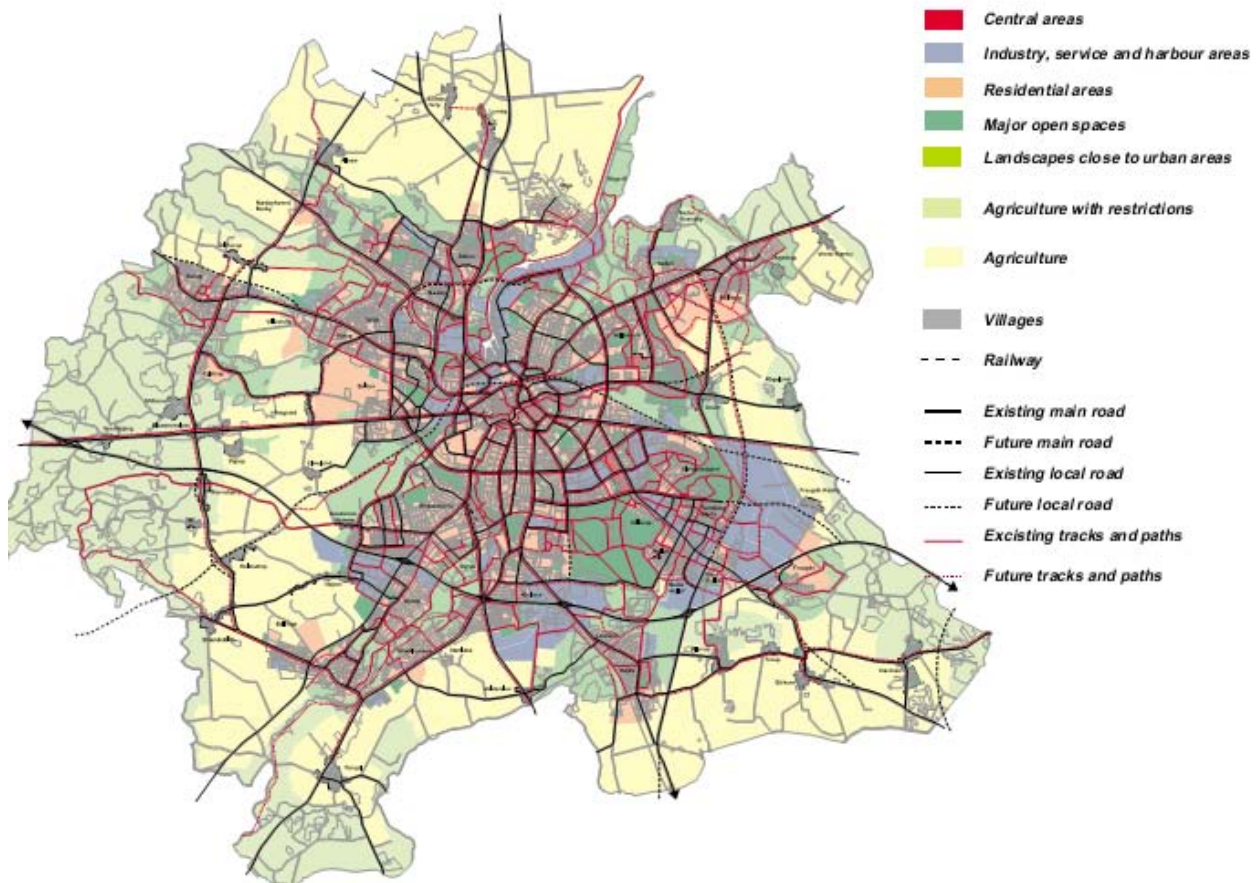


Fig. 14 Cycle network plan, Municipality of Odense.



Fig. 15 Shopping area in Præstø, Denmark.

3.2 Cycling on distributor roads

On distributor roads, regardless of whether they are located inside towns or in rural areas, the volume and travel speeds of motorised traffic are likely to be higher (see table below) and thus it is recommended that a form of separation is introduced between cyclists and motor traffic in order to improve the safety of cyclists. In the Netherlands, the SWOV recommends that this separation is not just visual, i.e. cycle lanes, but also physical, i.e. cycle tracks.⁴² An example from London of how the choice of cycling facility is made depending on traffic speed and volume is presented in the table below.

Matrix of cycle facility solutions based on motor traffic volume and speed	85%ile Speed			
	<20mph Very Low	20-30mph Low	30-40mph Medium	>40mph High
Very High >10,000VPD	Lanes or Tracks/paths	Lanes or Tracks/paths	Lanes or Tracks/paths	Tracks/paths
High 8,000-10,000VPD 800-1,000VPH	Lanes	Lanes	Lanes or Tracks/paths	Tracks/paths
Medium 3,000-8,000VPD 300-800VPH	Lanes or combined use with cycle symbols	Lanes or combined use with cycle symbols	Lanes or Tracks/paths	Tracks/paths
Low 1,500-3,000VPD 150-300VPH	Combined use with cycle symbols	Combined use with cycle symbols	Lanes or Tracks/paths	Lanes or Tracks/paths
Very Low <1,500VPD <150VPH	Combined use – no symbols necessary	Combined use with cycle symbols	Combined use with cycle symbols	Lanes or Tracks/paths

Table 3. Choice of cycle facility based on motorised traffic volume and speed.⁴³

Cycling lanes on the side of existing roads provide visibility for cyclists, particularly when the pavement is also coloured. They allow for a fast and low-cost roll-out of a cycling network, particularly as no extra road construction is needed.⁴⁴ Research has shown however that, due to the lack of a physical separation between cyclists and motorised traffic and the larger differences in speed, the safety benefits of cycle lanes can be very limited. The Transport Research Laboratory found “little evidence in the UK that marked cycle lanes provide a safety benefit, although they may achieve other objectives.”⁴⁵ An indirect relation between rolling out a network of cycling lanes and improving cycling safety could be construed however, provided that cycling lanes contribute to increasing the distance travelled by bicycle. The BIKE PAL cycling safety ranking showed that, for the countries where the data are available, cycling is safer per distance travelled in the countries where more people cycle.⁴⁶

Moreover, the Utrecht bicycle policy guide recommends that visual only separation between cyclists and motorised traffic is used primarily on access roads to residential areas, despite the legal status of the bicycle lane, i.e. the cycle lane has a separate legal status that forbids its use by cars.⁴⁷ Given this evidence, it is recommended that:

Cycle traffic and motorised traffic should be physically separated where the speed of the latter is too big to allow them to mix freely.

42 http://www.swov.nl/rapport/Factsheets/UK/FS_Bicycle_facilities.pdf

43 London Cycle Design Standards <http://www.tfl.gov.uk/businessandpartners/publications/2766.aspx>

44 Presto-give cycling a push (2010). Factsheet on cycle lanes <http://www.presto-cycling.eu/images/factsheets/presto%20infrastructure%20fact%20sheet%20on%20cycle%20lanes.pdf>

45 TRL (2011). Infrastructure and Cyclist Safety <http://assets.dft.gov.uk/publications/infrastructure-and-cyclist-safety/infrastructure-and-cyclist-safety.pdf>

46 ETSC (2012) Pedalling Towards Safety http://www.etsc.eu/documents/BIKE_PAL_Safety_Ranking.pdf

47 <http://www.fietsberaad.nl/library/repository/bestanden/document000114.pdf>

In accordance with the Homogeneity principle of Sustainable Safety, the SWOV developed the table below whereby safe travelling speeds for the different types of road sections, as well as at the junctions between them are detailed.⁴⁸ The relation between safe travelling speeds and volumes of motorised vehicles and the choice of appropriate cycling facility has also been addressed in a number of national and local settings, see figures 4, 5 and Table 3 for examples from Germany, France and London respectively.

Location	Safe travel speed (km/h)
<i>Rural road sections</i>	
Through road (no mutual road user crashes, fixed roadside objects only)	120
Distributor road (no conflicts possible with pedestrians and cyclists) with physical separation of driving directions	80
without physical separation of driving directions	70
Access road	40/60/80
<i>Rural intersections</i>	
Distributor road and access road without vulnerable road users	50
with vulnerable road users	30
<i>Urban road sections</i>	
Through road	70
Distributor road	50
Access road	30
<i>Urban intersections</i>	
Distributor road	50
Access road	30
<i>Pedestrian and cyclist crossings (urban and rural)</i>	
	30
<i>Against obstacles (urban and rural)</i>	
Head-on crashes	70
Side impacts	30

Table 4. Safe travel speeds on various road sections. Source SWOV.

When cycling lanes are used, the design of the lanes can have an important impact on their level of safety. Guidelines on the width required for the lanes to be safe and comfortable for cyclists usually exist at national level⁴⁹ and a fact sheet on infrastructural guidelines was produced in the framework of the Presto project.⁵⁰

48 SWOV (2006) Advancing Sustainable Safety. National Road Safety Outlook for 2005-2020. SWOV, Leidscham, 2006. http://www.swov.nl/rapport/dmdv/Advancing_sustainable_safety.pdf

49 For example in France: Certu (2009) Les bandes cyclables Fiche no. 2.

50 Presto-give cycling a push (2010). Factsheet on cycle lanes <http://www.presto-cycling.eu/images/factsheets/presto%20infrastructure%20fact%20sheet%20on%20cycle%20lanes.pdf>



Fig. 16 Marked cycle lane in Germany. Source: Planungsgemeinschaft Verkehr (PGV) and German Road Safety Council (DVR).

A focus on providing enough space for cyclists has been taken in Germany, whereby the appropriate width of cycling infrastructure, visible marking and the enforcement of parking regulations for motorised vehicles are combined with the advantages of the direct visual contact between road users provided by cycle lanes.⁵¹

Another possible problem which could pose high risks for cyclists who are using cycling lanes is 'dooring' whereby car parking is immediately adjacent to the cycle lane and collisions occur between cyclists and the open door of the parked car. In Germany, the ERA 2010 guidelines for the design of bicycle facilities propose to place the cycle track at a certain distance from the parking places, which would allow cyclists to be protected in the event a car door opens unexpectedly.⁵²

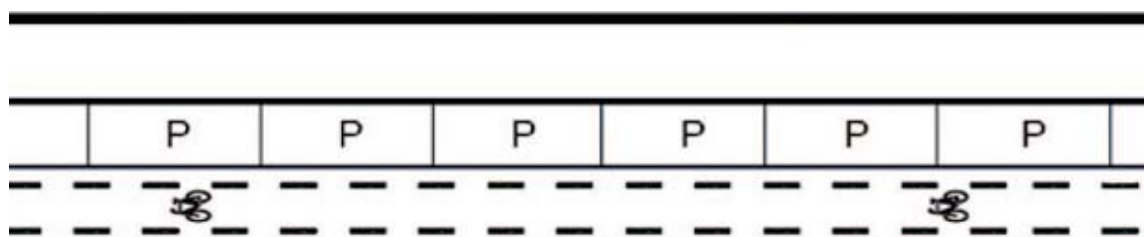


Fig. 17 Scheme of a cycle track adjacent to parking spaces. Source ERA 2010.

⁵¹ Cycling Expertise (2010) State of the Art Design for Cycling Facilities CyE Infrastructure factsheet CyE i-1 <http://www.nationaler-radverkehrsplan.de/en/transferstelle/downloads/cye-i-01.pdf>

⁵² Ibid.



Fig. 18 Cycle lane with protection space from the doors of cars which are parked adjacent to the lane. Source: Planungsgemeinschaft Verkehr (PGV) and German Road Safety Council (DVR).

Most often, the physical separation between motorised traffic and cyclists is made through the use of cycle tracks. Various guides for the design and building of cycling tracks have been developed in the European Union^{53,54} and three options are presented in a factsheet published in the framework of the EU-funded Presto project.⁵⁵

In France, cycling tracks are separated according to their proximity to the carriageway, into cycle tracks which are adjacent to the road and cycle tracks separated from the road. Moreover, the Certu look at various types of road-adjacent cycle tracks and provide examples of their implementation in France.⁵⁶ However, the fact sheet published by Certu in France highlights a particular problem which infrastructure designers and managers need to deal with when cycling tracks are provided. This refers to the re-entry of cyclists into the main flow of traffic following a road section where a cycle track was used.⁵⁷ The issue becomes most salient particularly when the re-entry into the traffic flow is coupled with negotiating a junction (also see section on junctions below). In several cases, Certu recommends that, in order to achieve a good level of conspicuity for cyclists and ensure that motorised road users and cyclists are aware of each other's presence on the road, the re-entry of cyclists into main traffic flow is done through the use of a cycle lane.⁵⁸

53 CROW (2006) Design Manual Bicycle Traffic.

54 Certu (2008) Recommandations pour les aménagements cyclables.

55 <http://www.presto-cycling.eu/images/factsheets/presto%20infrastructure%20fact%20sheet%20on%20cycle%20tracks.pdf>

56 Certu (2009) Les pistes cyclables Fiche no. 7.

57 Ibid.

58 Ibid.

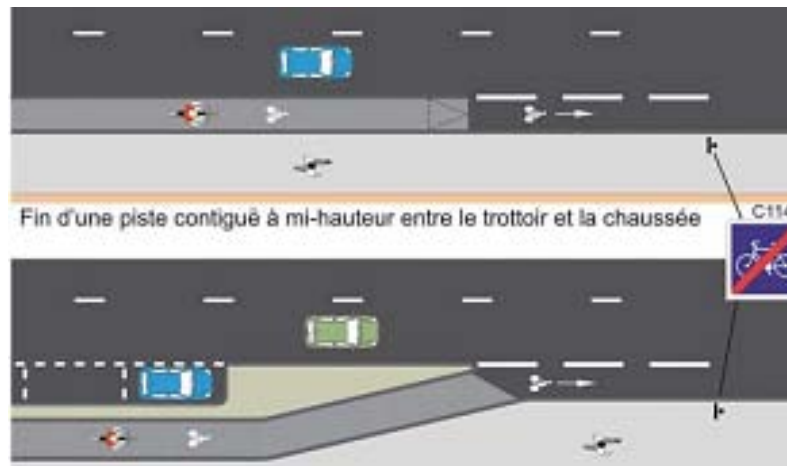


Fig. 19 Examples of re-entry into the main traffic flow after using a cycling track. Above: cycling track is elevated, at a level intermediary between the carriageway and the sidewalk. Below: cycling track is separated from the carriageway. Source: Certu.

Concern for visibility between road users has also been the focus in Germany, where particular attention has been paid to ensuring that cyclists are not obstructed from the view of motorists when they rejoin the main flow of traffic, and vice versa (see below). Particular attention has to be paid to mutual visibility in order to reap the safety benefits of the physical separation that cycle tracks offer.⁵⁹



Fig. 20 Protected re-entry of cyclists into the traffic flow in Germany. Source: Planungsgemeinschaft Verkehr (PGV) and German Road Safety Council (DVR).

While this approach of handling the re-entry of cyclists into the main traffic flow has the advantage of making cyclists visible, the lack of physical separation between them and motorised traffic exposes them as vulnerable road users. Thus, the concerns presented above on the use of cycle lanes apply. In particular, the speed of motorised traffic should be regulated so as to permit a safe mix of traffic (see also Table 3 on safe driving speeds).

For busy, narrow roads the Dutch Sustainable Safety also recommends the use of dual paths whereby cyclists and pedestrians share the same space on the footway with a visual separation which ensures that the higher speed of the cyclists does not lead to dangerous

⁵⁹ Cycling Expertise (2010) Cycling in Urban Main Streets CyE Infrastructure factsheet CyE i-2 <http://www.nationaler-radverkehrsplan.de/en/transferstelle/downloads/cye-i-02.pdf>

collisions with pedestrians (see below).⁶⁰ In Germany, the use of shared pedestrians and cyclists paths is recommended only in areas where the traffic density for both pedestrians and cyclists is low so as to reduce conflicts between them.⁶¹



Fig. 22 Common pedestrian and cycling path in Germany. Source: Planungsgemeinschaft Verkehr (PGV) and German Road Safety Council (DVR).

3.3 Intersections and road junctions

Of particular importance for the safety of cyclists are road junctions and intersections because of the inherent risk presented by the interaction with traffic coming from different directions. In the UK, a report published by the TRL reveals that, between 2005 and 2007, 63% of the collisions resulting in death or serious injury for cyclists occurred at junctions.⁶²

Lower speed limits should be introduced for junctions and intersections, as recommended in both the Netherlands (see table 3 above) and in the UK⁶³.

Side entry treatments for junctions, together with raised cycle crossings and improved signalisation of roundabouts, have been found to yield a reduction in cyclist casualties in the UK. The TRL recommends however that when traffic calming measures aimed at reducing the speed of motorised traffic are implemented, this should follow careful planning so they do not increase conflict between cyclists and other road users.⁶⁴ SWOV also suggests that the safety of crossings could be improved by the use of the UK 'Toucan' crossing ('two can cross'), which is a crossing that can be shared by both pedestrians and cyclists.

In Sweden, a study by Garder et.al. found a 33% reduction in collisions involving cyclists when these crossings were raised.⁶⁵ In this case, the raised intersection was used as a measure to reduce traffic speed in Gothenburg, Sweden.

60 SWOV (2006) Advancing Sustainable Safety. National Road Safety Outlook for 2005-2020. SWOV, Leidscham, 2006. http://www.swov.nl/rapport/dmdv/Advancing_sustainable_safety.pdf

61 Cycling Expertise (2010) State of the Art Design for Cycling Facilities CyE Infrastructure factsheet CyE i-1 <http://www.nationaler-radverkehrsplan.de/en/transferstelle/downloads/cye-i-01.pdf>

62 TRL (2010) Infrastructure and Cyclist Safety. Final Project Report PPR580.

63 TRL (2011). Infrastructure and Cyclist Safety <http://assets.dft.gov.uk/publications/infrastructure-and-cyclist-safety/infrastructure-and-cyclist-safety.pdf>

64 Ibid.

65 Gårder, P., Leden, L. & Pulkkinen, U. (1998). Measuring the safety effect of raised bicycle crossings using a new research methodology. In: Transportation Research Record 1636. Transportation Research Board, Washington D.C.

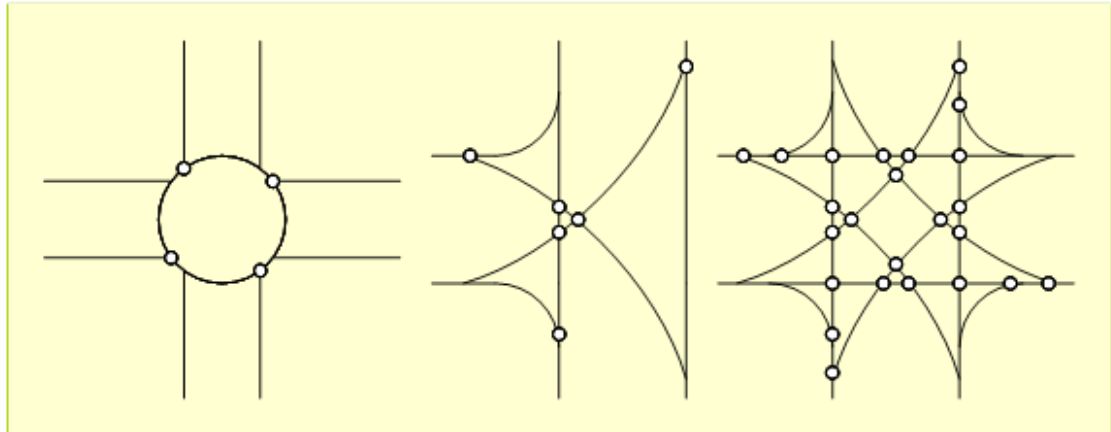


Fig. 23 Conflict points on a single lane roundabout, a three-arm junction and a four-arm junction. Source: SWOV.

A SWOV factsheet⁶⁶ looking at the types of junctions on Dutch roads indicates that, due to the reduced number of conflict points between traffic directions, roundabouts fit best within the purpose of Sustainable Safety, see figure above. The fact sheet also quotes research showing that roundabouts with separated cycle tracks are safer than those which do not have any cycling facilities, i.e. cyclists ride on the road without any facility, and than those featuring cycle lanes.⁶⁷ When roundabouts are considered for the treatment of junctions, the desired number of lanes of traffic should also be taken into account when identifying the conflict points between road users. The SWOV factsheet found that roundabouts with separate cycle tracks are safer if cyclists do not have the right of way over motorised traffic. The photo below shows a roundabout with separated cycle tracks in the town of Zwolle, the Netherlands.



Fig. 24 Roundabout in urban area in Zwolle, the Netherlands. Source: Fietsberaad.

66 SWOV (2010), Fact sheet Bicycle facilities on distributor roads. http://www.swov.nl/rapport/Factsheets/UK/FS_Junctions.pdf

67 Dijkstra (2005). Rotondes met vrijliggende fietspaden ook veilig voor fietsers? R-2004-14. SWOV, Leidschendam. <http://www.swov.nl/rapport/R-2004-14.pdf>

Changes in priority rules in intersections and roundabouts should be clearly explained to road users (see also Section 5 on training of road users) and when necessary they should also be complemented by raised exits alerting them of modified road situations (see also examples below from Germany and France).

In France, a set of objectives have been recommended to improve the safety of cyclists in all types of intersections:

- Allow a good level of visibility for both motorised road users and cyclists;
- Ensure that drivers correctly perceive the direction of cycling traffic in the intersection;
- Ensure that trajectories of road users are as direct as possible;
- Reduce the vehicles' speed, particularly in the case of turning vehicles, through small turning radii;
- Minimise the number and areas of possible conflict points;
- Avoid situations where cyclists successively have to yield priority.⁶⁸

In cases where a cycle track crosses a road section (i.e. not a junction per se), Certu also recommends that a middle island be placed between the two flows of traffic. In this case cyclists would cross the road section in two separate manoeuvres, while the users travelling on the road section would be alerted of the presence of cyclists (see figure below).

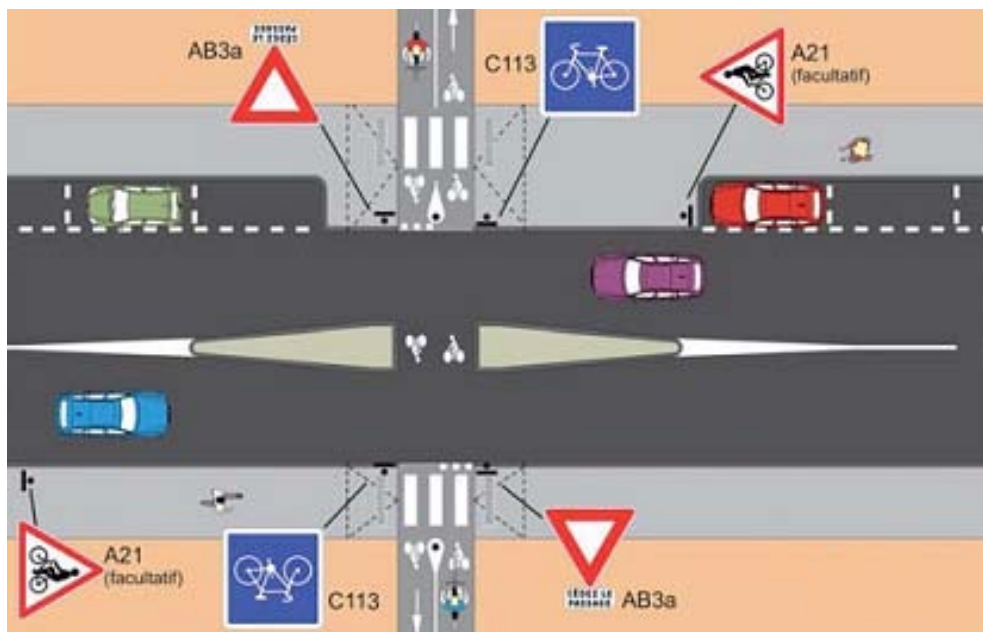


Fig. 25 Scheme of a cycle track which crosses a road section. Source Certu.⁶⁹

In Germany, the work to improve the safety of cyclists has been focused around a set of risk factors affecting cyclists, with the measures and policies that were put in place being aimed at reducing or eliminating these risk factors. Among these factors are:

- Cycling infrastructure which is either of poor quality or poorly adapted to the needs of cyclists;
- Junctions and intersections, where potential conflicts with other road users might occur;
- Inappropriate traffic behaviour from either cyclists or other road users and lack of mutual understanding between types of road users (see more in Section 5 below).

68 Certu (2009) Les pistes cyclables Fiche no. 7.

69 Ibid.



Fig. 26 Intersection between a bicycle path adjacent to a priority road and a minor road in Germany. Source: Planungsgemeinschaft Verkehr (PGV) and German Road Safety Council (DVR).

Several examples from Germany (see above) show the use of speed humps and road elevation, together with varying pavement colours at junctions to alert drivers of the existence and priority status of cyclists on the road.

Another infrastructural measure which is increasingly being used in the treatment of junctions is the Advanced Stop Line (ASL) which makes cars stop earlier at traffic lights and allow cyclists to use the remaining space, now free of cars. The goal of ASLs is primarily to allow cyclists a smoother and safer crossing of intersections by placing cyclists directly in the drivers' direct field of vision. The French guidelines for ASLs particularly look at how they are useful when cyclists need to turn left (far-side turn) in an intersection. The proposed depth of the ASLs is between 3 and 5 metres.

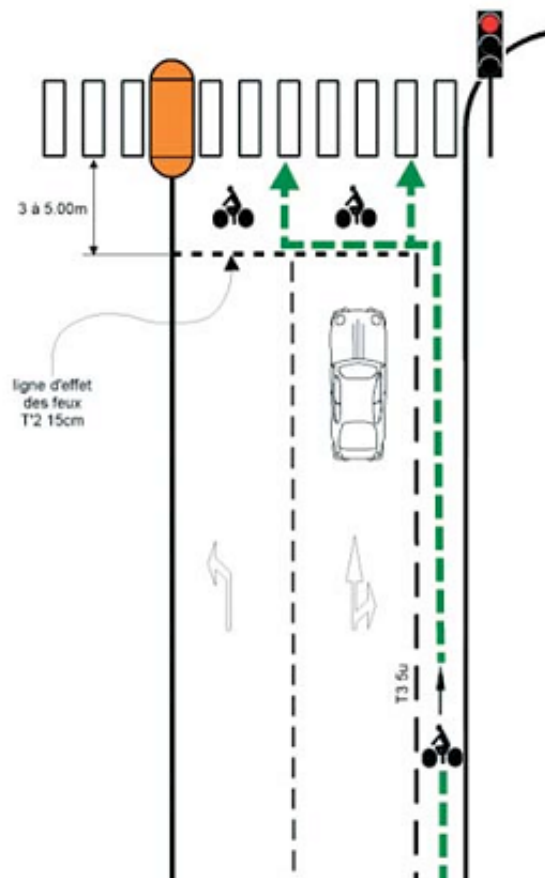


Fig. 27 Scheme of an Advanced Stop Line. Source: Certu.⁷⁰

Infrastructural developments to benefit the safe cycling could also benefit from existing EU legislation. Directive 2008/96/EC on road infrastructure safety management mandates the use of four already existing procedures for all roads which are part of the Trans-European Road Network:⁷¹

- Road safety impact assessments: demonstrate the road safety implications of different planning alternatives for a road project, whether construction of new infrastructure or rehabilitation of existing infrastructure, as in the case of environmental impact assessment;
- Road safety audits: an independent technical check aiming at identifying unsafe features of a road project, including proposals for remedy;
- Network safety management targeting remedial measures to parts of the network with high concentrations of accidents (high-risk road sections) and/or a high potential to avoid accidents in the future.
- Safety inspections: as part of regular road maintenance, enable the detection and hence reduction of accident risk in a preventive way through low cost measures.

If the requirements of Directive 2008/96/EC were extended beyond the roads included in the TEN-T network the use of the four instruments should enable road designers and planners to identify the need to design road infrastructure that is safe for cyclists. In its Road Safety Policy Orientations 2011-2020, the European Commission has committed to making sure that, when road infrastructure projects are co-funded with EU money, the requirements

⁷⁰ Certu (2009) Les sas à vélos Fiche no. 11.

⁷¹ Directive 2008/96/EC of 19 November 2008 on road infrastructure safety management <http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=CELEX:32008L0096:EN:NOT>

of the infrastructure safety and tunnel safety directives are met.⁷² ETSC welcomed this development and, in the context of the negotiations for the EU Multi-Annual Financial Framework, asked the European Parliament and the Council of Ministers to ensure that EU funds are used to build safe road infrastructure, regardless of whether it is part of the Trans-European Road Network or not.⁷³

As highlighted at the beginning of this section, infrastructure should not be viewed as a 'silver bullet' that would on its own solve all the issues which are currently associated with the safety of cyclists. The following two sections of this paper will look at how the safety of cycling can be improved through measures targeted at the vehicles, whether motorised or bicycles (Part 4), and through measures targeted at the behaviour of road users themselves (Part 5).

4. Vehicles

4.1 Motorised vehicles

4.1.1 Passenger cars

As collisions with motorised vehicles account for an overwhelming percentage of the number of collisions that lead to cyclist deaths, this paper will now look into ways in which technological developments can be a way of improving the safety of cyclists.

As detailed in the previous section, differences in speed, traffic volume and differences in mass between motorised traffic and cyclist traffic can lead to a road environment which is unsafe for cyclists. Managing the speed of motorised traffic can as such have a positive effect in improving the safety of cycling. While road infrastructure measures can play an important role in managing the speed of (motorised) traffic, e.g. speed humps, chicanes, there is an important case to be made for complementing these with in-vehicle technologies and vehicle design.

ISA

Research has shown that the use of in-vehicle technologies to manage speed, primarily in the form of Intelligent Speed Assistance, has a positive effect in improving road safety.⁷⁴ In vehicle monitoring can also pick up other driver behaviour such as aggressive accelerating which is often more intimidating for cyclists. In addition to the further road safety benefits that can be brought about by their implementation, a rollout of ISA systems could make a significant improvement in the safety of cyclists, particularly due to their position as vulnerable road users. As seen in Table 3 above, the safe speed limits for road junctions and intersections are generally lower than those on the corresponding road sections. If the posted speed limits follow the recommended values in table 3, then there is a possibility that actual driving speed exceeds these limits. A large scale rollout of ISA could prevent such unsafe behaviour from drivers and contribute to reducing the probability of collisions resulting in deaths and serious injuries, for cyclists as well as other road users. A study commissioned by the Directorate General for Mobility and Transport in the European Commission in the framework of the Intelligent Transport Systems Action Plan concludes that ISA would have a significant effect in improving the safety and comfort of vulnerable road users, including cyclists, particularly when travelling in urban settings.⁷⁵

⁷² European Commission, Policy Orientations on road safety 2011-2020, Objective 3, p. 7.

⁷³ ETSC (2012) EU Funds for Road Safety http://www.etsc.eu/documents/EU%20Funds%20for%20Road%20Safety_April_for%20MEPs.pdf

⁷⁴ Carsten (2012) Is intelligent speed adaptation ready for deployment? Editorial. Accident Analysis and Prevention 48 (2012)1-3.

⁷⁵ Eisses (2011) Safety and comfort of the Vulnerable Road User ITS Action Plan Framework Service Contract TREN/G4/FV-2008/475/01 http://ec.europa.eu/transport/themes/its/studies/doc/2011_05-safety-and-comfort-vulnerable-road-user.pdf

ISA

ISA can be configured in three variants depending on the desired level of intervention with the driver's speed control: advisory/warning, intervening with the possibility to override and intervening without the possibility to override.⁷⁶ According to research from the UK, the predicted benefits of implementing a non-overrideable ISA system amount to a 29% reduction in the total number of injury collisions.⁷⁷

The main requirement for the large-scale deployment of ISA is the availability of up-to-date maps detailing the prevailing speed limits on the road network, while, on the technological side, speed limiters (set by the driver) are available on many new vehicles.⁷⁸ Moreover, the life-saving benefits of this technology have to be communicated effectively to the road users in order to increase its social acceptability.

The European Commission, both in the 2011 White Paper on Transport⁷⁹ and the 2010 Road Safety Policy Orientations,⁸⁰ has identified 'in-vehicle systems providing real-time information on prevailing speed limits' as contributing to speed enforcement. ETSC would like to see more action leading towards a large-scale deployment of ISA, as noted in its response to the European Commission's Policy Orientations.⁸¹

Moreover, the Intelligent Transport Systems (ITS) Directive and Action Plan, adopted by the EU in 2008 and 2010 respectively, provide the legal framework to deploy ISA, particularly as they lay down the procedures for providing accurate public data for digital maps.

ETSC calls on the European Commission and the Member States to prioritise the large-scale deployment of Intelligent Speed Adaptation as a measure to improve road safety in general, as well as the safety of cyclists.

Safe car fronts

In cases where collisions between cyclists and motorised traffic cannot be avoided, vehicles play an important role in reducing the severity of the collision. In most of the collisions involving cyclists and a passenger car, the impact occurs between the cyclist and the front of the vehicle, making this area of the car of particular importance to improve the safety of cyclists. Requirements for pedestrian-friendly car fronts take into account shock absorbing areas where the pedestrian's head would hit the car bonnet in the event of a crash. However, the elevated riding position of a cyclist, compared with a pedestrian, results in a different area of a bonnet being hit by the cyclist's head in the event of a crash, and as such car fronts that deliver positive safety benefits for pedestrians may be ineffective in the case of cyclists.

76 Lai, F., Carsten, O., Tate, F., (2012). How much benefit does Intelligent Speed Adaptation deliver? an analysis of its potential contribution to safety and environment. *Accident Analysis and Prevention* 48, 63–72.

77 Carsten (2012) Is intelligent speed adaptation ready for deployment? Editorial. *Accident Analysis and Prevention* 48, 1-3.

78 Ibid.

79 <http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=COM:2011:0144:FIN:EN:PDF>

80 European Commission (2010) Towards a European Road Safety Area: policy orientations on road safety 2011-2020, COM (2010) 389.

81 ETSC (2010) ETSC Response to the EC Communication "Towards a European Road Safety Area: Policy Orientations on Road Safety 2011-2020" <http://www.etsc.eu/documents/ETSC%20Response%20to%20EC%20Communication%2022%20Sept%202010.pdf>

The technical requirements for the construction and functioning of vehicles and frontal protection systems in order to reduce the number and severity of injuries to pedestrians and other vulnerable road users who are hit by the fronts of those vehicles are laid down in the new Regulation on pedestrian protection. This replaces Directive 2003/102/EC on the protection of pedestrians in the event of a collision with a motor vehicle. It also replaces Directive 2005/66/EC related to the use of frontal protection systems on motor vehicles. Passive safety requirements (vehicle design) and also active safety measures such as Brake Assist System (BAS) are included in this Regulation. ETSC argued against the relaxation of tests on safer car fronts, maintaining that the benefits offered by collisions avoidance technologies should have been additional rather than substitutive.⁸²

Airbag for cyclists

The SaveCAP project identified several ITS measures that can deliver safety benefits for both cyclists and pedestrians. The most promising of these are the creation of a special external airbag and the introduction of automated braking systems in cars.⁸³

The special airbag proposed covers the lower part of the windshield, as well as the windshield-adjacent sides of the car. The car would have a camera which detects pedestrians and cyclists, as well as crash sensors in the bumper. The combination of the two would trigger the airbag.

Braking Systems

The Regulation 78/2009 lays down type approval requirements with respect to the protection of pedestrians and other vulnerable road users. It provides for the mandatory installation of Brake Assist Systems on new vehicles in an attempt to compensate for the relaxation of certain parameters on passive safety performance tests. Automated braking systems are also becoming part of new legislation under Vehicle Safety Type Approval, but only for certain types of vehicles.⁸⁴ European New Car Assessment Programme (EuroNCAP) is also including them in their safety ratings.⁸⁵ The further developments of such systems should also take into account cyclists and must ensure that the system is effective in preventing collisions with cyclists.

ITS for VRUs

The EU's ITS Directive cites "The definition of the necessary measures to improve the safety and comfort of vulnerable road users for all relevant ITS applications." The Action Plan includes the development of best practice guidelines concerning the impact of ITS applications and services on the safety and comfort of Vulnerable Road Users (VRUs). To date few ITS applications have been designed for vulnerable road users (see below Safe Cycle project).

The incipient development of car-to-car communication networks could be seen as an opportunity to also improve in-vehicle systems that detect and alert drivers of the cyclists' presence in traffic. Specifically, forward and rear collision warning systems and auto brake systems which detect vulnerable road users up ahead and inform the driver or intervene in case of no reaction should be singled out as a priority.

⁸² ETSC (2012) ETSC Contribution to the CARS 21 WP1 on Road Safety http://www.etsc.eu/documents/CARS%2021_WP%201_ETSC%20Contribution%2015%20Feb%202012.pdf

⁸³ More information is available on the SaveCAP project website www.savecap.org, as well as at http://www.tno.nl/content.cfm?Taal=2&content=prop_case&context=thema&item_id=1199&laag1=894&laag2=914&laag3=104

⁸⁴ Regulation 2009/661/EC concerning type-approval requirements for the general safety of motor vehicles: <http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2009:200:0001:0024:EN:PDF>

⁸⁵ More information available at www.euroncap.com

ETSC calls on the European Commission to use the provisions of the ITS Directive and the ITS Action plan as levers to spur innovation into how ITS applications can be developed and adapted to improve the safety of cyclists.

4.1.2 Goods vehicles

Road traffic collisions involving Heavy Goods Vehicles (HGVs) tend to be more severe than other collisions because of the vehicles' size and mass. The rate of death of HGV drivers in road crashes is lower than for other groups of road users, but they impose substantial risks on them. The number of injured people in collisions involving HGVs is about half the number of deaths, reflecting their relatively high fatality.⁸⁶

Blind spot reduction for heavy goods vehicles

Their larger size implies that vehicles designed for the carriage of goods or passengers allow for a reduced field of direct vision. As pedestrians and cyclists are among the road users which occupy the smallest amounts of road space, they are particularly sensitive to being involved in collisions where the other road users simply do not see them on the road, also known as blind-spot crashes. Data from London, UK, shows that approximately half of the cyclist deaths occur in collisions with HGVs.⁸⁷ To counter part of this problem, European level legislation has been adopted to reduce the blind-spot areas around large road vehicles.⁸⁸ The EC also commissioned a study on the implementation of the retro-fitting Directive and issued its report on the implementation of the legislation.⁸⁹ The study, conducted by the TRL, found that while the number of vulnerable road users killed in collisions with HGVs has declined sharply after the adoption of Directive 2007/38/EC, this fall cannot be fully attributable to the implementation of the Directive. Moreover, the study notes that while the Directive provides a basis for reducing blind-spot collisions with HGVs, several other measures not included in the legislative text can also provide benefits in reducing the number of such collisions.⁹⁰

86 ETSC (2011) Tackling Fatigue: EU Social Rules and Heavy Goods Vehicle Drivers. Preventing Road Accidents and Injuries for the Safety of Employees (PRAISE) Thematic Report 7 http://etsc.eu/documents/Report7_final.pdf

87 Transport for London http://www.tfl.gov.uk/microsites/freight/hgvs_and_road_safety.aspx

88 EC Directive 2003/97/EC on the fitting of blind-spot mirrors on new vehicles and Directive 2007/38/EC on retro-fitting mirrors to heavy goods vehicles.

89 More information is available at http://ec.europa.eu/transport/road_safety/topics/vehicles/blind_spot_mirrors/index_en.htm

90 TRL (2011) A study of the implementation of Directive 2007/38/EC on the retrofitting of blind spot mirrors to HGVs http://ec.europa.eu/transport/road_safety/pdf/retrofitting_mirrors.pdf

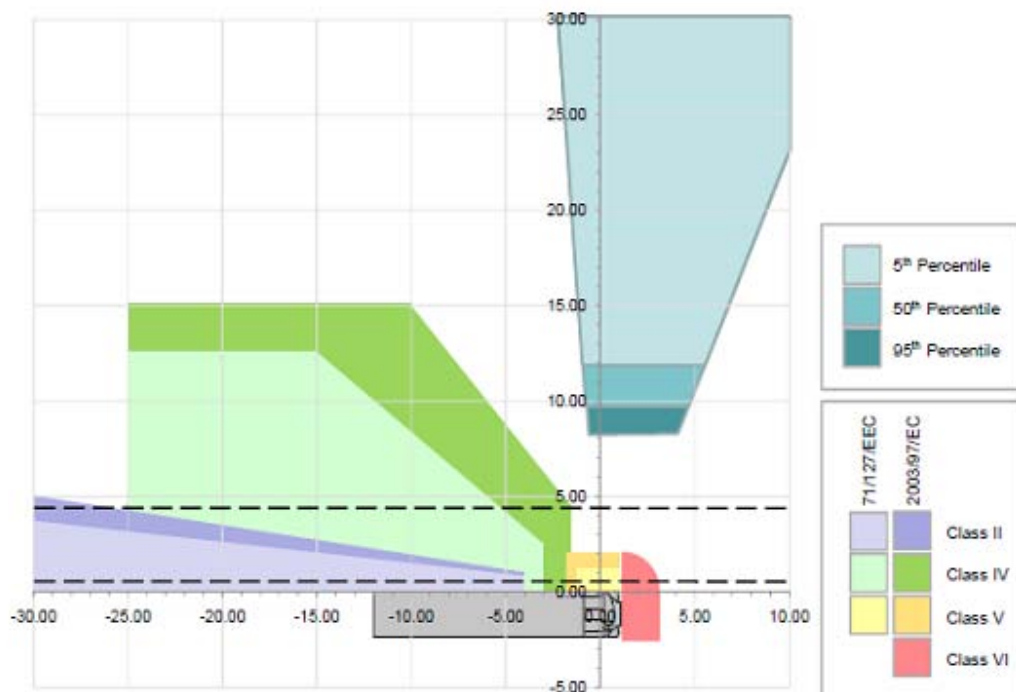


Fig. 28 Field of vision from a typical articulated truck (Renault Magnum) from direct field of vision and mandatory mirrors. Source: TRL, reproducing Dodd, 2009.

The TRL study identifies a wide range of measures available, or still being developed, which can further reduce the number of cyclist deaths occurring in collisions with near-side turning HGVs: extending the indirect field of vision through mirrors, alternative devices, e.g. Fresnel lenses or cameras, or roadside mirrors; improving the direct field of vision or the fitment of sensors and collision warning systems.⁹¹

As a measure to improve the safety of cyclists, Transport for London started promoting the use of Fresnel lenses, distributing 20,000 of them in 2008 and 5,000 were given to vehicles working on the Olympic site in London.⁹² Transport for London also asks that all drivers working on or delivering goods to its sites across the city have undertaken specialised training on interacting with cyclists and other vulnerable road users within an urban environment. Public procurement rules are also used to ensure these requirements are met.



View from driver's seat (right-hand side) of cyclist on the nearside of the lorry. Fresnel lens and side mirror. Source: TfL

⁹¹ Ibid.

⁹² Transport for London http://www.tfl.gov.uk/microsites/freight/hgvs_and_road_safety.aspx

Sensors and warning systems that would detect the presence of a cyclist or pedestrian in the HGV blind spot area and alert the road users of the possible danger are an area where more research would be needed. These systems are currently not mature enough to be rolled-out on a large scale, as shown by the TRL study.⁹³ TRL note that even after the running of the PREVENT⁹⁴ and Intersafe 2⁹⁵ European projects, Volvo, one of the partners involved in Intersafe 2, says that more work needs to be done in order to successfully identify vulnerable road users before moving to a production version.⁹⁶

The Belgian Road Safety Institute has also ran field tests with two warning systems, Lexguard and Lisa-2-alert, but they warn that more work needs to be done before the systems could be adapted to a large-scale rollout.⁹⁷ The Lisa-2-alert is an exterior system that alerts cyclists of an impending near-side turn by the HGV through the use of audible warnings. Despite an initially positive attitude from the cyclists (before the field tests), the results were inconclusive. The cyclists in the field tests reported they could not always perceive the warning coming from the Lisa-2-alert, but the system did not provoke panicked reactions, as was feared before the tests. However, by not perceiving the alert, several of the cyclists involved continued acting as if they had not been alerted.⁹⁸

ETSC recommends further research into the effectiveness of measures to reduce blind spot-areas around HGVs and to alert road users of impending near-side turning collisions, with the goal of achieving the highest safety levels for cyclists.

Moreover, preventing blind spot collisions at junctions with traffic lights can also be achieved by infrastructural measures aiming at separating bike traffic and HGV traffic. This can be done either by setting specific green light times (traffic lights regulation without conflict) or through physical separation of the types of road users. Such measures are detailed in a recent study of blind-spot collisions published by the Belgian Road Safety Institute⁹⁹.

Underrun protection currently also represents a problem for cyclists as well as other vulnerable road users when they travel on the near-side of HGVs or large buses or coaches. The TRL study quotes Cookson and Knight (2010) research findings that conclude sideguards are not sufficiently effective in reducing cyclist deaths in near-side turning.¹⁰⁰ The current requirements for side underrun protection permit the use of an 'open frame' (i.e. two side-planks with a maximum distance between them of 30 cm) which in some circumstances does not prevent the vulnerable road user from being run over.

Moreover, requirements for front and rear underrun protection systems on HGVs should be updated to take account of recent research. Such improvements would significantly contribute not only to improving the safety of the HGVs themselves, but also reduce the number and severity of injuries suffered by road users entering collisions with HGVs.

93 TRL (2011) A study of the implementation of Directive 2007/38/EC on the retrofitting of blind spot mirrors to HGVs http://ec.europa.eu/transport/road_safety/pdf/retrofitting_mirrors.pdf

94 http://www.prevent-ip.org/en/prevent_subprojects/vulnerable_road_users_collision_mitigation/usercams/

95 <http://www.intersafe-2.eu/public/>

96 TRL (2011) A study of the implementation of Directive 2007/38/EC on the retrofitting of blind spot mirrors to HGVs http://ec.europa.eu/transport/road_safety/pdf/retrofitting_mirrors.pdf

97 IBSR (2011) Etude de l'Efficacité des systèmes techniques anti angle mort

98 Ibid.

99 Sloodmans, F., Populer, M., Silverans P. & Cloetens, J. (2012). Blind Spot Accident Causation (BLAC). Multidisciplinair onderzoek naar ongevallen met vrachtwagens en zwakke weggebruikers in Oost- en West-Vlaanderen. Brussel, België: Belgisch Instituut voor de Verkeersveiligheid – Kenniscentrum Verkeersveiligheid.

100 TRL (2011) A study of the implementation of Directive 2007/38/EC on the retrofitting of blind spot mirrors to HGVs http://ec.europa.eu/transport/road_safety/pdf/retrofitting_mirrors.pdf

In the framework of the CARS 21 process, ETSC recommended to:

*Introduce energy absorbing front underrun protection for all new heavy goods vehicles.
Ensure that side protection closes off the open space between the wheels of all new heavy goods vehicles and increase current strength requirement to accommodate side collisions with motorcycles.*

Improve rear underrun protection systems with a lower ground clearance as well as higher test forces.¹⁰¹

4.2 Bicycles

Standards for maintenance of bicycles, including lights

As they are vehicles with the right to participate in the traffic systems, bicycles should also be in good condition. The mechanical parts required for the drive train, i.e. wheels, pedals, chain, as well as braking and devices ensuring the conspicuity of the bicycle should all be in a good condition, so they do not prevent the cyclist from safely performing the riding task. It may be self-evident, but an important point nevertheless is that cycling requires a complex combination of balancing the vehicle, coupled with managing the speed of the vehicle, as well as acknowledging and reacting to traffic situations. Due to the specific cognitive requirements of the cycling task, it is important that the vehicle is in a good running condition that does not hamper the cyclist from focusing their attention on the task of interacting with traffic. The German Cycling Plan, covering the period 2002-2012, also takes note of the importance of the technical safety of cycles, which is indispensable for safe cycling.¹⁰² While other road vehicles in the EU are subject to type-approval legislation, such rules are not in force for cycles, due to the nature of the vehicle, whereby parts can be interchanged. However, a level of consumer protection for bicycle components is ensured through EU Directive 2001/95/EC and CEN (minimum) standards are applicable for bicycles. A list of the applicable standards is provided in the 2011 DEKRA report on the safety of pedestrians and cyclists.¹⁰³ It is noted, however, that the standards do not cover bicycle lighting systems (neither passive nor active) and they provide minimum requirements which could be superseded by more stringent national regulations.

The regulations in force in Germany related to the lighting equipment for bicycles are presented below.



Fig. 29 Prescribed equipment for safer all-around lighting. Source: ADFC Germany.

101 ETSC (2012) ETSC Contribution to CARS 21 work package on road safety http://www.etsc.eu/documents/CARS%2021_WP%201_ETSC%20Contribution%2015%20Feb%202012.pdf

102 Federal Ministry of Transport, Building and Housing (2002). National Cycling Plan 2002-2012 Ride your bike! Measures to promote cycling in Germany <http://www.nationaler-radverkehrsplan.de/en/>

103 DEKRA (2011) Road Safety Report 2011: Pedestrians and Cyclists. p. 51.

ETSC recommends that the lighting systems of bicycles ensure the highest level of conspicuity for the riders, thus making them visible for other traffic road users.

In terms of the brakes used on bicycles, the German cycle plan mentions the importance of updating technical regulations related to their performance to the latest available technology.¹⁰⁴ The DEKRA report goes further in recommending the use of brakes which apply their force progressively, thus reducing the possibility of the cyclist violently applying the brakes and crashing.¹⁰⁵

ETSC recommends that the braking system, and the bicycle's drive train more generally, is kept in good condition so as to ensure rider's highest level of safety and comfort available. The mechanical parts of the bicycle should function in such a way that the rider's attention can be fully focused on interacting with traffic.

Helmets and reflective equipment

While neither helmets nor cycling clothing are an effective part of the bicycle, they are a part of the way in which cyclists are noticed by the other traffic participants. Cycle helmets are designed to protect the cyclist's head and skull in the event of a crash, while reflective gear is closely associated with the conspicuity debate which was looked at above.

Country	Reflective jacket	Helmet
Austria	No	For children under 12
Belgium	Recommended	Recommended
Bulgaria	No	No
Cyprus	No	No
Czech Republic	Recommended	Mandatory under 18, recommended for other cyclists
Denmark	No	No
Estonia	n/a	Mandatory under 16, recommended for other cyclists
Finland	No	Mandatory
France	Outside urban areas at night or when visibility is poor	No
Germany	No	No
Greece	No	No
Hungary	Outside built-up areas at night or when visibility is poor	No
Ireland	No	No
Italy	Outside urban areas and in cases of poor visibility	No

104 Federal Ministry of Transport, Building and Housing (2002). National Cycling Plan 2002-2012 Ride your bike! Measures to promote cycling in Germany <http://www.nationaler-radverkehrsplan.de/en/>
 105 DEKRA (2011) Road Safety Report 2011: Pedestrians and Cyclists.

Country	Reflective	Helmet
Latvia	Recommended	Recommended
Lithuania	At night and when visibility is poor	Mandatory under 18, recommended for other cyclists
Luxembourg	No	No
Malta	At night	Recommended
The Netherlands	No	Recommended
Norway	No	No
Poland	No	No
Portugal	No	No
Romania	No	Recommended
Slovakia	When visibility is reduced	Mandatory under 15, mandatory outside urban areas for cyclists over 15
Slovenia	No	Mandatory
Spain	No	Outside urban areas and not compulsory in high temperatures and on long upward slopes
Sweden	No	Mandatory under 15
Switzerland	No	No
United Kingdom	No	No

Table 5. Requirements for cyclists wearing helmets and reflective equipment. Source: European Commission¹⁰⁶

Cycle helmets are designed to protect the cyclist's head in case of a collision and they have to conform with international standards which prescribe the protection they need to offer. However, as noted by Walker (2005), the helmets are primarily designed to protect the cyclists in case of falls at speeds below 20km/h without any other vehicle involved. The tests cycle helmets go through mean, according to Walker, that they offer the protection similar to that offered to a pedestrian tripping and falling on the pavement.¹⁰⁷ Moreover, he notes that the testing procedure involves a vertical drop of the helmet – filled with a head form – over three types of anvils, which hardly replicates real-life collision settings. Walker also shows that the standard currently in use for the EU, EN1078, is less stringent than the Snell B-90 and Snell B-95 standards that were applied in the UK during the 1990s.¹⁰⁸ As such, the helmets currently on the market in Europe could in fact provide more protection to cyclists.

ETSC recommends that standards for testing bicycle helmets are revised to offer high levels of protection. Moreover, research should be undertaken into designing helmets to protect the cyclist in a real world environment.

106 http://ec.europa.eu/transport/road_safety/going_abroad/index_en.htm

107 Walker, B.(2005) Heads Up <http://www.cyclehelmets.org/papers/c2023.pdf>

108 Ibid.

The EU-funded Safe Cycle project evaluated several devices or systems which are innovative in their attempt to increase cycling safety, but they have yet to become known to the public at large. The project¹⁰⁹ evaluated such devices using a SWOT analysis of the relevant features. Thirty applications were reviewed including, for example, providing correct information on the safest route, avoiding red light offences, bicycle detection by vehicles or blind spot signalling for trucks.

Electrically-assisted cycles

Pedelecs are a type of bicycle where the cyclist's pedalling power is supported by an electric battery-powered engine, primarily designed to aid the rider when starting to ride or when cycling uphill. The EU legislation currently in force provides limits on the power and speed provided by the electrical assist in order for the vehicle to still be considered a bicycle. The maximum power is of 0.25 KW and the assistance has to be cut off when the cycle reaches a speed of 25 km/h, as reaffirmed by the recently-approved regulation on the type approval and market surveillance of L-category vehicles.¹¹⁰ The German Road Safety Council recommends differentiating between pedelecs and 'light electric mopeds' which are pedelecs with a higher power electrical engine. For example, the 'light moped' category of vehicles has been created in the Netherlands (pedal cycles with combustion engine assist, also known as bromfiets) with special traffic rules on the settings in which these can mix with cycle traffic. Moreover, in Germany it is also recommended that an expected increase in the market penetration of pedelecs is taken into account in the planning of new cycling infrastructure, so minimum width dimensions are to be avoided (see Section 3 above).¹¹¹

ETSC recommends that further research is undertaken to impede users from tampering the electric motor of a pedelec to increase its performance above the maximum allowed requirements.

As also mentioned at the end of the previous section, improvements to the vehicles on the roads have to be considered as part of the policy mix that is needed to improve road safety in general, and that of cyclists in particular.

5. Road User Behaviour

The infrastructure and vehicle developments presented in the sections above can only be fully effective if they are also supplemented by correct user behaviour on the roads. Integrating cycling into the traffic system hence requires that motorised road users act in a way which cyclists can predict and react to safely, and vice versa. Such behaviour can be achieved through an optimal combination of education on safe road use, as well as enforcement of traffic rules.

5.1 Cyclists

While cyclists do not need a license to travel on the public roads, it is important that they have at least a minimum of traffic education. The knowledge of road signs and signals is necessary if cyclists are to correctly assess and predict traffic situations, as well as the behaviour of other road users. On the other hand, the knowledge of the traffic code can help cyclists assert their role in the traffic system, and prevent other users from treating them as 'second class' traffic participants.

109 www.safecycle.eu.

110 <http://www.europarl.europa.eu/sides/getDoc.do?type=TA&language=EN&reference=P7-TA-2012-424>

111 Cycling Expertise (2010) State of the Art Design for Cycling Facilities CyE Infrastructure factsheet CyE i-1 <http://www.nationaler-radverkehrsplan.de/en/transferstelle/downloads/cye-i-01.pdf>

Training courses are provided by local, as well as central authorities throughout the EU, with abundant examples of education and awareness raising campaigns from several Member States. Most often such campaigns have a dual objective of improving the road skills of existing cyclists and promoting cycling to people who do not cycle often. Such campaigns are largely based on the premise that most people know how to ride a bicycle but do not view cycling as a transport mode and attach only recreational value to it.

Direct Cycling Support in the borough of Ealing, London

Apart from infrastructural changes, a focus of the work in Ealing is cultural change to increase the level of cycling. 'Cultural change' aims to produce an increase in the number of people cycling, seeing this as a vital part of increasing the safety of cyclists. In 2012 the Direct Cycling Support programme received a 'Best Cycling Achievements' Award during the National Transport Awards, as well as several other recommendations and distinctions.¹¹²

Rücksicht im Straßenverkehr - courtesy in traffic campaign in Germany

A campaign promoting courtesy among different types of road users, sponsored and supported by the Federal Ministry of Transport, Housing and Urban Development. With pilot campaigns in Berlin and Freiburg, the goals of the campaign are promoting courtesy on the road in the context of a rise of the rate of cycling in Germany, improving road users' attitudes towards cyclists and reducing the number of collisions involving cyclists.



More information on <http://www.rücksicht-im-strassenverkehr.de/>

112 More information at <http://www.tfl.gov.uk/corporate/media/newscentre/metro/26036.aspx>. A report describing the Ealing borough Direct Cycling Support programme is available at http://1e3de8be9eb9f6172fd3-fbec1a74094b5b5567335038623e5584.r36.cf2.rackcdn.com/Direct_Support_for_cycling_LBE.pdf

Life Cycle project

The goal of this three-year project was to change sedentary life habits by increasing the level of physical activity in people's daily routine. An intervention manual was created, which looks at methods to introduce a life-long approach to cycling. Actions were undertaken in Austria, Belgium, Liechtenstein, Germany, Poland, Portugal, Slovenia and the UK.

More information on www.lifecycle.cc.

Bike Experience programme

Organised once per year, the 'Bike Experience' programme in Belgium works as a peer-to-peer training course where 'novice' cyclists are paired with experienced ones to ride to work every day for a certain period of time, thus improving both their riding skills and their confidence in traffic.

More information on www.bikeexperience.be.

Bikeability scheme

The Bikeability scheme in the UK is a programme aimed at improving the skills of cyclists at all ages. Organised in three levels of difficulty, children can start with the programme once they have learnt how to ride a bike and move to the second level around the age of 10-11. The third level is open to secondary school pupils (11-18 years old). Those following the programme are motivated throughout and children are motivated to progress through all levels. Moreover, Bikeability training is provided through the education system.

Training for adults can also be provided, with adults starting the programme at a level that matches their current cycling skills and they can progress, build confidence to ride a bicycle in real-world traffic conditions and get advanced riding skills. Several local authorities in the UK fully or partially subsidise Bikeability courses for residents.¹¹³

113 More information available at <http://www.dft.gov.uk/bikeability/>

Cycling certificates and the Great Cycling Exam

Cycling certificates and the Great Cycling Exam in Flanders, Belgium, are issued by the Flemish Foundation for Traffic Knowledge (VSV) to pupils in elementary schools.⁸ Certificates are issued for beginner cyclists, intermediate cyclists and also to all children who take part in the Great Cycling Exam. The training sessions for children are organised in a school setting and the VSV provides a package of tools aiding them to organise the cycling skills test for the Cycling Exam. The five basic skill requirements for passing the Great Bicycle Exam are:

- Riding right on the road.
- Turning right on the road.
- Turning left on the road.
- Avoiding an object on the road.
- Yielding priority on a crossroads with no traffic signs.

The VSV asks schools to ensure the safety of the setting for the exam and use checkpoints manned by teachers to create a controlled road environment. Children who do not pass the Great Cycling Exam are also given certificates showing any errors committed and recommendations for improvements.



Do the right mix

The three-year campaign managed by the DG Mobility and Transport in the European Commission is targeted at sustainable urban mobility campaigners, as well as those who are new to the topic and its main objective is to promote the advantages of combining different modes of transport. An annual competition is organised where cities across the EU, Norway, Liechtenstein, Iceland and Croatia formulate and submit Sustainable Urban Mobility Plans (SUMP). The entries are judged on the quality of the development and implementation of the SUMP and the winners receive an Award recognising their efforts.

More information on <http://dotherightmix.eu/>

Moreover, cycling clubs and organisations take the lead in providing their members with training materials to explain safe behaviour in certain traffic situations. The Belgian organisation Gracq launched a series of videos which explain safe behaviour on contraflow one-way streets, in roundabouts, avoiding blind-spot crashes with HGVs. The videos are available at <http://www.gracq.be/CAPSULES/Accueil>.

Campaigns also focus on cyclists' conspicuity at night. In the Netherlands, the multi-annual Campaigns Road Safety focused, among others, on the use of bicycle lights at night.¹¹⁵ In the university town of Leuven, Belgium, the local police have widely-publicised enforcement nights when they check that bicycles comply with the national rules that make use of bicycle lights at night compulsory. Fines for riding at night without lights are 50 EUR.

In terms of the conspicuity of cyclists, campaigns can also focus on wearing reflective and high-visibility gear at night. The European Parliament called "on the Commission to submit a proposal laying down minimum requirements in respect of lights and reflective devices which must be met by bicycle manufacturers."¹¹⁶

While the use of any specific gear, or type of gear, should not be mandatory, certain requirements for visibility during the night would improve the conspicuity of cyclists and would have a positive effect on their safety by reducing the chances of drivers not being aware of the cyclists' presence, particularly in poor visibility settings.

Relating to the use of helmets, as explained in Section 3 above, further research would need to be undertaken to improve the level of protection they provide and the type of collisions they are useful in. As such, the use of helmets while riding should not be mandatory. However, as they provide an additional amount of protection to cyclists – albeit a limited one – cyclists should be encouraged to wear them. Any campaign promoting the use of helmets should be coupled with clear explanations, to both cyclists and motorists, that the best way to reduce injuries and deaths among cyclists is to avoid collisions. Designers of awareness-raising campaigns and activities for the use of helmets should also aim to send a balanced message, one which does not dissuade people from cycling by portraying it as an inherently dangerous activity. Moreover, if helmets are not strapped and secured properly, they do not protect the cyclist's head, so educational campaigns should also focus on the proper use of helmets.

Drink and drug cycling

It is also important to note that, while participating in road traffic, cyclists must also obey the prevailing traffic rules. Drink driving is one of the three main killers on the roads and as such alcohol poses a significant risk when cyclists engage in traffic while under its influence. A recently-completed Dutch study which reviews the state of cycling safety in the Netherlands quotes the relative risk of injury for different categories of road users.

115 SWOV (2006) Advancing Sustainable Safety. National Road Safety Outlook for 2005-2020. SWOV, Leidscham, 2006. http://www.swov.nl/rapport/dmdv/Advancing_sustainable_safety.pdf

116 <http://www.europarl.europa.eu/sides/getDoc.do?type=REPORT&reference=A7-2011-0264&language=EN>

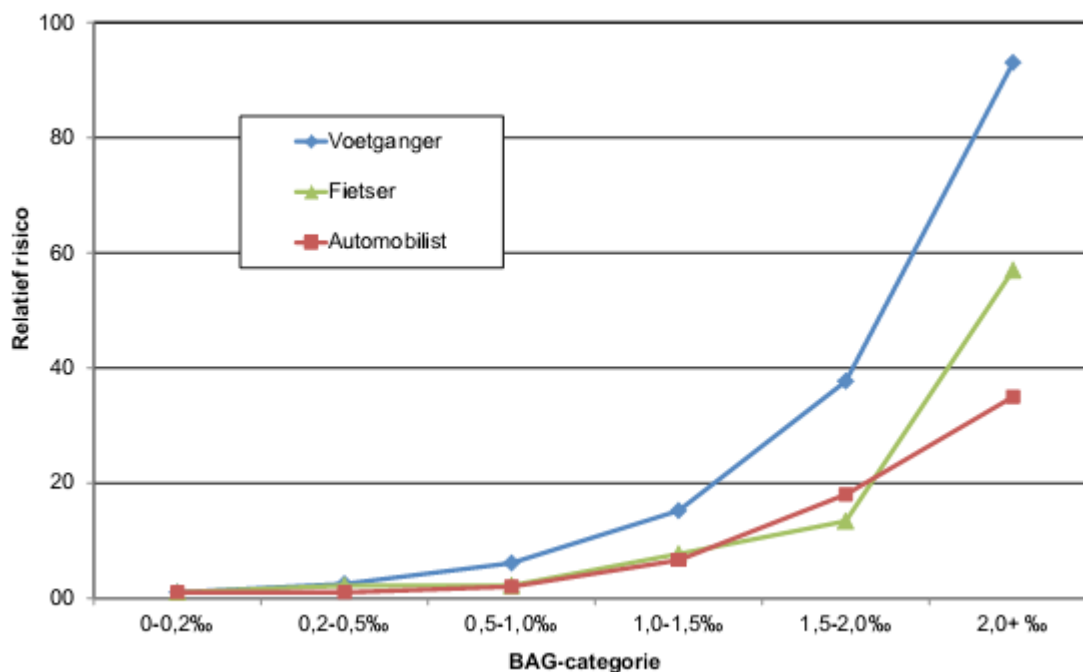


Fig. 30 Relative risk for a pedestrian to fall or be injured (blue line), for a cyclist to be involved in a crash or fall (green line) and for a car driver to be involved in a collision (red line), in relation to BAC levels.¹¹⁷

According to the study, the risk of being involved in a road traffic collision is similar for drivers and cyclists, with the major difference between the two groups being that drunken drivers injure other road users while drunken cyclists most often only injure themselves. In the German city of Muenster, also known as the 'cycling capital of Germany', high Blood Alcohol Content (BAC) levels play a role in a large share of the collisions resulting in cycling deaths. According to Martin Schulze-Werner, the head of the public order department, 5 out of the 8 cyclist deaths recorded in Muenster in 2011 were drunk. He added that during 2011, 135 cyclists were caught riding their bicycles with BAC levels of more than 1.6‰.¹¹⁸ A study on the cycling collisions in Muenster conducted by the Trauma Centre of the University Hospital has shown a high incidence of crashes by people in the 20-29 age group, with most of these crashes occurring in the early morning and without any other vehicle involved.¹¹⁹

The lack of a mandatory 'cycling licence' which acts as a deterrent in the case of drink driving should not be seen as a way of condoning drinking and riding. More research and innovative enforcement methods must be promoted to ensure that cyclists who use the roads, do so in an unimpaired state.

ETSC recommends that EU Member States introduce a Zero Tolerance approach to use of drugs and alcohol to cover cyclists and for further research to be undertaken to identify methods of identifying and enforcing BAC legislation for cyclists.

117 Reurings et. al. (2012) Van fietsongeval naar maatregelen: kennis en hiaten, SWOV, Leidscham, 2012.

118 Drunk cyclists face bike ban in university town, The Local newspaper, published 9 March 2012, <http://www.thelocal.de/society/20120309-41225.html#.UMndieSw-Rh>

119 http://www.klinikum.uni-muenster.de/index.php?id=vollstaendiger_artikel&tx_ttnews%5Btt_news%5D=1005&cHash=f522f2063199ef74bc3ca4bc3af3dd5d6

5.2 Motorised traffic

5.2.1 Drivers of passenger cars

General road safety measures to improve road safety can go a long way to improve the safety of interactions between cyclists and passenger cars. In particular, drivers must also receive training on how to act when sharing the roads with cyclists and also at crossings and junctions.

A future revision of the EU Driving Licence Directive – which mandates minimum EU-wide standards for driver training – should also include provisions on the interaction of drivers with cyclists, at least in the theoretical part of the test. Rules related to the right of way in intersections should be predictable for drivers and respecting cyclists as other vehicles should be the norm. Campaigns or cycle days when drivers are asked to take their usual route to e.g. work or shopping, using the bicycle could provide a good way of popularising cycling while also allowing drivers to experience the journey from the vantage point of the other road users, thus making them more understanding towards vulnerable road users. The European Day of Courtesy on the road, organised annually throughout the EU, could provide such an opportunity.

5.2.2 Drivers of HGVs and buses

Given the risk posed by blind spot collisions between trucks and vulnerable road users, as well as the specific provisions described in the section above, the training of HGV drivers on the detection of potential risky situations can play an important role for the safety of cyclists.

The EU Directive 2003/59/EC on the initial qualification and periodic training of drivers is the main legal instrument which sets the training requirements for professional drivers in the EU. Particularly as these drivers must undergo periodic training, there are opportunities for their training to include specific modules focused on the interaction with vulnerable road users, especially when the HGVs are undertaking their trips in urban areas. The Annexes of the Directive also contain a list of the syllabus that periodic training courses could cover, but there is no specific reference to this topic.

ETSC recommends that a revision of Directive 2003/59/EC should also consider including training of interaction with vulnerable road users as part of the syllabus for the periodic training of drivers.

Besides the EU legislation mentioned above, employers can also play a role in increasing the safety of cyclists. This is because when HGVs operate, the trip is part of a remunerated, contractual activity. The employer could include specific clauses in the contract related to the training of the drivers performing the given operation. In the cases when the employer is a public organisation, requirements related to the specific training of drivers could be included in the public procurement procedures, thus pass good practice to the contractors, who then also have the opportunity to pass it down the supply chain. This also applies to private procurement where a transport contractor can insist on certain conditions to sub-contractors.

In terms of campaigns and awareness-raising activities that would help drivers in their interaction with cyclists, a good example is Transport for London, who, as part of a training exercise, put cyclists to ride as passengers in an HGV and also enabled HGV drivers to ride a bicycle on the same road as HGVs. Both groups reported a higher level of understanding for the concerns of the other group at the end of the session.¹²⁰ In Ireland, the Road Safety

120 http://www.tfl.gov.uk/microsites/freight/hgvs_and_road_safety.aspx

Authority, in collaboration with the Department for Transport, the Irish Road Haulage Association, Cyclist.ie and the Dublin City Council applied the same concept in their attempt to make cyclists and HGV drivers more aware of each others' needs while in traffic.¹²¹ Such training and awareness-raising campaigns are produced in the framework of the Irish National Cycle Policy Framework 2009-2020.¹²²

Conclusion

As explained in the introductory chapter, there are many benefits that can be gained if the rate of cycling is increased, particularly in terms of public health, reducing pollution as well as traffic congestion. However, due to the intrinsic vulnerabilities of cyclists – as there is practically no protection in the case of collisions – cycling remains a mode of travel with a relatively high level of risk. The arguments made above show that the safety of cyclists can be improved and thus cycling in itself is not an unsafe mode of travel. The examples presented here could be used as good practice scenarios which show that, with minimal investment, the benefits of cycling can be reaped, not only at the individual, but also at the societal level.

6. Recommendations:

Recommendations to the EU

General

- Promote cycling within the context of health and reducing GHG, but with the emphasis on safe use of the roads.
- Make cycling one of the top objectives of road safety management.

Enforcement

- Encourage Member States to increase enforcement of speed limits in areas where there are high numbers of cyclists.
- Encourage Member States to adopt the Cross Border Enforcement Directive including a focus on speeding offences and thus encourage compliance with speed limits.
- Support and promote research into effective and innovative methods of enforcing traffic rules for cyclists.

Road Users' Training and Behaviour

- Revise the Directive 2003/59/EC and include training of interaction with vulnerable road users as part of the syllabus for the periodic training of professional drivers.
- Revise the Directive 2006/126/EC and include training of interaction with vulnerable road users as part of the syllabus of training of all drivers.
- Encourage the uptake by EU Member States of zero tolerance to alcohol on the road and extend these principles also to cover cyclists.
- Support research to identify risk to cyclists caused by the use of mobile phones and

121 <http://www.rsa.ie/RSA/Road-Safety/Education/Road-safety-tips/HGV-drivers-and-cyclists1/>

122 More information on <http://www.transport.ie/upload/general/11387-0.pdf>

portable media devices by cyclists. Support action aimed at reducing this risk.

Infrastructure and Road Network Planning

- Prepare guidelines for promoting best practice in traffic calming measures, based upon physical measures such as roundabouts, road narrowing, chicanes, road humps and techniques of space-sharing. These measures should be introduced as an integral part of setting up speed limit zones of 30km/h in residential areas.
- Support the assessment of the safety impact of new traffic codes, e.g. allowing contra-flow cycling on one-way streets.
- Encourage Member States to adopt maximum 30km/h in residential areas and areas with high levels of pedestrians and cyclists and maximum 50km/h in urban areas.
- Encourage the integration of road safety of cyclists into land use and transport planning.
- Recognise that the provision of ITS on travel information and travel planning includes a consideration of safety in promoting different modes including cycling and route choice.
- Encourage Member States to include cycling targets on safety within the context of the planned European Urban Mobility Scoreboard.

Vehicles

- Regularly monitor developments in passive and active safety technologies for the protection of unprotected road users and adopt legislation when necessary.
- Support the development of car windshield airbags as a viable safety measure to improve the protection of pedestrians and other vulnerable users struck by cars.
- Introduce minimum requirements for cycle lighting and reflective elements.
- Contribute to the development of harmonised standards for Intelligent Speed Assistance (ISA) systems towards eventual universal fitment.
- Support the introduction of Intelligent Speed Assistance (ISA) which in managing speed has the potential to reduce risks to pedestrians and cyclists.
- Adopt legislation for mandatory fitting of all fleet cars with Intelligent Speed Assistance systems.
- In the short term, introduce a driver set speed limiter as a standard equipment in all new vehicles.
- Develop a European standard for a "speed limit service", i.e. over the air provision to in-vehicle systems of current geo-data on road speed limits.
- Require Member States to provide a standardised "speed limit service" over the air.

- Adapt the EU Directive on the promotion of clean and energy-efficient road transport vehicles to include in vehicle technologies (ISA) for safety in public procurement. Use the provisions of the ITS Directive and the ITS Action plan as levers to spur innovation into how ITS applications can be developed and adapted to improve the safety of cyclists.
- Support further research into the effectiveness of measures to reduce blind spot-areas around HGVs and to alert road users of impending near-side turning collisions, with the goal of achieving the highest safety levels for cyclists.
- Legislate for the introduction of rigid side underrun protection systems and ensure that the strength of such systems be increased to also increase their efficiency in collisions with powered two-wheel vehicles.
- Support research into designing helmets to protect the cyclist in a real world environment.
- Revise standards for testing bicycle helmets to offer high levels of protection.
- Maintain the current definition of pedelecs – with a design speed of 25 km/h and a maximum power of the electric assist of 0.25 KW is cut when the vehicle reaches its design speed.
- Promote research into methods of preventing tampering with the electric motor increase either its power or the vehicle maximum speed.

Recommendations to Member States

General

- In addition to the overall target of reducing deaths by 50% between 2010 and 2020, adopt a specific target of reducing by 50% between 2010 and 2020 the number of cyclists killed in road collisions.
- Support cycling as a mode of transport in its own right and an integral part of all transport systems.
- Introduce sanctions for non-compliance of key traffic rules for cyclists that reflect relative risk.
- Ensure for high and visible levels of enforcement linked to information campaigns on cyclist respect of the traffic rules.
- Carry out regular campaigns linked to traffic law enforcement on conspicuity in areas with high levels of cyclists.
- Carry out increased levels of enforcement of speed limits in areas where there are high numbers of cyclists.
- Implement the Cross Border Enforcement Directive and EC Recommendation on Enforcement (2004) including a focus on speeding offences and thus encourage compliance with speed limits.

Road Users' Training and Behaviour

- Introduce a Zero Tolerance approach to use of drugs and alcohol to cover cyclists.
- Support research/action on reducing risk caused by the use of mobile phones and portable media devices by cyclists.
- Ensure that all cyclists have a minimum level of traffic education and awareness of the traffic rules through cycle training and education.
- Introduce specific training for professional drivers of HGVs on interaction with cyclists.
- Introduce cycling and driver interaction and safety considerations into driver training.

Infrastructure and Road Network Planning

- Provide safe and attractive infrastructure and in other ways encourage more cycling as "safety in numbers" will increase individual safety.
- Develop a policy of modal priority for road users, particularly in urban environments: the hierarchy being based on safety, vulnerability, and sustainability. Pedestrians should be at the top of the hierarchy, followed by cycling and public transport.
- Provide shorter and safer routes for cyclists by ensuring that routes are direct and that the quickest routes are also the safest. Travel time should be increased on unsafe routes and decreased on safe routes.
- Promote "Safe routes to school" schemes to increase the safety of children.
- Tackle the high level of underreporting of cyclist collisions.
- Consider the issue of, and absence of data surrounding, other risks to which cyclists are exposed, such as falls resulting from lack of adequate infrastructure or from poor infrastructure design or maintenance.
- Create conditions so that cyclists can mix freely with motorised traffic where the travel speed, volume and mass of motorised traffic does not pose a significant risk to the unprotected road users.
- Ensure that cycle traffic and motorised traffic should be physically separated where the speed of the latter is too big to allow them to mix freely.
- Introduce lower speed limits for junctions and intersections

Vehicles

- Prioritise the large-scale deployment of Intelligent Speed Adaptation as a measure to improve road safety in general, as well as the safety of cyclists.
- Ensure the highest level of conspicuity in the lighting system of bicycles for riders, thus making them visible for other traffic road users.

- Encourage cyclists to ensure that the braking system, and the bicycle's drive train more generally, is kept in good condition so as to ensure rider's highest level of safety and comfort available. The mechanical parts of the bicycle should function in such a way that the rider's attention can be fully focused on interacting with traffic.

A research agenda for safe cycling in the 21st century

- Optimise models to monetise the various costs and benefits associated with cycling
- Identify and improve methods to estimate the rates of cycling
- Identify and test effective and innovative methods of enforcing traffic rules for cyclists.
- Identify risk to cyclists caused by the use of mobile phones and portable media devices by cyclists.
- Continue research and development work into how ITS applications can be developed and adapted to improve the safety of cyclists.
- Continue research into the effectiveness of measures to reduce blind spot-areas around HGVs and to alert road users of impending near-side turning collisions, with the goal of achieving the highest safety levels for cyclists.
- Identify appropriate designs for cycling helmets to protect the cyclist in a real world environment.
- Identify methods of preventing tampering with the electric motor of a pedelec to increase either its power or the vehicle maximum speed.

ETSC wishes to thank the following experts for their contribution to this report:
Brian Deegan, Agustin Galdon Medina, Jacqueline Lacroix, Christophe Ramond,
Divera Twisk, Ceri Woolsgrove.



Cover photo www.istockphoto.com

ISBN NUMBER: 9789076024370

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