Safety and vulnerability of cycling
The interdependency between mobility and safety

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Summary

In the framework of road safety policy, cyclists and pedestrians are considered to be vulnerable road users. This kind of presentation is often accompanied by a warning that promotion of cycling and walking may result in an increase of traffic deaths. Although the additional message may be that measures are needed to improve the safety of cycling (and walking), the wrong conclusion could be that first safety standards should be improved before cycling is to be promoted.

The core question that will be raised in this contribution is:
"*Can measures that improve the safety of cycling, be isolated from provisions that contribute to a higher share of cycling in traffic and transport?*".

The current safety of cycling will be reviewed. Then the interdependence between safety and mobility of cycling will be analysed. Conclusions will be drawn about the best approach to enhance the safety of cycling.

1. How to assess the safety of cycling?

To assess the safety of road users, road safety experts primarily consider the chance to get killed per kilometre. The first reason is that priority should be given to prevent fatal injuries. The second is that data concerning fatal accidents are far more reliable than data concerning accidents with less severe injuries.
To compare the risk of cycling to other modes of transport, we also have to choose for an exposure measure. However, what is the right exposure measure: kilometres, hours travelled or a trip? The debate about this is still in an early stage. The European Transport Safety Council ETSC recently presented data regarding the EU in which the fatality risk of cycling is compared to the fatality risk of car drivers. ETSC prefers to use kilometres as the measurement of exposure because 'it relates to the decision about how to travel a certain distance rather than how to spend a certain amount of time'[i]. This is a very questionable approach. A particular destination may be the target for a trip, but not anyone has the option to choose for a certain distance, not anyone can make use of a car, and most of the times, people do not want to make more kilometres than needed. It is moreover a matter of policy to bring destinations closer to residential areas and to promote walking and cycling as an alternative for car driving. According to the ETSC report, the fatality risk of cycling is 8 times higher than for car drivers per million km. The difference in risk is only 3 times when hours are used as exposure measure.

If we consider that people would like to choose for the nearest destination, it would be better to use trips as exposure measure. In a comparison using data from the UK from 1979 - 1989, the risk of cycling per km is 10 times higher than car driving, per hour 5 times and per trip 2,5 times.[ii]
It is not my intention only to choose for the exposure measure that presents the best results for cycling. It is always necessary to motivate the choice.

Welleman approached risk comparisons in a different way. He makes use of kilometres travelled but argues that driving on motorways has to be excluded since there is no equivalent for cycling and therefore the hazards representing other road users have to be included. In an EU report [iii] the following table is presented on the basis of his calculations with Dutch data:

Table 1: Risk of accident per million kilometres in the Netherlands, excluding motorways and including risks for others.

Age group	**Car drivers**	**Cyclists**
12 – 14	-	16.8
15 – 17	-	18.2
18 – 24	33.5	7.7
25 – 29	17.0	8.2
30 – 39	9.7	7.0
40 – 49	9.7	9.2
50 – 59	5.9	17.2
60 – 64	10.4	32.1
> 64	39.9	79.1
Total	**20.8**	**21.0**

This comparison shows that for the Netherlands the risk of cycling is equal to the risk of car driving, but there are huge differences according to age. For elder people, the vulnerability of the body increases the severity of injuries.
We have to take into account that the Dutch safety record for cyclists is the best in Europe. A comparison of the risk of having a fatal injury per kilometre cycling between several European countries has been done in the EU project WALCYNG [iv] The risk of a cyclist of having a fatal accident on the road per kilometre in the UK is about 4 times higher than in the Netherlands, in Finland it is 3 times higher.
The best explanation for this is the experience of Dutch road users with cycling traffic and the great amount of high standard facilities of. Moreover, when road users are not used to meet a certain mode of transport, they may not perceive and anticipate adequately. As is stated in WALCYNG: "Rare events are dangerous".

The conclusion here is: to express the safety of cycling compared to other modes of transport, one has to decide first what the best exposure measure is. It can not be concluded that cycling in general is more risky than car driving. There is evidence that the chance of a fatal accident per cyclist decreases when more cyclists use the roads.

2. To plan for safety, the cyclist has to be understood

A short retrospection indicates that there is much confusion about how to improve the safety of cyclists, if cycling is not integrated in planning and design of the traffic and transport system.
In the Netherlands, during most of the twentieth century, there have been complaints about the behaviour of cyclists. They: 'behave careless, unpredictable, undisciplined and they are not well trained'. The more cars came on the road, the more cyclists were considered as intruders of the road, that obstruct the traffic flow. Transport and traffic policy neglected investments in cycling provisions ([v]).

In a report on walking and cycling, the OECD concluded that "rapid expansion of car ownership and the resulting accommodation of car traffic during the 60's and 70-ties, had disastrous effects for vulnerable road-users and residents of built-up areas. Widening of the carriageway took place at the expense of road sides and pedestrian footpaths, with increased vehicle speeds as a side-effect. Urban areas expanded, so travel distances increased and thus eliminating walking and cycling as means of transport. Some new residential areas were built on the principle of complete segregation of pedestrians and motor vehicles.
The trend started to reverse at the end of the 1970s when it was found that the street networks of old towns and city centres could not cope with an unlimited increase in traffic. In residential areas, a new concept of integration of mixed traffic appeared, based on the idea that drivers would have to slow down. The Dutch 'woonerf' (residential area with restrictions to slow down traffic) and traffic calming were introduced. In the 1980s, the idea of a comprehensive network for pedestrians and cyclists started to gain acceptance, together with the notion that fast motor traffic might have to give priority to local traffic and vulnerable road-users. In the 1990s, long-term planning for sustainable transport policies, aimed at fulfilling mobility needs while reducing health costs, was promoted" (OECD[vi]).

In 1983, the Ministry of Transport of the Netherlands admitted that the concern of policy makers for cycling had been minimal. The expectations during the sixties and seventies were that cycling as a mode of transport could almost be neglected in favour of car traffic. The ministry regretted that investments were omitted[vii].
In the nineties, local cycling policies received a boost when the central government launched a Masterplan, e.g. to subsidise investments and to finance experiments and research. At the evaluation, one of the conclusions was that since 1980 the kilometres travelled by cyclists had increased by 31% and at the same time fatalities and hospitalisation amongst cyclists decreased by 37%. This means that the chance of a fatal accident per kilometre was reduced with 50%[viii].
Another example showing that risk decreases when exposure increases, regards the city of Graz (Austria). There, cycling measures have been introduced alongside area wide "Tempo-30" zones. The number of cycle trips have increased by 50 % between 1984 and 1995, and the number of cycling casualties have fallen by 20 % over this period

In 1998, EU commissioned a research project to study the opportunities for safety measures regarding cyclists and other vulnerable road users, that are not restrictive[ix]. The project, called PROMISING, will be published later in 2000. The EU request underlines the change in policy concerning cycling (and walking).

We have to diagnose that there is not much tradition in planning for cycling as a mode of transport, not to speak about a tradition that combines planning for safety and transport. It is

obvious that many safety measures are restrictive, such as speed limits, seat belts and severe alcohol limitations. Road users ask for safety measures but at the same time they want these measures as far as possible to be tuned to their other needs. Cyclists feel they have been ignored in planning and design. So if the behaviour of cyclists is considered to be unpredictable or undisciplined, the question should be: 'what conditions have been created to make safe behaviour easy, comfortable and efficient?'. To combat confusion about their behaviour, communication would be helpful. The politicians and planners should acknowledge that a cyclist will not only put his 'vulnerability' on the agenda, but that he will ask for an attractive way of cycling. Only recently there is a development to focus on the needs of the road users. The change is to look for non- restrictive safety measures.

3. How to enhance mobility and safety together?

If we want to develop a balanced approach for cycling safety and for cycling as a mode of transport, what are the main elements of the strategy? The following elements will be presented:

- take the needs of cyclists as a start
- build a network of bicycle routes
- create provisions for a safe mix of motorised and non motorised traffic
- support the infrastructure with regulations
- support the use of the system with education
- help to create good conditions of bicycles.

The needs of cyclists

To follow the Dutch manual Sign up for the Bike, 5 criteria have to be met to come forward to the needs of cyclists([x]):

- Safety: Protect cyclists from fast moving motorised traffic and create conditions where they share the road
- Coherence: Cycle routes need to guarantee continuity, consistency of quality, recognition and completeness.
- Directness: Save travel time and avoid delays and detours.
- Comfort: Attention is needed for smoothness of road surface, curving, gradients, number of stops between origin and destination, and complexity of rider's task.
- Attractiveness: Visual quality of the road, overview, variety of environment, and social safety.

Build a network

A hierarchical division of roads and streets in built up areas is suggested in the PROMISING report. Cyclists need a network of main routes with in general priority to motorised traffic. The network plan depends on origin and destination patterns. Since most streets have an access or a residential function, the speed limit in the majority of built up areas is recommended to be 30 km per hour. Streets with a distribution or flow function for motorised traffic may have a speed limit of 50 km per hour. Segregated facilities for pedestrians and cyclists are needed. At crossings the speed limit should be 30 km/h.

Create conditions for a safe mix

There are different ways to create safe conditions on streets where motorised and non motorised traffic needs to share the road. Speed limits to 30 km per hour has been mentioned already.

Roundabouts and upgraded crossings have been proved to be effective. The will of drivers to anticipate towards cyclists can be improved by advanced stop lines for cyclists at junctions. These kind of measures have a cost benefit ratio of about 1: 9 according to calculations of the PROMISING project.

Support the infrastructure with regulations
There is a wide variety in traffic regulations in Europe.
Some examples of safety measures that enhance directness of cycling traffic are:

- cyclists may overtake cars on both sides
- cyclists are allowed to ride side-by-side, and have the opportunity to communicate with each other
- cyclists may ride in both directions on one way roads
  small roads are transferred into a cycle street where cars have to behave as a guest

Support the use of the traffic and transport system with education
Safety education can very well be combined with education about the advantages and benefits of cycling, and it is logical to combine these.
The advantages for different modes of transport for the individual in terms of: their efficiency in relation to trip length, purposes, and conditions, in terms of health, and in terms of safety in relation to the use of facilities; serve as a very good framework for traffic education. Besides, topics as: the benefits for society, for the environment, the city climate, making good use of available space, and prevention of congestion etc. are very good subjects for lessons in primary and secondary schools.

Help to create good conditions of bicycles.
Reliable and sustainable devices make the requirements the least restrictive, for if the devices do not work properly, and when it needs repair, the bicycle will be used less.

4. Applicability world wide

The question is if this approach, based on data, experiences and expertise in Europe, can be applied to other continents in the world.
The local context has to be taken into account for any application. The opportunities for cycling as a mode of transport and for safety measures depend very much on the actual modal split and road features. Culture and history may be barriers for politicians and road users to treat cyclists as road users with equal rights. Facilities on the road that show the rights of cyclists and pedestrians, treat them as modes that need ample space and a road surface of high quality and provide them with right of way, may change tradition. Speed limitations for any situations where motorised and non motorised traffic have to share the road, are a condition for safety to enforce anticipation of drivers to other road users. Important is also to create provisions for both pedestrians and cyclists, because they both need them and cyclists will make life of pedestrians difficult when they do not have an attractive alternative and pedestrians do the same to cyclists.

E.g. in Delhi, bicycle tracks have been designed for some arterial roads. Since many cyclists are killed on these roads and most of them at midblocks, these tracks will certainly improve safety. They can also change the decrease in cycling use and they will also improve the traffic management: the

capacity of these roads will double. More difficult will be the design of facilities at crossings. Some pilot projects to evaluate the design proposals would be very important[xi].

An illustration of the need to better integrate facilities for cyclists with road improvements, is amongst many others Morogoro Tanzania. The city, with 200.000 inhabitants, has two main roads, total 15 km. The surface of one has been improved and made flat. This evokes high speed. All fatal accidents take place on this road. There are more plans for reconstruction. The city government requested the central government to built cycling facilities (cycling has a share of 20% in the modal split). Morogoro was one of the cities that participated in the World Bank Sub Saharan African Transport Programme. One of the conclusions of several years pilot projects and research in this programme, was that serious urban pedestrian- and bicycle traffic accidents can almost be eliminated by a suitable programme of road (and intersection) redesign and traffic calming[xii].

My conclusion is that the 5 criteria that come forward to the needs of cyclists are applicable everywhere. But the conversion to measures is not a matter of duplication. Adaptation to the local context is essential..
It has to be noticed that the state of confusion by politicians about the behaviour of cyclists seems to be a world wide phenomenon and cycling countries like the Netherlands are not an exemption. This underlines that there is much experience to share. Expertise to improve safe cycling has been built upon many experiences with pilot projects, research and debate. Exchange and support is a condition to bring this expertise at higher levels.

Notes

[i] Exposure data for travel risk assessment current practice and future needs in the EU. European Transport Safety Council, Brussels, 1999, ISBN: 90-76024-04-9

[ii] Cost benefit Analysis; Results of WP5 of PROMISING, by TRL (to be published in 2000)

[iii] Cycling: the way ahead for towns and cities, DGXI, Brussels, 1999, ISBN 92-828-5724-7

[iv] Walcyng, EU project, How to enhance WALking and CycliNG instead of shorter car trips and to make these modes safer; C.Hydén, A. Nilsson and R. Risser. Lund University Sweden en FACTUM, Wenen, 1998

[v] See page 66 and 54 of Cycling traffic in practice and pictures in the 20th Century, Min. of Traffic, The Hague 1999, ISBN: 90-369-0047-6.

[vi] OECD-report on Vulnerable road users, Paris, 1998

[vii] Facts about cycle use in the Netherlands, Min. of Transport, The Hague 1983.

[viii] Final Report Masterplan Bike, Min. of Transport, page 61; The Hague, 1998

[ix] PROMISING, co-ordinated by the Dutch Road Safety Research Institute SWOV. The author was before researcher at SWOV and co-ordinated the execution of PROMISING.

[x] Sign up for the bike, 1993. Design manual for a cycle-friendly infrastructure. Ede,

[xi] Road Design for Improving Traffic Flow, A Bicycle Master Plan for Delhi G. Tiwari, TRIPP/ITT Delhi, 1998

[xii] Liveable African Cities, a Guideline for Urban Pedestrian and Bicycle Traffic in Africa, M. de Langen, IHE Delft, 1999.