

## Cycling more for safer cycling

Cycling presents a lot of benefits to the individual and to society. Health, environment, accessibility, local businesses, ... all gain when more people cycle. Yet many governments are reluctant when it comes to promoting cycling, mainly because of (perceived) safety issues. Since studies have established a clear and consistent relationship between bicycle use and cyclist accident risk, this lack of bicycle promotion will influence the safety outcome of bicyclists.

In this paper the relation between bicycle use and cyclist safety will be described on different levels of aggregation. Secondly its consequences on road safety will be discussed.

### *More cycling, less risk*

In literature different studies have established a relation between a higher bicycle use and a lower accident risk. The results are quite remarkably consistent and hold on different levels of aggregation. Comparisons have been made between countries, between cities and on a micro level. Risk models, also describing risk on a micro level, confirm their findings.

In the European project WALCYNG a comparison was made between 8 European countries. They found that risks faced by bicyclists were lowest in those countries where bicycle use was highest. In figure 1 a comparison of 13 European countries based on the IRTAD data is presented. Countries with twice as much cycling have on average a risk that is about a third lower. So doubling cycling would only increase the number of cyclist deaths with around 30% instead of doubling it.

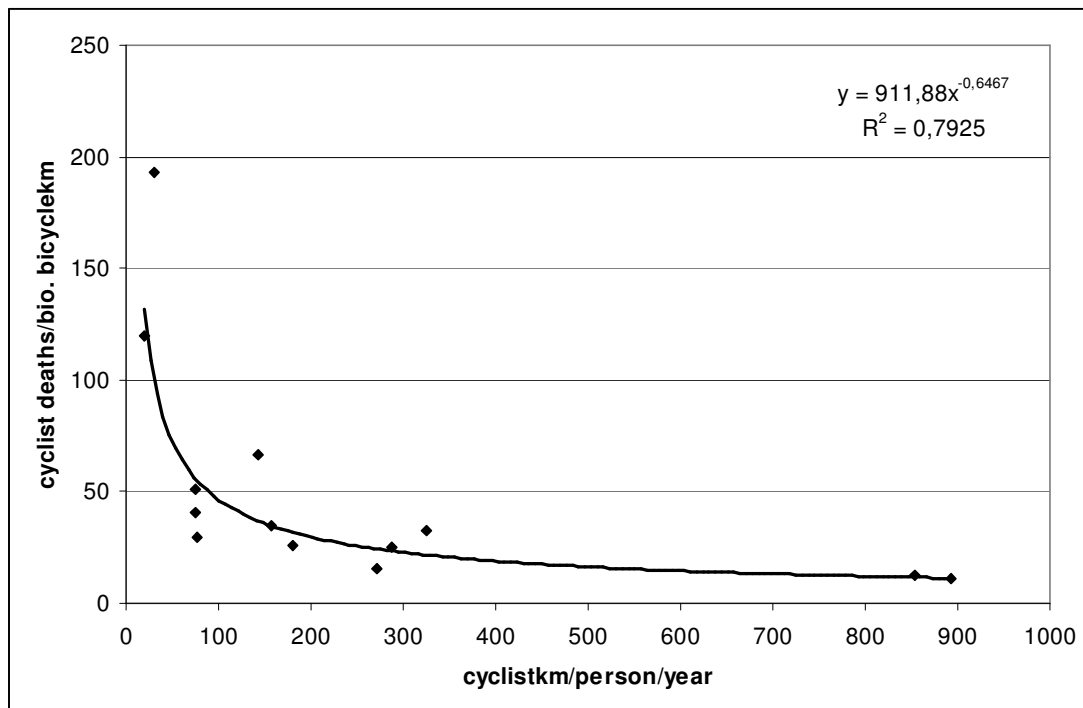


Figure 1: Bicycle use versus fatal risk – a comparison between 13 European countries

Source: IRTAD

Jacobsen (2003) studied the risks cyclists face in 68 Californian and 47 Danish towns (figure 2). He found that the number of cyclists struck by motorists varies with the 0,4 power of the amount of cycling. Furthermore this value seems consistent across geographic areas. Krag (2005) reported similar results from a study in cities in Northrein-Westphalen (Germany) and Fietsersbond (Netherlands) concluded that in (Dutch) towns with a high bicycle use a cyclist has a 35% lower risk of getting injured in traffic compared to towns with few cyclists.

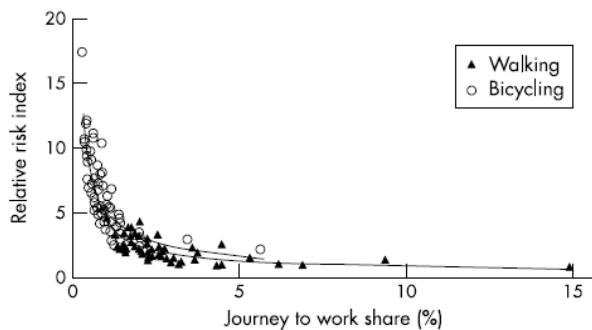


Figure 1 Walking and bicycling in 68 California cities in 2000.

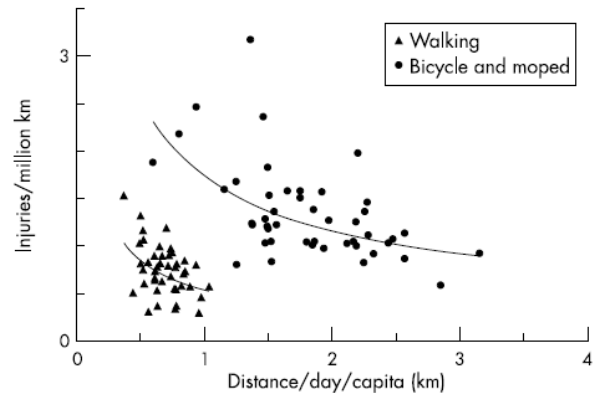


Figure 2 Walking and bicycling in 47 Danish towns in 1993-96.

Figure 2: Bicycle use versus fatal risk – a comparison between Californian and Danish towns

Source: Jacobsen (2003)

The relationships found are usually assumed to follow a power function. Ekman (1995), using moving average lines, finds for 95 non-signalized intersections in Malmö and Lund a less smooth curve (figure 3). He finds, consistent with the previous, a higher conflict rate for bicyclists at locations with a low bicycle flow compared to locations with a high bicycle flow. He finds however a steep drop in the curve at levels of bicycle flow of around 50. Under this threshold the conflict rate is about twice as high compared to situations above the threshold. It is clear from this picture that the relationship between bicycle use and risk isn't (always) well described by the simple power function, at least not on this micro level.

Nevertheless the power function is used extensively, also in risk models describing the number of (bicycle) accidents in terms of a set of independent variables, including traffic intensity and bicycle use. Several authors (Busi, 1998; Greibe, 2003; Jonsson, 2005; Van Hout et al, 2005) give such risk models. The power they found depends on the variables that are included in the model. When only bicycle flow or intensity is used as a independent variable a value of around 0,5 is often found for bicycle accidents on road segments. When both traffic intensity and bicycle flow are included the power value for the bicycle flow decreases slightly to 0,4-0,5. Finally when, apart from both traffic variables, also environment variables are used, a value of around 0,35 is found in the models proposed by Jonsson (2005) and Van Hout et al (2005). Most results are quite

similar and in the range found on other aggregation levels. Leden et al (2000) found the same relationship in a before/after study of 45 bicycle path intersections with roadways.

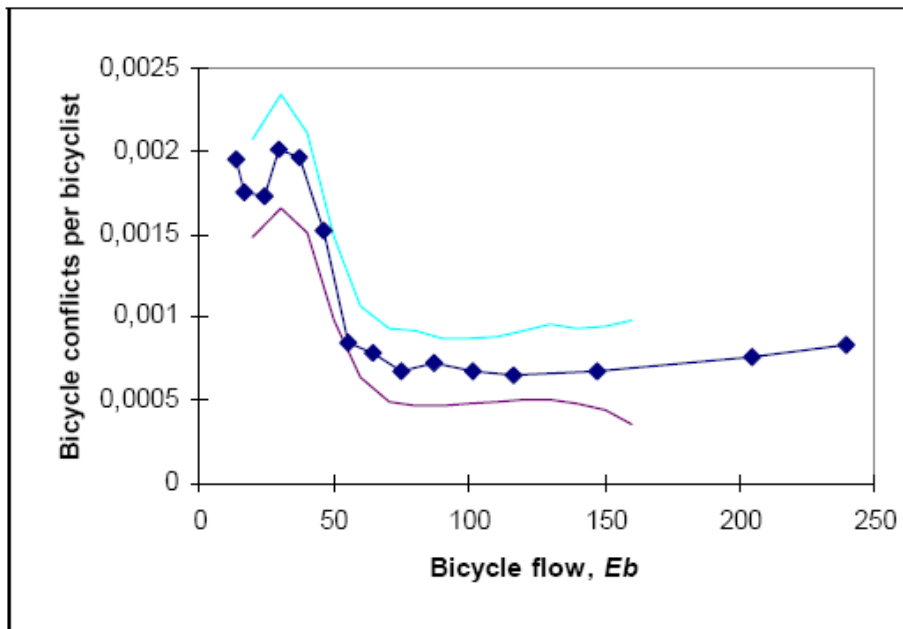


Figure 3: Risk Performance Function  
Source: Ekman (1995)

### *Explanations*

All results point in the same direction. The number of cyclist victims or bicycle accidents augments with increasing bicycle flow. The risk for the individual cyclist however decreases because the growth of accidents is less than the increase of the bicycle flow power value is always less than 1). The literature presents several explanations why cycling gets safer when more people ride a bicycle more often..

More cycling generally leads to a higher proportion of experienced cyclists on the road. As was pointed out in Bikewest (n.d.), a more experienced cyclist tends to have a lower risk compared to the less experienced (fig. 4). When experienced cyclists make a larger part of the cyclist population, the average risk will resemble more the lower risk of these experienced riders.

The capacity of road users to perceive and process signals from their surroundings is limited. Therefore road users form a standardized image of the environment based on their expectations. These mental models guide the attention of the road users to risky locations. When cyclists are a common part of the traffic environment other road users will more often include cyclists into their mental models and into their visual search pattern. Therefore cyclists will be noticed better and other road users will anticipate more often on their presence. Furthermore drivers will be, in that situation, also more often be a cyclist for part of his journeys. This will help them to understand cyclist behavior better, again giving rise to a more accurate anticipation.

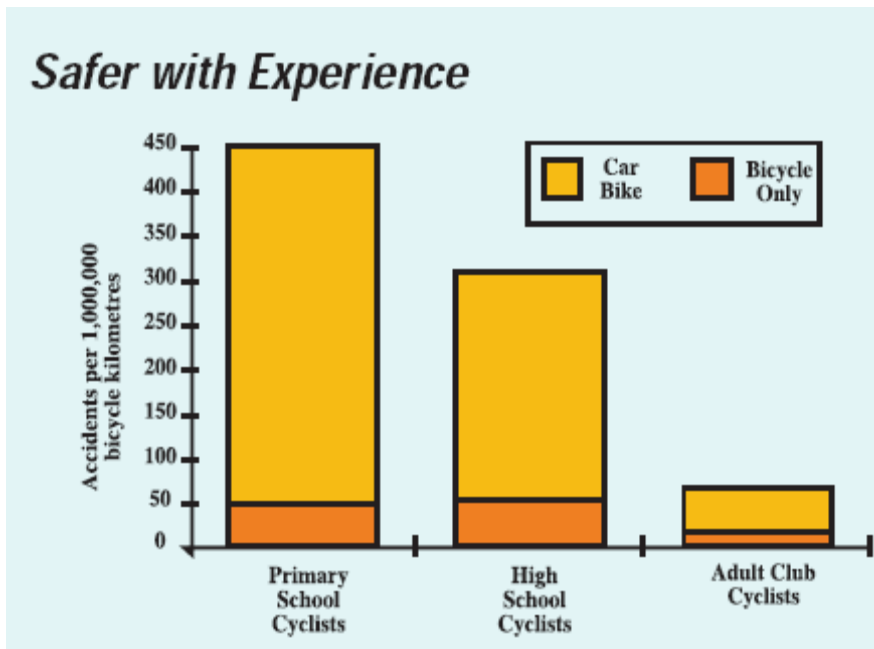


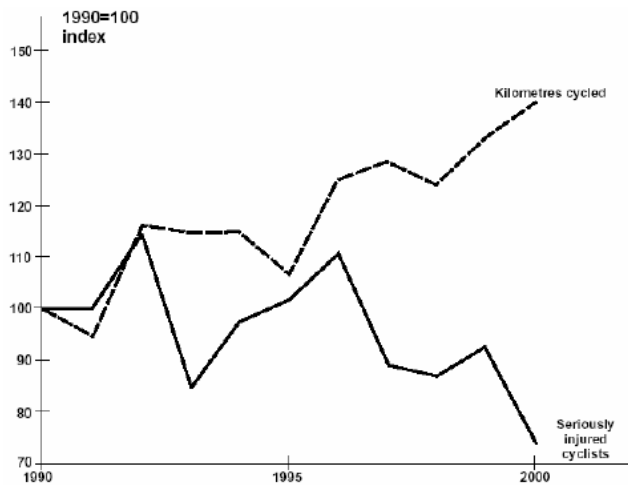
Figure 4: Safer with experience  
Source: Bikewest (n.d.)

A third reason could be that conditions are generally safer where a lot of cycling occurs. Governments tend to take more care for cyclists when there are more (they're voters too). Safety measures for cyclists will be taken thereby improving cycling conditions and attracting more cyclists. It works both ways. Bicycle use and safety will reinforce each other thereby creating an upward spiral. Safety is a condition for a higher bicycle use and a higher bicycle will lead to more safety.

#### *More cycling leads to more accidents?*

The examples described above all led, despite the decreasing risk faced by cyclists, to a higher number of bicycle accidents or cyclist victims when the number of bicyclists increases. The Risk Performance Function proposed by Ekman suggests that in certain situations the number of conflicts can decrease even when bicycle flows increase considerably. Time series analysis also reveals, in several cases, a general downward trend of bicycle accidents despite growing bicycle and car traffic (Jacobsen, 2003; Krag, 2005; fig. 5).

As was already clear from several risk models mentioned above, cycling flows and traffic intensity are not the only determinants for cycling risks. Safer bicycle provisions, a raised awareness on traffic safety, better medical care all have contributed in decreasing cycling risks even further so that a lower number of bicycle accidents follows. Van Boggelen et al (2005) drew up a conceptual framework describing the relationship between bicycle use, bicycle policy and road safety (fig. 6). Bicycle policies influence both the safety conditions for the cyclists and bicycle mobility. Most of its elements influence each other. This means that cycling risks can further be reduced by taking the appropriate measures in order not to only decrease the risk, but also the total number of victims.



Copenhagen, Denmark, 1990-2000. The trend generally shows an increase of cycle traffic and a decrease in the number of seriously injured cyclists<sup>47</sup>.

Figure 5: Increasing bicycle use and decreasing number of injuries (Copenhagen, Denmark)

Source: Krag (2005)

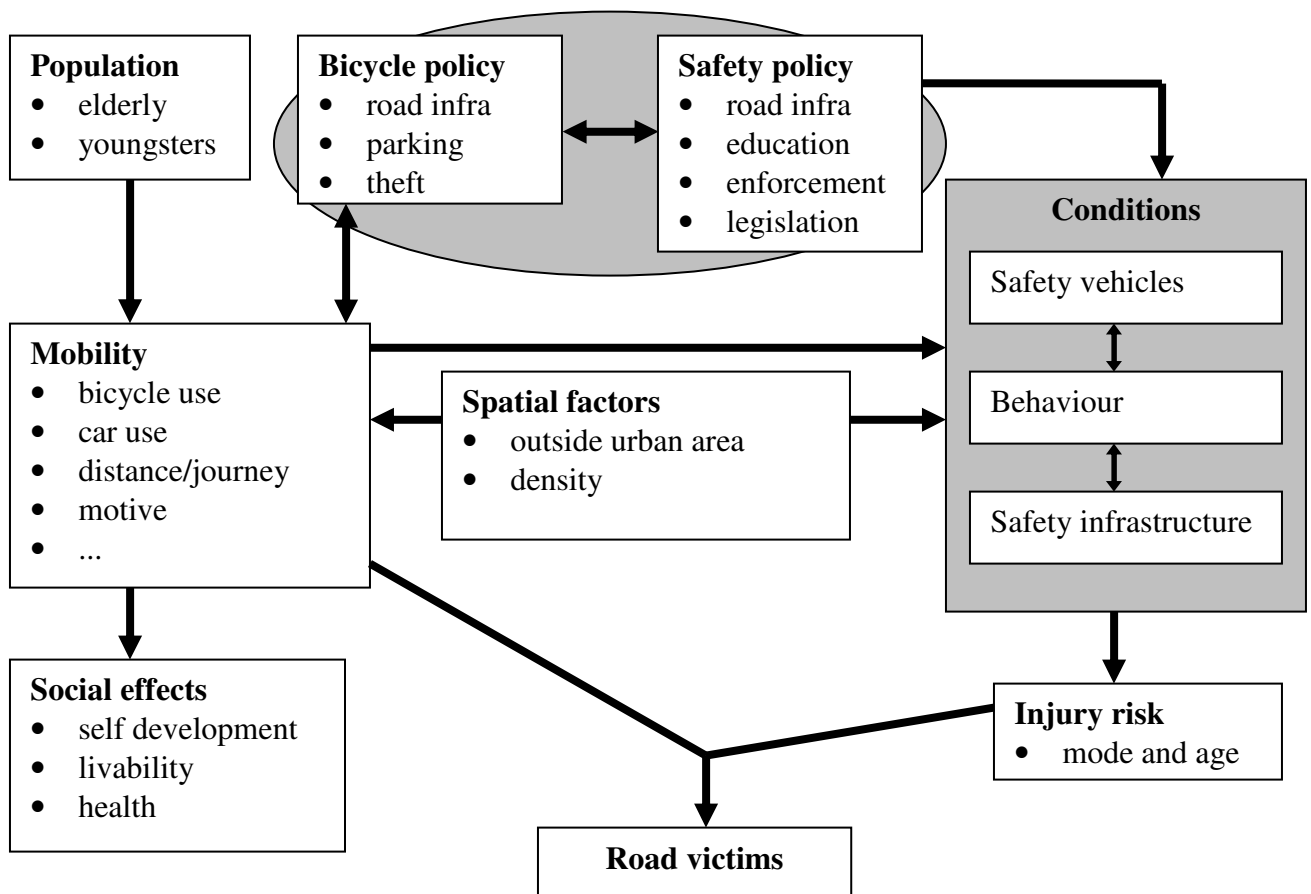


Figure 6: Conceptual framework describing the relationship between bicycle use, bicycle policy and road safety

Source: translated from van Boggelen et al (2005)

## *When car drivers become cyclists*

As stated before, many governments hesitate to promote cycling instead of the car because of the high risks related to cycling. The high risk faced by cyclists only occurs when risk is expressed per distance travelled (fig. 7). When expressed in terms of journeys made or time travelled, cycling is about as safe as driving a car.

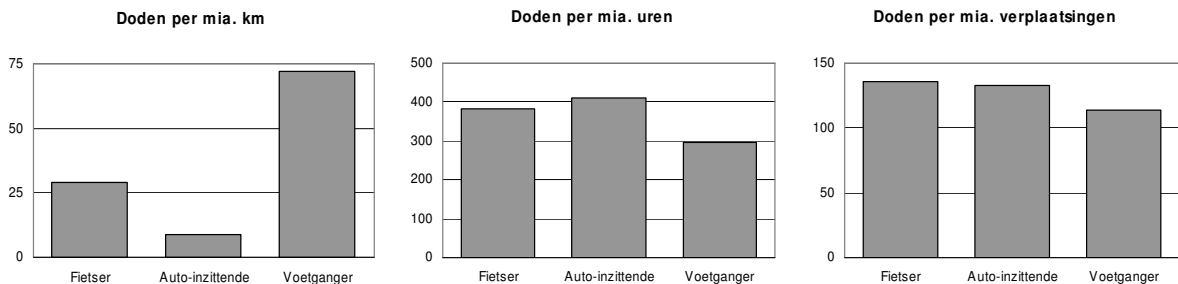


Figure 7: Comparison of cycling risk, car user risk and pedestrian risk, expressed per bio. km (left), per bio. hours (middle) and per bio. journeys (right), Flanders, 2000  
Source: Van Hout (2007)

Cycling journeys differ from car journeys in many ways. The cycling population is not the same as the driving population (young children aren't allowed to drive e.g.), cyclists ride in other places (more in built-up areas, not on the relatively safe highways) and under different conditions. According to the framework proposed by van Boggelen et al (2005) this will reflect on the safety outcome.

Another aspect of cycling and safety is often disregarded. Cycling may be to some extent a risky activity, it is by no means a dangerous one. When in an accident, cyclists get injured easily because of the lack of protective devices. The threat they pose on other road users is however negligible (Wardlaw, 2002). In order to assess the complete effect on road safety this threat to other road users should also be included.

When a modal shift from car to bicycle is established, it should be noted that not every car journey is easily replaced by a bicycle trip. Especially short car trips, often in a built-up area, can be substituted by bicycle trips. Risks comparisons should therefore be made for journeys that are feasible doing by bicycle.

From figure 7 it can be assumed (and this is often done) that the number of deaths will increase for every kilometer travelled by bicycle instead of by car. These risks, however, are based on the global distances travelled, regardless of the road type and journey characteristics. When e.g. abstraction is made of distance travelled on highways and accidents on that (relatively safe) road category, the differences between risk of cyclists and car users diminishes and in some cases even disappears. Risks will also differ for other road types.

As indicated by van Boggelen et al (2005) person characteristics should be incorporated also. Wittink (2000) showed, for the Netherlands, that cyclists only have a higher risk compared to car drivers in the age groups older than 50 years. Between 18 and 50, car

drivers have a higher risk than cyclists. In other countries with less cycling most cyclists will probably have a higher accident risk than car drivers (except maybe the novice driver age group). Depending on which car drivers make the transition to the bicycle the net effect on road safety will be different.

### *Conclusion*

From the above it is clear that estimating the effects of a modal shift from car to bicycle is not as straightforward as just comparing the risks faced by cyclists and car users. The estimation should take into account personal characteristics such as age and journey characteristics such as distance, time and location. Risk should therefore be examined on a more disaggregated level. Van Boggelen et al (2005) calculated the effect of an increased bicycle share on road safety in the Netherlands, taking into account these aspects. They found a net beneficial effect on the number of victims when people younger than 40 shift to the bicycle. When people older than 50 take up more cycling, the net effect will be negative.

### *Literature*

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