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Traffic Safety and Perceived Safety – How to cycle and survive

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Every day in the Traffic Department in Copenhagen we receive many mails and phone calls from cyclists and other road users. It is one of my many tasks to answer their questions concerning traffic safety. I have access to a data base with all traffic accidents in the city that the police register and when I examine the accidents at the intersections I often find that places that are perceived as dangerous by the drivers/ cyclists are some of our safest intersections. How can this be?

In traffic safety work we make a distinction between safety and "perceived safety".

Traffic safety is related to objectively registered problems with traffic accidents. In Copenhagen a major part of this work is dedicated to the safety of cyclists as they make up a large part of the injured in traffic. This is shown in figure 1.

Our political goal is to increase the share of cyclists and at the same time reduce the number of cyclists injured; and we are doing well. Traffic injuries and fatalities are a great cost for society and cause pain and grief for the victims, so cycling safety is important for us.

Perceived safety is the subjective feeling that is created when the road user interacts with the traffic environment and with the other road users. Different people perceive a traffic situation differently, whether you are old, young, have experience or not.

Cycling has always been considered an important means of transport in Denmark, also outside the cities. The Danish Road Standards (Danish road design guidelines. See Appendix) treats safety for cyclists with great importance and relies on Danish and

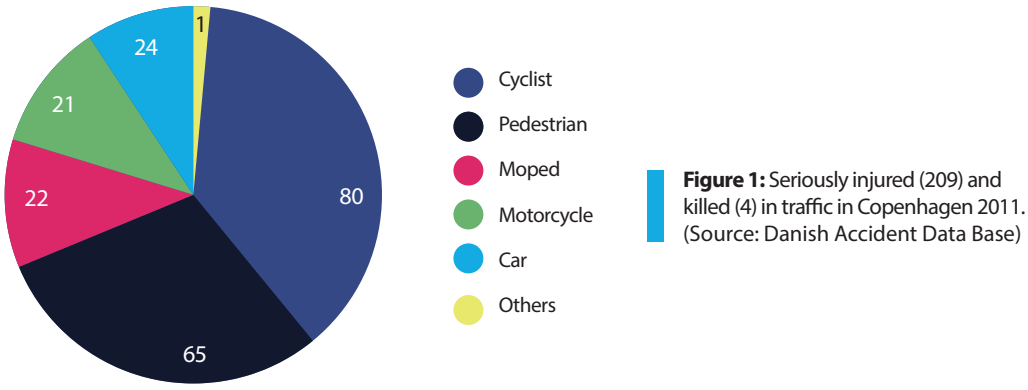

Figure 1: Seriously injured (209) and killed (4) in traffic in Copenhagen 2011. (Source: Danish Accident Data Base)

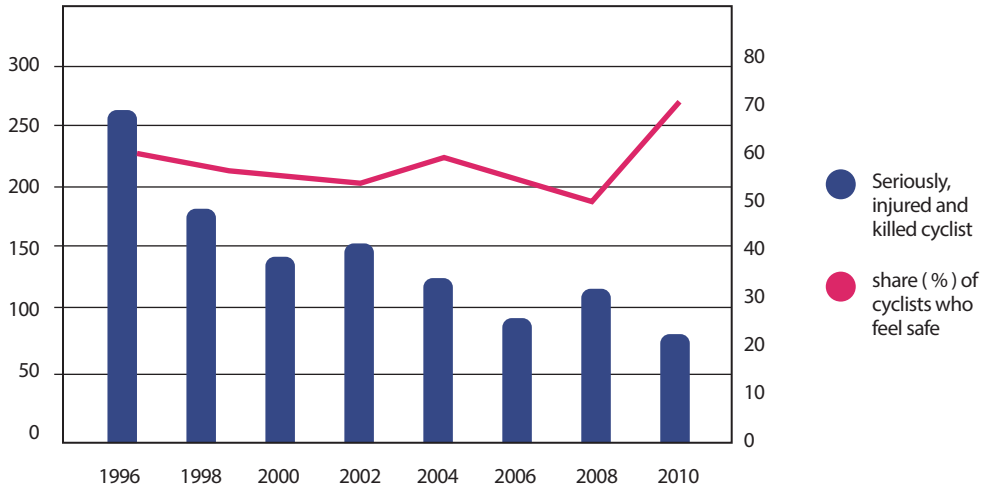

Figure 2: Seriously injured and killed Cyclists and Cyclists perceived safety. As can be seen, safety and perseived safety does not always follows each other.
Sourde: Copenhagen bicycle account 2010 and Danish Accident Data Base

international experience regarding effective traffic safety measures. In Copenhagen we use these recommendations and we conduct our own experiments as to what improves safety for cyclists and at the same time provides a good cyclist flow.

Accidents with cyclists

We know little about single vehicle (= bicycle) accidents and we know more about accidents involving the cyclist and another road user.

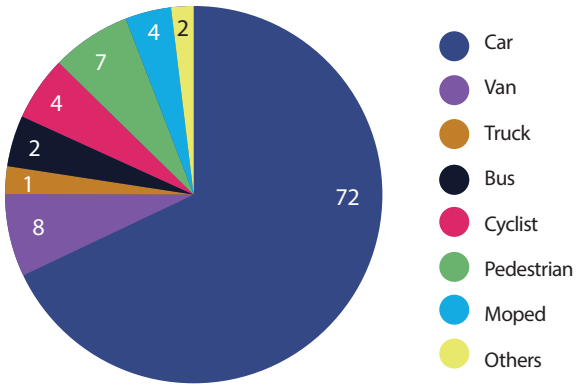

Figure 3: Other party in accidents with cyclists in Copenhagen, 2009. (Source: Danish Accident Data Base)

The information on accidents with single cyclists comes from hospital reports, as they are rarely reported to the police. Some accident circumstances are; slippery road surface (snow, ice, wet leaves etc), holes in the road, stones, loose belongings, like shopping bags or clothes, getting stuck in the wheel or chain. Transporting small children without a child seat can result in accidents when the child´s foot gets stuck in the wheel.

Surfaces for cyclists require high quality maintenance, higher than the road surface, as even a small crack or pot hole can have very serious consequences.

The pie chart shows the other party in accidents with seriously injured or killed cyclists in Copenhagen. Not surprisingly, the most common is the car as it is the most frequent motorised vehicle. But accidents with heavy vehicles like busses and trucks more often result in more serious injuries and a higher share of killed.

Accident prevention and injury reduction

This paragraph will give an overview of measures that reduce the risk for accidents and injury, and also I will touch upon how the measures affect perceived safety.

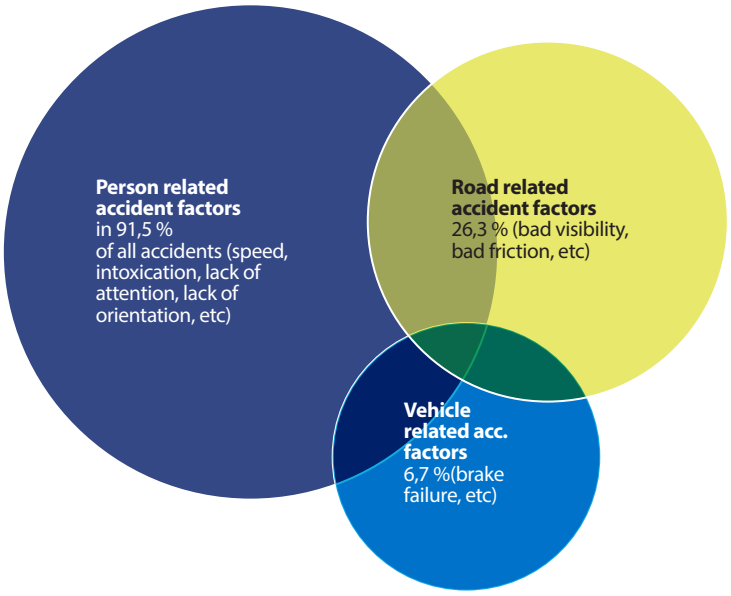

Figure 4: Accident factors (source: Transport Research Laboratory 2003)

Figure 4 shows the factors that contribute to accidents and it can be seen that the person (the road user = driver/pedestrian/cyclist) plays an important role in accidents. Accidents can be prevented by using measures that change the behavior of the road user towards more safe behavior. Some safety measures also increases perceived safety but not all.

The cyclist and the bike

Cyclist behavior is important for safety. As a cyclist you need to know the basic rules in traffic and the basic signs. In Denmark, safe cycling is taught to children and young people. It is a discipline in the municipal and private schools. It includes cycle tests, checks of safety features like brakes and lights, and police visits where the children learn about traffic rules and signs. When you are competent and your bicycle is safe you feel safer in traffic.

Accidents between a vulnerable road user (cyclist or pedestrian) and a motorised vehicle are not always caused by the driver of the motorised vehicle. The Danish Accident Investigation Board[2] has concluded in several in-depth analyses of cycling accidents that

Figure 5: Courses for adult immigrants increase the participants' feeling of safety. (Photo: The City of Copenhagen)

Figure 6: Safety features on a bicycle can be: brakes, chain protector, child seat (if you are transporting children), reflectors, lights, skirt guard, bicycle basket. A helmet reduces head injury. The municipality gives free bike checks, hand out reflectors and helmets etc. (Photo: Troels Heien)

the car driver could not have avoided the accident. This includes for example, accidents where cyclists made left hand turns in front of cars without looking first.

The car and the driver

As I mentioned before, motorised vehicles are by far the most common "protagonist" in collisions where cyclists are injured or killed. To avoid accidents and reduce injury, a lot can be done to improve driver behavior and to ensure that cars are designed to be safe.

Driver training needs to be adapted so that drivers can assess the accident risks related to cars and cyclists. In Denmark, you know that in order to pass the drivers´ test you have to glance over your right shoulder so you can see the cyclists when turning right. All Danes know how to cycle. This makes them safer drivers. Maybe a trip by bike could be made compulsory for everyone who is training for a drivers´ license?

Rear view mirrors for pickups and trucks are very important as the drivers' visibility through rear windows is little or nothing, see figure 6. The Danish Road Accident Investigation Board (HVU) analysed 25 serious accidents between right turning trucks and cyclists going straight ahead. Their findings indicated that in all the accidents the driver had failed to see the cyclist at the crucial moments when turning. The majority of the cyclists had been run over by the front wheels.

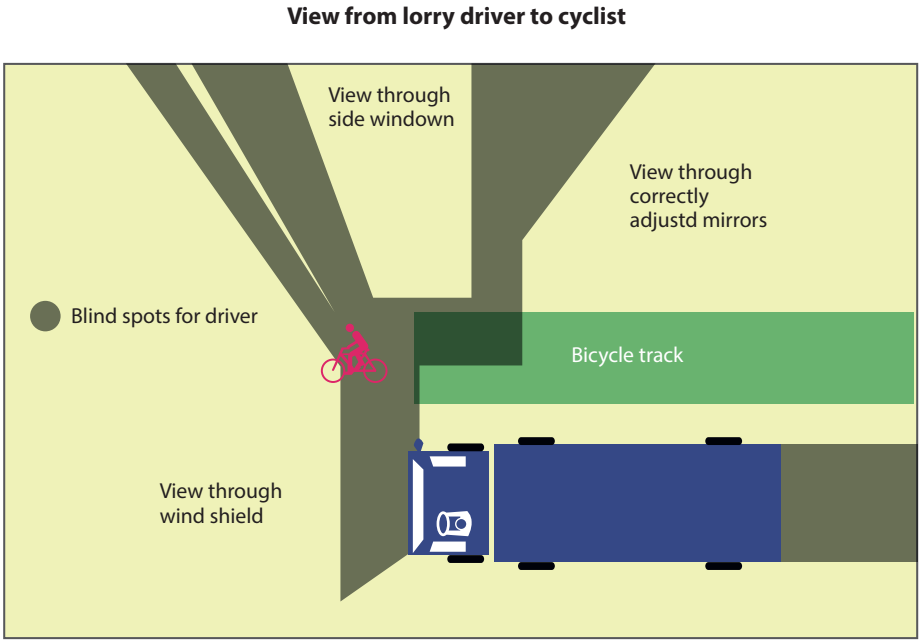

Figure 7: Blind spots (grey) for lorry drivers. Visibility can be improved by glass doors and low cabins.
(source: HVU, Danish Accident Investigation Board 2006)

The report came up with many recommendations for vehicles and drivers and for the road design. Front and side underrun protection can reduce the risk of cyclists getting caught under the truck. Badges and other decorations on the car windows reduce the visibility: they should be of limited use or prohibited.

After the report was published, the Danish police intensified the control of badly adjusted mirrors. Several transport companies also gave better instructions to their drivers on how to adjust mirrors.

Better safety can be achieved by cooperation or agreements between the actors when buying transport. When the contract for garbage collection in the City of Copenhagen was renewed for at 5-year period it included requirements for safer trucks with low cabins and glass doors.

Cars and their design is big business and the safety of the cyclist or pedestrian can be forgotten in the search for a flashy design. Some features like front guards (bull bars) can be fatal for cyclists even at low speeds. In Europe, the Euro NCAP institution gives

stars to car models for safety. The Euro NCAP now assesses cars´ safety in collisions with pedestrian. The next step should be the car's safety in crashes with cyclists.

Road design and cycle safety

In road design, the principles for safety are to minimise the number of potential conflicts between road users, to inform the road user of possible conflicts and finally to ensure that the drivers drive at a suitably low speed when there is a possible conflict. Speed is the single most important factor when it comes to being the cause of accidents which result in serious injury or death. Also, the higher the speed, the more serious the accident gets. So low speed is good both for safety and it is also good for perceived safety for cyclists.

An aspect in road design where safety and perceived safety go in opposite directions is space. More space around you and your vehicle is often perceived as safer. But when a traffic area is designed in a very spacious way with large radii in curves and wide car lanes, the car drivers increase their speed and this increases accidents and injuries.

Figure 8: "Catch the cyclists at a glance - not with the door", campaign to prevent accidents with cyclists and open car doors. These accidents are frequent in shopping streets.
(Photo: Gottlieb&Co)

Road sections

There are principally three different layouts for cyclists on road sections; cyclists and other vehicles share the road, cyclists go on a separate cycle track or cycle lane, sometimes mixed or shared with pedestrians, or cyclists go on separate paths, at a distance from or independent of the road.

Cyclists on the road

If the cyclists and cars are mixed it is important to ensure low speeds, preferably lower than 50 km/h. This can be done by using speed reducing measures, but avoid the type that can cause cyclists to fall, like plant boxes, poles, kerb stones etc. The simplest speed hump, made of asphalt across the whole width of the road, is the best for cyclist safety. Speed cameras are also effective for reducing car speed.

Cyclists on cycle tracks or cycle lanes

In Denmark, the cyclist is considered to be a vehicle and therefore the cycle tracks are mostly placed next to the car lanes and are unidirectional. If the road has car parking lanes these should be between the car lanes and the cycle tracks/lanes to reduce the possible conflicts between parking cars and cyclists. This also gives the cyclist a feeling of safety but accidents between cyclists and car passengers who open doors still present a risk.

Cyclists on separate paths

When cyclists are separated totally from car traffic they are safe from crashes with cars. But still safety needs to be taken seriously when designing a separate path. A narrow, badly lit cycle path with sharp turns in combination with slippery surface presents a serious risk and cannot be used if you take cycling seriously.

Separate cycle paths can be perceived as insecure, especially at night, and this can make cyclists avoid a path and choose the road. In some neighborhoods or areas it might be better to make good cycle infrastructure next to the road instead of paths that won't be used.

Intersections

Low speed and good visibility are important in intersections, small and large. In Denmark we use blue thermoplastic or marking with "sugar cubes" (dotted line markings 30X50 CM) to mark the cycle track through the intersection. In smaller, non-signalized intersections we continue the kerb stone bordering the cycle track on the main street to lower the car speed when crossing the cycle track.

Figure 9 and 10: "Capture island" Gyldenløvesgade - Nørre Søgade, Copenhagen. The island and the signals omit the conflict between right turnings cars and ongoing cyclists (Photo: Copenhagen Municipality)

To reduce the risk of accidents between right turning cars and cyclists going straight ahead the cyclists should be close to the cars before the turn. To be close to cars makes cyclists feel unsafe but it makes the driver and the cyclist more aware of each other. Close to the intersection there should be no parking, no bushes or other barriers between cyclist and driver. Even mixing turning cars and cyclists in the same lane has proven safe.

Signalized intersections

When the cycle tracks continue up to the intersection the cyclists can have their own traffic signals. This allows for two seconds pre-green for the cyclists and gives them a head start which makes them more visible. This can also be done by withdrawing the stop line for the cars 5 meters.

A high degree of separation in signals makes the cyclists feel safer and can also reduce the risk of accidents. This is true however, on condition that the red light is respected, both by cyclists and cars. Signals have to be clear and very visible to reduce the risk of being overlooked or misinterpreted.

Final advice

Put safety first if you want to improve conditions for cyclists. As I have mentioned, most safety features also improve the feeling of safety for the cyclist. Traffic is a risky business and when you feel a bit unsafe in a traffic situation you also pay more attention and so you act in a safer way. Information about safe behavior makes cyclists more competent and thus increases the feeling of safety.

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