4. Overview of traffic safety problems - vulnerable road users

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This presentation covers selected parts of a preliminary report in the RS7 OECD group on traffic safety and vulnerable road users. The report deals with "traffic safety and intermediate methods" and is a summary of articles received from different OECD countries.

4. 1. FACTORS AFFECTING SAFETY FOR VULNERABLE ROAD USERS

The aim of this work is an attempt to describe general patterns that can be found in connection with the appearance of accidents. The major source is intermediate data like conflict data and behavioural data. It has sometimes, however, been unavoidable to refer to studies based primarily on accident analysis since corresponding studies with surrogate data are missing. This is not so devastating as many parts of the traffic safety discussion is quite unanimous and rather independent of which type of data the analysis is based on. The common denominator for a lot of the traffic safety work is to find out what it is in the traffic process that causes safety problems. As it has been stated so many times before, it is quite impossible to extract one single cause and advise one single solution to all safety problems for vulnerable road users. It is instead a combination of factors, behavioural and environmental, that prepares the ground for unsafe situations.

From a general traffic safety point of view and especially from vulnerable road users' point of view, the traffic environment must allow the road users to make mistakes. Making a mistake should not inevitably result in being killed or severely injured. Low speeds is the fundamental principle for a safe environment. If we could make sure that all interaction between road users was performed at low speeds then it is possible to set up the following additional traffic safety principles to improve safety for vulnerable road users.

- Good view

- Easy to make decisions. It should not be too complicated to understand how to behave at an intersection.

- Enhanced attention in critical situations. The demand for an adequate level of attention is crucial.

- No feeling of right of way. The road users should not have an obvious feeling of right of way. It makes the road users less prepared for unforeseeable situations.

- A big feeling of responsibility. Road users must feel that they have responsibility for other road users' life and health. The responsibility must be mutual.

- Equality is the basis for good interaction in traffic. All road users must to a great extent take part in traffic on fairly equal terms.

- A sense of uncertainty about coming events is good for traffic safety. It makes the road users better prepared if something unforeseen happens. The uncertainty should however not be so big that it creates stress. On the other hand, there should not be any uncertainty at all when it comes to identifying hazardous situation. When the road user for instance approaches a certain type of intersection, the traffic environment must give distinct messages about the imminent demand of increased attention.

- Support for a socially acceptable behaviour. The traffic system is our greatest social system and it must work according to certain acceptable social rules.

- Integration. Very often the conditions in urban areas do not make it possible to let vulnerable road users cross in a grade-separated way. The alternative is to integrate the vulnerable road users with motorized traffic, to let the road users meet and interact, in order to "force" car drivers to interact safely.

4.1.1 Speed

There is a very close relationship between vehicular speed and safety. There are two aspects on this relationship. First the probability of an accident to take place at all, the accident risk, is dependent on the involved road users speeds. Secondly the outcome of the accident, the consequences of the accident, is highly dependent on the speed at the moment of collision. As the word implies, cyclists and pedestrians are more vulnerable than for example car drivers and passengers in case of an accident. There are many studies supporting this relationship between speed and safety and Eero Pasanen has for instance applied a mathematical model to the connection between driving speed and the safety of pedestrians (Pasanen, 1992). Here Pasanen defines pedestrian safety as the risk of being killed. It includes the probability of an pedestrian to get hit by a vehicle and the probability of getting killed when being hit. The explanatory variables in the model are vehicle speed, driver's brake reaction time, deceleration of the vehicle and time that the pedestrian remains in the vehicle's collision course. As a result of this model a speed of 50 km/h means a risk of death that is almost eight times higher compared to a speed of 30 km/h. If collision speed is less than 30 km/h, injuries to the pedestrian are often moderate. On the other hand if collision speed exceeds 60 km/h the pedestrian probably dies.

Eero Pasanen has also analysed 18 video recorded traffic accidents at two intersections in Helsinki (Pasanen, 1993). Comparison with police statistics show that 80% of the injury accidents were captured on the tape. Ten pedestrian accidents and eight including only motor vehicles. The free-vehicles, vehicles not in queue, have an important role to play in these accidents. A vehicle is defined as free if the time gap to the previous vehicle exceeds 3 seconds. All pedestrian accidents involve a free-vehicle though only 40% of the reference traffic consists of free vehicles. Eight of the pedestrian accidents involved a straight on moving vehicle. When speeds were analyzed Pasanen found that the average speed of the vehicles involved in the eight accidents was 47 km/h i.e. 9 km/h higher than the average speed of all reference vehicles. Compared to the average speed of free vehicles in the reference traffic, the average speed of the collision vehicles were 4 km/h higher.

4.1.2 Interaction

Good interaction between road users is interpreted as safe interaction. If we turn this argument upside down then the very opposite would be that bad interaction between road users creates unsafe situations. Bad interaction is often characterized by anonymity and priority to the own mobility often at the expense of safety. An interesting part here is to think of who it is that dares to put the own mobility in front of safety. Up to a certain level, a majority of the road users are prepared to give up some safety for the benefit of mobility. When the risk exceeds

what is acceptable from the instinct of self-preservation then the vulnerable road users are too vulnerable to consciously do this trade off. If the vulnerable road users still give priority to the own mobility at this point it must be assumed that the vulnerable road users are not fully aware of the risk they expose themselves to. This is for instance the case for red running pedestrians and cyclists. As an example it might be worthwhile mentioning that a typical pedestrian behaviour is to start crossing some seconds before receiving green assuming that the signal will turn green very soon and that all conflicting traffic has red. The pedestrian assumes he is walking safely, and is not prepared to interact and is for that reason even more vulnerable. The main responsibility for bad interaction most often lies with the motorized traffic. Car drivers are at least protected by a hard shell and are therefore in the position of being able to do a trade off between safety and mobility at a rather high level of risk. Thanks to all passive safety measures introduced to-day, a car driver easily gets the feeling that he can not be injured. The big number of red-running cars is a good example of this. Red-driving cars is a major safety problem for pedestrians. Good interaction is achieved when motorized traffic, either voluntarily or by force, limit their mobility and let the vulnerable road users have a more equal position in the traffic process compared with car riders. It seems as if force is a much more successful way of doing it, at least in the short run. It is unavoidable to once again mention the significance of speed. High speeds create an environment where the interaction between the road users is bad and therefore increases the probability for unsafe situations to appear. It is possible to promote interaction by lower speeds and by letting the road users get physically closer in space.

4.1.3 Expectations

Difference in expectations between road users and the fact that people sometimes have a wrong expectation of the prevailing situation, is the third factor to be brought up here in the context of factors contributing to the appearance of accidents.

How different road users' expectations can cause problems - the case with the marked zebra crossing. In Sweden, the most common measure to promote safe crossings for pedestrians, has been to introduce marked pedestrian crossings. No safety evaluation was ever conducted to establish the true safety potential. It was so obvious that pedestrian safety must increase if they were provided with an area of their own to cross at. Painting white stripes in the road and putting up signs was very cheap compared to other more sophisticated measures. It also turned out to be a very good measure to introduce with the intention of calming parents that were concerned with their children's safety, since everybody believed in it's safety potential. In 1988 Lars Ekman finalized a study where pedestrian risks on marked pedestrian crossings were compared to risk at other locations of crossing. His findings were (are perhaps still today) very controversial. Ekman concludes that the risk is higher for a pedestrian to cross on a marked zebra crossing or on a signalized marked crossing than at other intersectional crossings. Control was made for car flow and the presence of children and elderly but that could not explain the poor result of marked pedestrian crossings.

The main result is that the number of accidents per crossing pedestrian is two times higher at crossings compared with similar locations without marked pedestrian crossings. The behaviour of the car drivers as they approach a marked crossing is studied by analyzing the approaching speed and speed profile. The speed profile shows that the car drivers to a very small extent stop and let pedestrians pass. Neither does a higher degree of pedestrians present influence the approaching speed.

One explanation, according to Ekman, to the higher risk on marked pedestrian crossings could be that the pedestrian expectation of the marked crossing's safety effect is higher than the

respect car driver's show for the marked crossing. Here we have a clear case where the different road users' expectations can cause problems. Everybody is taught from childhood that the marked pedestrian crossing is the place for pedestrians to cross. This puts pedestrians into a sense of security. They are not so attentive to dangerous situations that they according to statistics should be. Pedestrians use the marked pedestrian crossing with a false security. Drivers on the other hand consider the road as their territory and pedestrians should not attempt to cross until the motorized vehicles have passed by. At locations where pedestrians feel less safe i.e. at locations with no crossing facilities, they act more cautious. The pedestrians know that they cross the road "at their own risk" and are therefore more attentive to dangerous situations.

How expectations of the normal situation can cause problems - The difference between the normal, most frequent, situation which has been handled in a safe way many times before and the prevailing in some sense extreme situation that leads up to a hazardous situation. That is, the problems arise when the expectations are not in accordance with the prevailing situation. According to the traffic safety principal about "uncertainty", traffic safety do benefit if there is a sense of uncertainty about coming events. It makes the road users better prepared if something unforeseen happens. To expand this a little, the "normal" situation can either be site and perhaps time specific or situation specific.

Site and time specific - Let us say that we have a car driver that drives through a certain intersection daily. He never meets a pedestrian or a bicyclist there. So one day he happens to pass the same intersection, but at an other time of day. He knows back in his head that there is nothing in this intersection that demands him to be extra attentive - the feeling of security is high. If a pedestrian or cyclist appears in this latter case, the buffer for handling the situation in a safe way has dramatically decreased.

Situation specific - There is a report by Summala et. al. 1995 where the connection between bicycle accidents and drivers' visual search at left and right turns is studied. This study is based on the findings in the Helsinki City accident data base, Pasanen 1992. Analyses indicated a higher accident risk between vehicles crossing a cycle path while entering the intersection to turn right and cyclists coming from the right than for vehicles turning left. So drivers' scanning behaviour was studied from video recordings in two T-junctions. The result supported the hypothesis that right turning drivers scanned the left leg more frequent than the right leg thus failed to notice the cyclists coming from the right. There was no difference in approach speed between the right turning and left turning vehicles so the difference in scanning behaviour can not be explained by difference in approach speed. An other, in this context very interesting, finding is that drivers tend to prefer detection of more frequent danger and pay less attention to information about less frequent danger. This finding supports the basic hypothesis that there is a distinct difference between the normal situation in an intersection, the situation that road users are used to and has found a strategy to handle, and the abnormal situation that creates a dangerous outcome. In the two T-junctions the normal situation would be that the most frequent and dangerous interaction for the drivers turning right is the traffic coming from the left. More attention is paid to the left leg. When the abnormal situation appears and a cyclist is coming from the right, the cyclist is usually not discovered since the driver does not include the right leg in his scanning of the intersection.

This example can be situation specific. Normally the risk of getting into safety problems is created by the motorized traffic from the left. Therefore the car driver focuses his attention to the left leg. Now, if the same driver approaches a similar intersection with the same precondition of turning right but with the big difference that he has to pass a two-way cycle

path first, then the risk is imminent that he fails to detect a bicyclist on the cycle path coming from the "wrong" direction.

In both situations the traffic environment has failed to give the correct message to the driver, there is no feeling of uncertainty, the driver has not enhanced his attention enough and is therefore not prepared to handle the prevailing situation.

Other examples on this topic are:

- The general shortcomings of two-way cycle paths at intersections. The message to the motorized traffic is not clear enough, drivers do therefore not expect cyclists to appear from the "wrong" direction. Both the car driver and the cyclist travel with the feeling of having right of way.

- The problem with too complicated intersectional design and signal strategies that are hard to understand. This makes people do bad decisions due to wrong expectations.

- The problem with red-runners. Other road users do not realize the necessity to interact when the own signal shows green. The feeling of having right of way when the signal shows green is too strong in signalized intersections..