Child Pedestrians' Quality Needs and how these needs relate to interventions

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Abstract

Cost 358 is to present a handbook on Pedestrians' Quality Needs in 2010 for all age groups. One age group is children. The main objective is to provide knowledge of pedestrians' quality needs and how these needs relate to structural and functional interventions, policy making and regulation to support walking conditions across the EU and other interested countries. This paper suggests a new way to satisfy children's rights to road safety.

According to the UN 'Children's Charter', its Convention on Children's Rights, their rights include road safety, and ratifying countries, are obliged to take all appropriate measures to implement the Convention. Child Consequence Analyses, i.e. preliminary tests of the consequences that an intended decision may have on children and young people and on their right to health, survival and to play etc. should be carried out to ensure that Children's Rights are fulfilled according to the convention.

Free movement of children in the physical environment is important for their health as well as for their social, cognitive, and motor development. With increasing age, children's desire for free movement increases - and their territory gradually expands. However, this leads to increased exposure to risk: accidents to children as pedestrians are a function of mobility.

The objektive is that children of preschool age should not encounter cars in their play areas or where they walk; though in some cases, vehicles travelling at a maximum of walking pace (or crawling speed) can be accepted. Children 7 to 12 should not cross streets at locations where vehicle speeds exceed 15-20 km/h. For older children, the same principles apply as for adult unprotected road users: they should not cross at locations where motor vehicle speeds exceed 30 km/h. This applies to routes to school, to leisure activities, and to friends.

However, other measures than low speed is needed to accomplish systematic traffic planning for children. Approaches should have only one entry and one exit lane, and typically be separated by a refuge island where pedestrians cross. This is proposed to be systematically provided at bus stops, at schools, in residential areas, and other places where children can be expected to walk. For traffic quantity and composition, the aim is that traffic flows should be low, with few or no heavy vehicles. Layouts and sections should have clear visibility and clarity. Countermeasures are proposed to be used in a systematic way to achieve a safe and independent freedom of movement for children.

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Introduction

According to the statistics 35,000 children are injured on European roads every year, 250 of these children are killed. In 2005 in Italy as many as 9,924 children were injured on the roads, 97 died (Safeway2 school's homepage, 2009). Child pedestrians (younger than 15) have three times the risk of being killed in urban traffic compared with the groups with the lowest risk, young people between 15 and 24 and adults 25 to 44 years old according to Swedish travel survey data (Gustafsson and Thulin, 2003).

According to the UN 'Children's Charter', its Convention on Children's Rights, and ratifying countries, are obliged to take all appropriate measures to implement children's right to health, survival and to play etc. Child Consequence Analyses, i.e. preliminary tests of the consequences that an intended decision may have on children and young people should be carried out to ensure that Children's Rights and Needs are fulfilled according to the convention (Swedish Road Administration, 2003).

Quality needs of children

The quality needs of children are strongly linked to their age. A review of safety problems and children's characteristics as road users aiming at defining appropriate age groups with specific needs concerning their right to survive, to play etc. is presented below.

Toddlers are at risk on driveways and in other relatively protected areas, since they are drawn to moving vehicles rather than avoiding them (Schieber and Thompson, 1996). Children from the age of 18 months have the ability to fantasise and the physical ability to escape from their surroundings.

Figure 1. Already during their earliest years children develop the motor skills that enable them to run and jump (Photo L. Leden).

It is widely accepted that pre-school children cannot experience a viewpoint or attitude other than their own. If children can see someone else, such as a car or driver, they tend to think that the other person can see them even though they may be standing between parked cars.

Midtland (1995) and Schieber and Thompson (1996) argue for a break point at 6 or 7 years. The difference between that age group or younger compared with older children is considerable in

terms of [safe] road-user behaviour. The difference is assumed to depend largely on deficiencies in attention and cognitive abilities, rather than on inadequate perception. There can be significant differences between the behaviour of children when they cross a street at a pedestrian crossing (MacGregor, et al, 1999).

Based on the UN 'Children's Charter' and the above review of safety problems and characteristics of this age group of children it is suggested that pre-school children should not encounter cars in their playing and walking areas. In exceptional cases, they can interact with vehicles travelling at a maximum speed of walking pace.

Acceptable speeds of conflicting motor vehicles are further elaborated below for different age groups. The reason to elaborate on appropriate speeds is that it affects children's possibility to cross streets safely and to survive if an accident occurs, as will be explained below.

The next stage lies between age 7 and the teens (Schieber and Thompson, 1996, Connely et al, 1998 and Arnold et al, 1990). At this age, children examine the environment logically and grow accustomed to forming hypotheses about it. Such skills can be used to recognise dangerous situations, but children's behaviour becomes inconsistent because they are still learning how the traffic environment works. In their teens, people become able to think in abstract terms and understand events even though they themselves have not experienced them. It then becomes possible to consider a vehicle's speed and distance simultaneously. Cognitively, crossing the street is a difficult task, and children have not developed the necessary capabilities before the age of 11 or 12. Children under 12 have difficulty estimating the direction, speed, and distance of vehicles in motion (Piaget 1969, von Hofsten, 1980 and 1983 presented in Arnold et al, 1990, Leden, 1989, Foot et al, 1999, and MacGregor et al, 1999). As early as 1969 Piagets suggested theories that children make decisions that lead to dangerous road-user behaviour because of their inability to understand the connection between time, speed and distance. Therefore, the tendency of children to run out in front of cars can make sense in the child's conceptual world (Cross, 1988).

Younger children accept the same distance gaps when crossing a street in front of cars travelling towards them irrespective of the speed of the cars (Connely, et al, 1998), i.e. children assume shorter time intervals when the vehicle speeds are higher, and longer time intervals when the speed is lower. Most children make 'safe' assessments when vehicle speed is low, but not when the speed is high. One conclusion is that children younger than nine cannot make safe assessments of time intervals to vehicles in traffic. Similar results were produced by Demetre and Lee (1992), with children choosing shorter time intervals than adults; however, children also missed more safe time intervals, so that in some cases children were more careful than adults.

Based on the UN 'Children's Charter' and the above review of safety problems and characteristics of this age group of children the following objective concerning vehicle speeds is suggested. Children of age 7-12 years should not cross at locations where vehicle speeds exceed 15-20 km/h. Such a speed improve interaction and gives legal priority to pedestrians and cyclists over motorists according to Dutch and other countries experience with Woonerf. It is proposed to use a modified Woonerf concept at locations where children of age 7-12 years have to cross.

Intelligent Speed Adaption, ISA prevent the driver from travelling faster than the local speed restriction. Therefore the objectives can be implemented immediately as soon as there is enough political support. Also speed reducing devices are useful.

Another possibility is to activate the speed limit only when needed, in principle when school children are present along the road or is to cross at the pedestrian crossing. Leden et.al. (2008) describe two different systems to activate the speed signs or Advanced Driver Assistance System (ADAS). The first is tracking the schoolchildren. All school children have small transmitters (for example in a key ring), sending a signal, which is activating the system, i.e. lowering the speed

limit, at a certain distance from the receiver at the pedestrian crossing. The lower speed limit is shown as long as a signal is received from any transmitter. There could be more than one receiver if there is a need to reduce speeds also when school children are approaching other locations. The second system is based on microwave or infrared surveying of a specified area around the pedestrian crossing. When the system detects a movement within the specified area the system is also activated and the lower speed limit is shown. When a signal is received from any of the two systems, the speed limit is changed to 30 km/h and the text “Reduce Speed” is shown. When no signal is received, the variable speed sign is turned off and the base speed, typically 30 km/h, is shown again after a certain threshold time of, for example, 20 seconds.

In the early eighties Von Hofsten suggested that children’s development as road users depends on their absorbing more information about their environment over time, so that the information flow gives guidance about what is required as a road user. Moreover, young children lack experience of crossing streets and therefore cannot do so safely, since they do not know what to watch out for in traffic (Foot et al, 1999).

The ability of children to cross a quiet street, cross a street with parked cars, and cross a street at an intersection improved after training (Rothengatter, 1984, Van Schagen 1988). However, research has shown that training children is not clearly linked to their true behaviour in real traffic, nor what behaviour can be considered to be safe, or regarded as undesirable, in traffic. Training children to be in traffic can give them better knowledge about how to cross a street safely, for example, but does not mean that their behaviour will improve in terms of acting more safely. Nor can it be established that training leads to a blind faith in the person’s ability and thus to new dangers. An alternative possibility may be that it is important to train children in safe road behaviour. It is suggested that what children need is practical knowledge instead of descriptive knowledge.

Children’s ability to choose safe ways to cross a street, i.e. their assessment of safe routes or places to cross a street, also increases with age (Ampofo-Boatang et al, 1993, Lee et al, 1984). Younger children do not understand, either, that an obscured view of cars is less safe for crossing the street (Demetre and Gaffin, 1994). Mobile telephones can be equipped with intelligent signposting systems to recommend the safest route; and also to allow parents to keep track of children (see e.g. TomTom).

Car drivers bear the responsibility for child safety in traffic, along with the children’s parents. It is motorists’ inadequate knowledge and anticipation of how children can react that constitutes the threat to child safety, so it is the drivers who should apply strategies for driving safely on roads where there are children. With the right arrangements, education of children can be seen as a component in preparing them for traffic, but that does not mean that we can trust the results of the training. The traffic environment should be designed and regulated so that motorists can take greater responsibility.

Figure 2. A 5th grade pupil thinks it is dangerous to use the pedestrian crossing at the intersection because "You feel all dizzy" (Photo L Leden).

Another extremely important Quality Need especially for children is to see and be seen. Obstacles to visibility are therefore adverse factors in child safety, see e.g. Räsänen and Summala (1998). Children are killed more often than other age groups at places with sight obstacles (Johansson, 2004). When children were killed at crossings, there were sight obstacles in 36% of cases, and on stretches of road in 60% of cases.

Measures for increased safety

As mentioned above ISA prevent the driver from travelling faster than the local speed restriction. Also speed reducing devices are useful. Efficient ones are humps and speed cushions, see e.g. results of a meta-analysis of the effect of speed reducing devices by Elvik and Vaa (2004), who estimated that humps reduce the number of crashes by 48% (95% confidence interval of effectiveness: -54%;-42%). The location of humps and speed cushions might be crucial. Leden, Gårder and Johansson (2006) suggest that speed cushions located at a further distance about 10 m before the crosswalk might improve interaction between child pedestrians and motor vehicles (and also be an advantage to elderly pedestrians).

To satisfy the Quality Need to see and be seen on streets where parking is permitted, it is proposed that there is always an extended pavement at pedestrian crossings to decrease road width and increase visibility between parked cars. However, the safety effect may not be dramatic. Elvik and Vaa (2004) estimate that pavement extension reduces the number of accidents by 5% (confidence interval: -58; +117). Since children are more likely than others to step out between parked cars (Johansson, 2004, Demetre and Gaffin, 1994), it is clear that such measures are more important for them than for other age groups, since small children can be entirely hidden behind cars.

The street should have only one lane in each direction, since more than one lane creates problems especially for children. At signalized multi-lane approaches, the stop lines should be pulled back to increase the view and visibility of children. In principle this is also needed at non-signalized crosswalks, but at present it is not feasible due to legal reasons. It is clear that this type of measure is more effective for children than for other age groups since children are more often involved in accidents at places with more than one lane in the vehicle direction. Children were

more often involved in crashes with overtaking cars than other age groups were (Johansson, 2004).

There should always be refuge islands in the middle of a road at pedestrian and cycle crossings. Elvik and Vaa (2004) estimated that refuge islands decrease the number of accidents by 18% (confidence interval: -30; - 3). Refuge islands are effective by simplifying the crossing task as there is only one vehicle direction to be taken into account, and the distance to a safe area (the island) decreases.
Mixed phases at signal-controlled crosswalks should be avoided. The number of personal injury accidents increase by 8% (Elvik and Vaa, 2004). When crossings are signal-controlled, there should be separate phases for pedestrians and right or left turning traffic. If this is not possible, the pedestrian phase should start several seconds earlier than the vehicle phase.

Intelligent signal-controlled crossings for pedestrians should automatically detect pedestrians, as well as prioritising and adapting green phases. As an alternative or supplement to pedestrian pushbuttons, highly placed microwave and infrared sensors are used to detect pedestrians automatically. Intelligent systems have also been developed for marked non-signalized pedestrian crossings (see e.g. Jarlebridge AB's home page, 2007).

Figure 3. The risk of collision between cycling school children and motor vehicles was high at intersections controlled by traffic signals with a mixed phase (Leden, 1989).

To increase orientability, it is proposed that footpaths and cycle paths be moved to sections of road between intersections to reduce the number of directions vehicles can come from, assuming that vehicle speeds are low. Leden (1989) found that the interaction between children and drivers can increase if the crossing point is on a section of road where vehicle speeds are low, which means that speed reducing devices or ISA has to be implemented to secure safety at the crossing.

Design principles for child traffic safety

The first step in achieving a safe traffic environment is taken when planning an area. Localisation, separation, and differentiation principles have traditionally been considered to be effective in achieving traffic safety. Localisation means that an area should be designed to reduce traffic flows and conflicts. Separation means that different kinds of traffic are kept away from each other horizontally, vertically, or in time. Differentiation means that long-distance through traffic is not

mixed with local traffic and that traffic should not go through built-up areas where it does not have a destination (Statens planverk, SCAFT, 1968, Englund et al, 1998).

The design principles for traffic configuration for children described above can be summarised in the following hierarchical systems where Requirement No. 1 is the most important:

1. The objective is that children of preschool age should not encounter cars in their play areas or where they walk. In exceptional cases, vehicles travelling at a maximum speed of walking pace can be interacted with. Children 7-12 years should not cross at locations where vehicle speeds exceed 15-20 km/h. For older children, the same principles apply as for adult unprotected road users: they should not cross at locations where motor vehicle speeds exceed 30 km/h. This applies to routes to school, to friends and to other leisure activities. Intelligent Speed Adaption, ISA prevent the driver from travelling faster than the local speed restriction. Therefore the objectives can be implemented immediately as soon as there is enough political support. Also speed reducing devices are useful.

Very efficient ones are humps and speed cushions, see e.g. results of a meta-analysis of the effect of speed reducing devices by Elvik and Vaa (2004), who estimated that humps reduce the number of crashes by 48% (95% confidence interval of effectiveness: -54%;-42%). The location of humps and speed cushions might be crucial. Leden, Gårder and Johansson (2005) suggest that speed cushions located at a further distance about 10 m before the crosswalk might improve interaction between child pedestrians and motor vehicles (and also be an advantage to elderly pedestrians).

2. Approaches should have only one entry lane, which is proposed to be systematically provided where children cross streets, at bus stops, at schools, and in residential areas. Bus stops and school buses need special equipment to ensure safety for children.

3. For traffic quantity and composition, the aim is that traffic flows should be low, with few or no lorries/trucks or buses. When heavy vehicles are involved, the degree of seriousness of accidents was independent of vehicle speed (Leden, Gårder and Pulkkinen, 2000). However, the chance of accidents occurring varies with speed. Therefore, it is even more important that safety measures are implemented if collisions with heavy vehicles are to be avoided.

4. Layouts and sections should have good visibility and clarity. There should always be refuge islands in the middle of the road at pedestrian and cycle crossings, both at formal crosswalks and at other locations where pedestrians frequently cross.

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