# 8.Urban density and accident susceptibility for young pedestrians

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Pedestrian accidents are particularly prevalent during childhood : in 1994 in France, pedestrians under 15 represented 28% of pedestrian accidents as a whole. For children, the resulting injuries are not only associated with mortality and morbidity with the serious consequences that ensue, but also they affect there day to day life in big cities. Traffic is a constant source of danger and as such is in part responsible for restricting the autonomy of young children and their use of space in large urban areas. The educative role of the city is deferred until children have grown older which does not seem to be the case in small towns or rural or even semi-urban communities, where a child comes into contact with his natural environment at an earlier age.

In this paper, our objective is to substantiate current hypotheses concerning the type of psychological or even cognitive factors thought to be at the root of the accident-causing errors attributed to young children in traffic. Then, we will try to identify what, hypothetically, could be hazardous urban situations for children.

The interest of the question is to envisage road crossing layouts better adapted to a child capabilities, facilitating their movements and their autonomy in large urban areas which seem to be in themselves somewhat hostile towards this population category.

## *8.1. DIFFERENT POINTS OF VIEW ON THE VULNERABILITY OF CHILDREN IN THE CITIES.*

Our interest for the question originated from different points of view on the subject, as followed.

### 8.1.1. Vulnerability factors of children in traffic

Over the past twenty years, considerable research work has dealt with accidents involving children. It is known that young children are over represented in pedestrian accidents as a whole, although this cannot be attributed to their being more exposed to danger than during other periods of their lives (Johan & Engel, 1983). On the contrary, they cover shorter distances on foot and spend less time in traffic than adolescents or adults. If they are more

accidented than other categories, it is more likely to be due to factors endogenic to childhood : their behaviour in traffic. What should a pedestrian do to cross a road, and what can lead to error? To locate the error, reference is usually made to a description of the activity, which theoretically is necessary to perform a given task, in this case crossing a road. Firth (Firth, 1982) identifies six different stages that are, in theory, essential :

when preparing to cross:

- choosing where to cross: on or not on a pedestrian crossing ... (1)
- when to cross, which is then decided after 4 successive and indissociable stages:

  observation, i.e searching for relevant information (relevant to safety) on the environment (2),

  the perceptive process (physiological and cognitive) used to analyze the information acquired during the previous phase (3),

  a comparative evaluation of the perceived objects (4), the decision of whether or not to cross, in which case the pedestrian restarts the task at phase 1 or 2 as above (5).

  the crossing itself (6).

The performance of each stage varies in importance in relation to the safety of the crossing. Thus, the choice of where to cross could be unfortunate (e.g. no visibility), and the pedestrian could compensate for this deficiency by increasing his alertness. Inversely, the stages linked to perceptive behaviour would seem to be essential : crossing the road without monitoring the traffic, the crossing can only be safe if there are no vehicles on the road at this precise moment in time. However, as has been noted, perceptive behaviour or more simply paying attention to traffic, is relatively complex and involves a succession of several different types of activity, before the behaviour can actually become effective: observing, analyzing information, evaluating this information, decision-making.

## 8.1.2 Current hypotheses

### *8.1.2.1. The attention children pay to traffic*

Paying attention, to traffic raised several questions. The first was to find out whether this actually exists, in other words : do children fail to look before crossing, does the observation phase really take place? Although it is very difficult to monitor this in an accident situation, it is now thought, e.g. Thomson (Thomson, 1991), that children tend to pay more attention to traffic (quantitatively) than adults. This, in fact, refers to the degree of attention given to traffic. There are two contradictory hypotheses on this subject, one dealing with evaluating speed and anticipating vehicle movement and the other with collecting visual information.

### *8.1.2.2. Evaluating speed*

Assuming that children fail in tasks where they are asked to anticipate the movement of a mobile object (Piaget, 1964), some authors (Lee, 1984, van Schagen, 1988) thought that the accidental error would appear when evaluating vehicle speed and choosing when to cross. For others this error could, in the case of children, appear when collecting and analyzing visual information.

### *8.1.2.3. Searching for visual information and deciding when to cross*

According to Vurpillot (Vurpillot, 1971), children up to the age of about 9, search for visual information without structuring in relation to what is required of them. This is unreliable. In traffic, where there are also many details they are unable to see because of their small size, failure to structure when searching for visual information that can be of use when crossing could certainly be a vulnerability factor. In this context, we carried out the following experiment (Laya, 1989).

Three groups of subjects, one comprising adults and the others young people aged 6 1/2 and 11 were shown a series of slides representing a street as seen by a pedestrian about to cross. They were asked to assess for each slide, whether it was possible to cross or not. While the subjects were looking at each slide, we recorded their ocular movements and fixation points. The results show that the number of fixations on a same object (e.g. pedestrian crossing, a vehicle...) were greater with the youngest subjects, as if they needed more time and exploratory activity to identify an object (this has in fact been noted by Vurpillot in other situations). Also in this group, however, fixations were limited to the crossing area, and were rarely found in the more distant areas; as if only the crossing area needed to be monitored. In the adult group, ocular fixations were immediately divided between the "strategic" areas: the crossing point, and the different axes from which vehicles could approach. The behaviour of the group comprising 11 year olds was sometimes similar to that of the younger group, and sometimes similar to that of the adults, depending on the complexity of the situation in question. If this visual exploration strategy were applied in an actual situation this would mean that:

1. a child would take longer than an adult to perform the visual exploration phase,

2. looking is not sufficient to guarantee a child's safety, visual monitoring must not only cover the area that the pedestrian is about to move into, but also enable him to anticipate the approach of a vehicle on courses that may conflict with that of the pedestrian.

It was also noted that, the greater the amount of visual information contained in the visual situation shown, the more visual scanning was restricted to the crossing area. This led us to suppose that the complexity of the " visual scene" provided by a situation where the pedestrian must cross the road, could prove more difficult for young pedestrians to analyze perceptively, and could result in more errors when crossing roads.

### *8.1.2.4. Discussion*

The two types of hypotheses were not however exclusive one to another, as some accidents could have resulted from an erroneous evaluation of the speed of approaching vehicles and others from poor visual exploration. Recently, however, Demetre (Demetre, 1992) resumed research work into the evaluation of crossing times and reached different conclusions on the part it plays in the errors made by young pedestrians. He compared, in a simulated situation, the decisions made by young children and by adults to cross when a vehicle was approaching. According to the results obtained, the decisions made by children are no more hazardous than those made by adults. On the other hand, children are more likely than adults to overestimate risk, and miss a greater number of opportunities to cross, which is in line with other research work which noted that children wait longer than adults before deciding to cross. He suggests that the dangerous decisions made by children in traffic result from errors of attention when collecting information, and not from an erroneous time evaluation.

This result strengthens our view that it is highly probable that the accident-causing error for young pedestrians:

- originates when the child is visually exploring the state of traffic to decide whether or not to start crossing (task phase 2 ) .

- is more likely to occur in urban situations that are saturated with visual information.

The research on which these considerations were based was almost completely carried out in a laboratory or in semi-simulation. Very little covered actual accidents and if it did, it was obviously only for retrospective studies. However, as seen by Grayson (Grayson 1975) it was difficult to reach conclusive results by observing a phenomenon as sensitive as, for example, the direction of a glance. Furthermore, is it not true that the shock caused by an accident involving a child acts retrospectively on the memory of witnesses and to an even greater extent on those involved? Other research has been directed towards child behaviour outside the accident phenomenon. It was performed in a semi-simulated situation, either by recreating a specific situation in a laboratory (Cambon de Lavalette, Laya) or on an actual street (Lee, van Schagen, Thomson). However subjects were asked to reenact part of their behaviour e.g. the decision they would have made in such a situation.

This research dealing with the cognitive factors assumed to be involved in driving behaviour, is extremely interesting as it provides a way of devising a conceptual tool with which to further investigate the accident-causing phenomenon in childhood. From a methodological standpoint however, this research is open to criticism. It deals essentially with the standard behaviour, supposedly spontaneous, of children in traffic and not their behaviour in an accident situation Furthermore, the situations are not actual road situations. Lastly, the behaviour is described using a statistical method. As the accident-causing phenomenon is extremely rare, how therefore can the observations be categorized? Is it not true that the residual data in fact represent potential accidents? In sum, it has become essential to match these hypotheses based on a spontaneous activity with real accidents that occur during the course of this same activity. This is not however an easy task.

It is in no way possible to attempt to control phenomena as tenuous as the value of a glance in the course of an unpredictable event. We are therefore faced with a need to develop a second level of hypotheses, relating for example to situations in which this event could occur. This is

what has been done in this instance, by assuming that the density of the urban fabric may provide an environment in which accidents involving children are more likely to occur.

To summarize, a certain amount of research has been aimed at identifying the factors which, when present in young children, could be considered to have led to the act that triggered the accident : namely their poorly structured visual attention in relation to the urban environment. If this assumption were proved valid, it would then be probable that the frequency with which accidents involving children occur increases as the environment renders perceptive structuring more difficult. This was suggest by some results as followed.

## *8.2. URBAN VARIATIONS IN CHILD ACCIDENT.*

A previous research work on the accident susceptibility of young pedestrians (B. Cambon de Lavalette, 1993) was aimed at providing a better definition of the population categories at risk. A very significant variation in the accident susceptibility of young children was noted in relation to the size of the urban areas in which these accidents occured. In this research, we compared the frequency of accidents involving children under 15 in several different urban categories. These categories ranged from rural communities, urban areas with populations of under 5000, 5000 to 20 000, 20 000 to 50 000, 50 000 to 100 000 up to the city of Paris. Not all the children seem to be exposed to the same risk, those in large urban areas being more frequently exposed to risk than those in the other categories. The results also showed a constant accident susceptibility risk according to the size of the urban area. The larger the urban area, the greater the number of accidented children. The city of Paris, where a far greater number of children are involved in accidents, is unique in this respect : 8 times more than in rural communities and twice as many as in urban areas with over 100 000 inhabitants. Greater Paris, if the inner city is excluded, is no different to other large urban areas. The reason for this variation can probably be found in the density of the urban fabric. In Paris, space is used to a maximum. It is probable that a specific factor of cities is the intensive use made of public areas, and the uniformity of this density throughout the city. So in view of current hypotheses on child accident factors, it would appear that the density of the urban fabric may, in fact, produce an environment in which accidents involving children are more likely to occur.

### 8.2.1 Research project.

We therefore assumed that a complex environment that contains a wealth of all types of information and from which pedestrians have to quickly make a relevant choice, should make the task more difficult to perform and be the cause of additional error, and consequently accidents. Urban environments such as these correspond relatively well to the environment found in city centers where there is complex structuring of the urban fabric and where, due to city life itself, vehicle and pedestrian traffic is constant and where visual stimulation, other than traffic, acts as a continuous "fading" for passers by. The concept of density is relative to that of population, land-use, buildings, interchanges, flows and space. This type of environment, with

both the complexity of its spatial layout and the density of visual information must, for children, prove difficult when collecting visual information (due to a masking effect), visual structuring and selecting information. They could therefore be involved in more accidents when moving in this type of environment than in a more peaceful environment, where it is easier for them to cross roads.

This assumption may perhaps prove to be true in the work carried out on children in central Paris where their vulnerability is twice that of children living in other large urban areas. This has still to be substantiated.

If this can ultimately be proved, we are also fully aware that other variables influence accident occurrence upstream from the accident itself and before the pedestrian has performed the action that led to the accident : time spent in traffic i.e. exposure for example. Main roads with a reputation for being "hazardous" (due to their density and the speed of vehicle traffic) are used less frequently than others. There are also fewer accidents involving children on these roads.

Epidemiological research has revealed a link between the number of accidents and data related to the urban environment. For instance, it has often been noted that accidents involving children occur in the vicinity of their homes. The hazardous nature of the environment is not the only variable in question, the frequency with which they cross this area also increases their exposure to danger. If the accident susceptibility of a certain type of urban environment is to be studied, the number of children who live there has to be taken into account.

Other population-related variables have also been noted. According to Rivara (Rivara, 1985) children from low-income families appear to be more accidented than others. Similarly, he also found a relationship between accidented children and the size of their living space, in that these children are more likely to live in small apartments. It is probable that the lack of living space encourages them to play more frequently in the street.

In order to prevent interference from the child exposure rate variable in their area of residence (the greater the number of children the greater the number of accidents), the urban density coefficient will be weighted using the number of children living in the area. The SEG of the parents will also be taken into account.

The result of "household surveys" carried out by INSEE (French Government Statistical Office) will provide additional information on the mobility of children in urban areas.

## *8.3. CONCLUSION*

In this paper, we saw that child capacities are poorer than adult's to perform the task to crossing the street, particularly in scanning the environment as a whole. So, we can expect that, on average, the more the traffic environment will be complex, the more the task will be difficult to perform by children. If so, the density of urban fabric (e.g. the number of streets at crossing place, number of crossing place, traffic density, shops, local live...) will make the task more difficult for children, and provide more errors and accidents.

It will be necessary now to evaluate child accidents from this point of view.

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