Developing Safe Route Planning Strategies in Young Child Pedestrians

JAMES A. THOMSON

This paper identifies deficiencies in young children's route planning strategies in traffic contexts and reviews intervention programs relating to this ability. Evidence concerning age-related changes shows that only a small proportion of children aged 5 years are able to construct safe routes to a destination, with the proportion increasing steadily through the middle childhood years. Intervention programs utilizing pre-test/post-test comparisons and no-treatment controls show that 5-year-olds' abilities can be improved dramatically. Longer term stability of such improvements is also assessed. Intervention programs tailored for use with groups of young children and for use by parents from socio-economically deprived areas of Glasgow, Scotland, are also evaluated.

Most road crossing strategies are concerned with the mechanics of the crossing task itself—for example, with ensuring that children stop at the kerb; look in appropriate directions for traffic; and cross the road without running (Sargent & Sheppard, 1974). Little attention has been paid to *where* crossing takes place. However, analysis of child pedestrian accidents suggests that certain locations and road structures crop up repeatedly, raising the possibility (a) that such locations are intrinsically dangerous and (b) that young children may not recognise this nor know what action is appropriate when they are encountered (Ampofo-Boateng & Thomson, 1991). Common examples of such locations include parked vehicles or other roadside obstructions; bends; hills; locations where visibility is restricted by hedges, bushes, walls or similar street "furniture"; and a variety of junctions or intersections. The features that such road structures seem to have in common is either that they obstruct the child's view of the road (and drivers' view of them); or else the structures are complex, thereby taxing the child's attention and information-processing capacities. Clearly, it is essential that children understand the dangers posed by such locations and know how to find safer ones. The problem is crucial because if children attempt to cross on the brow of a hill,

Direct all correspondence to: James A. Thomson, Department of Psychology, University of Strathclyde, Glasgow G1 1QE, Scotland.

for example, then they will be in considerable danger no matter how "good" their attitude to safety or how well they may have mastered the mechanics of the crossing task itself (Ampofo-Boateng & Thomson, 1990).

To examine children's perception of risk in such situations, we asked children between 5 and 11 years of age to construct "the safest possible" routes between specified locations in the streets near their schools (Ampofo-Boateng & Thomson, 1991; Thomson, Ampofo-Boateng, Pitcairn, Grieve, Lee & Demetre, 1992; Ampofo-Boateng, Thomson, Grieve, Pitcairn, Lee & Demetre, 1993). Children were asked to lead the experimenter to their preferred road-crossing location, and to indicate through pointing their route across the road. The experimenter then recorded the location and route on a map of the road layout. The starting position for each route was always at a dangerous location: that is, walking directly to the destination was never a safe option. Thus, the children had to actively construct a route taking relevant environmental features into account. Four sites were visited on each test session and four routes were constructed at each. The tests were repeated on three separate occasions, so each child generated a total of 48 routes. Each route was then scored on a 4-point scale from very unsafe to safe. The latter category comprised routes which we considered to be the safest available had we actually permitted the child to cross the road.

Figure 1a shows the proportion of such safe routes generated by children in each age group: that is, the proportion that satisfied our criterion of being safe enough for use in a real road crossing situation. A clear developmental trend is apparent, with older children constructing a far larger proportion of safe routes. Among 11 year-olds, for example, 75% of the routes were deemed to be safe ones. By contrast, only about 10% of the routes chosen by 5 year olds fell into this category.

The routes constructed by younger (5 and 7 year-old) children were characterized by two fundamental errors. First, there was an almost complete failure to appreciate the dangers posed by the location or local road structure. Not only were the children unable to say *why* the sites were dangerous, they would not accept *that* the sites were dangerous in the first place. This confirmed the results of earlier experiments in which great trouble was taken to find a means of eliciting appropriate responses from young children (Ampofo-Boateng & Thomson, 1991). As in this study, we seldom found evidence of even elementary comprehension of such dangers. Not until around nine years do children begin to appreciate why a sharp bend or the brow of a hill are dangerous places to cross the road.

Second, younger children tended to think that the most direct route to the destination was the safest. Because the destination was never placed directly opposite them, this meant that they often favored walking *diagonally* across the road. They frequently suggested doing this even at cross-roads where the strategy meant exposing themselves to danger from all directions! They would justify this by saying they were going "straight across the road"—an apparent misinterpretation of common advice to young children. They apparently failed to realize what is meant by "straight" in this context and they certainly failed to realize the purpose of the advice, namely to minimize the time spent on the road. The finding represents one of many illustrations of how literally and inappropriately children may follow verbal

rules, especially where these are taught out of context (Thomson, 1991; Thomson, Ampofo-Boateng, Pitcairn, Grieve, Lee & Demetre, 1992).

We also noticed that the younger children's judgements were heavily influenced by whether or not cars were visible at the time they were asked to make their judgement. We have found that children are very sensitive to the presence of cars and will regard any site as dangerous if cars are visible in the vicinity (Ampofo-Boateng & Thomson, 1991). This does not always mean cars that happen to be approaching the point of observation: the rule is quite often applied to distant cars passing on neighboring streets—or even to cars moving in the opposite direction. Once again, the children seem to be adhering rather rigidly to a rule they have been taught, namely "don't cross if you see cars." Of course, such a rule might be interpreted as safe, if a little conservative.

Unfortunately, when no cars are immediately visible children show a strong tendency to judge the site as safe. Thus, the brow of a hill or a site where visibility is limited by obstructions are almost always regarded as eminently safe places to cross the road. The children completely fail to realise that such sites are dangerous precisely *because* no cars are visible. Not until about nine years of age does the danger posed by such situations begin to become apparent to them (see Demetre, this issue).

These decisions would clearly place children at risk if taken in real traffic. It seems certain that children should be taught how to make such judgments. However, at present, no educational programs take this problem seriously. Indeed, most programs simply make the erroneous assumption that children can recognise a safe or dangerous site when they see one, and that children need to be instructed in how to monitor for traffic when attempting to cross from any given location. We have therefore devised a program of training aimed at improving

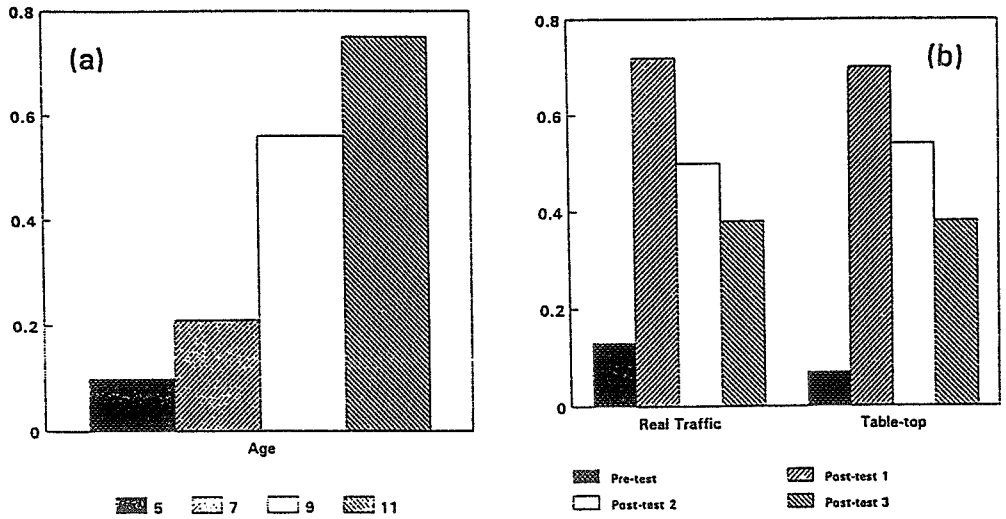

Figure 1. Mean proportion of constructed safe routes as a function of (a) age and (b) two practical training methods.

children's judgements concerning safe crossing locations and routes. The program was devised with five year-olds as the target group and was designed to tackle the two main errors committed by these children: failing to appreciate the danger posed by the various locations; and heading straight for the target when crossing.

TWO ACTION-BASED METHODS FOR IMPROVING ROAD SAFETY JUDGEMENTS

In this study, children were individually trained in one of two ways: at the roadside in streets near their schools; or on a table-top traffic model set up in their classroom. There is now a considerable amount of evidence showing that practical training is the most effective way of teaching pedestrian skills and that, in general, the closer training mimics the natural situation the better (see Thomson, 1991; Thomson, Tolmie, Foot & McLaren, 1997, for reviews). However, while we do not doubt that real-world training is the ideal to aim for, we were also conscious of the difficulties of carrying out substantial amounts of training in this way. Aside from practicalities like the weather, roadside training is time-consuming and requires a good deal of advance planning and organization. We were therefore interested to compare the effectiveness of models in improving children's judgements. Of course, models might be thought to constitute a relatively weak simulation of the real traffic environment. On the other hand, earlier studies by ourselves and others have obtained rather positive results with models (van Schagen, 1988; Ampofo-Boateng & Thomson, 1991). This encouraged us to investigate the approach further.

Both training groups were pre-tested on three separate occasions in order to establish baseline measures of skill. These tests were all conducted at the roadside, even where training subsequently took place on the model. Thus, we were interested in the extent to which training would transfer to judgements in the real traffic environment. In the case of the roadside group, the sites used for test purposes were quite different from those used for training. The children were retested immediately after training ended (post-test 1) and a further test was given approximately two months later (post-test 2) to determine how robust the training would prove in the longer term. A final test was held approximately eight months after training ended (post-test 3). In addition, we obtained control data from age-matched children who had received no training at all.

The aim of the training was to get children to appreciate the dangers posed by: (1) obstructions limiting their view of the road; (2) intersections where relatively complex traffic movements might take place; and (3) the risks involved in meandering across the road. In doing so, we adopted an indirect, structured learning approach in which our aim was to guide the children's thinking so that they would discover the error of their judgements through their *own* rather than through *our* reasoning. At all costs, we wanted to avoid giving the children a list of "do's" and "don'ts" to be applied blindly. Rather, our aim was to get the children to discover *principles* which they could then apply to a wide variety of situations, including ones they had not yet encountered. Detailed descriptions of the training procedure can be found in Thomson et al. (1992) and Ampofo-Boateng et al. (1993). Each child

received six training sessions, each lasting approximately 30 min, at the rate of one to two sessions per week.

The results are presented in Figure 1b. It can be seen that prior to training the children constructed very few safe routes, as in the previous study. By contrast, after training their judgements improved dramatically, with up to 70% of the routes falling into the "safe" category. Referring to Figure 1a, it can be seen that this places trained 5 year-olds almost at the performance level of untrained 11 year-olds. Moreover, both training methods proved equally effective in improving children's judgements. By contrast, control children showed no significant improvement at all. After a two month delay, however, there was a significant deterioration in the proportion of "safe" routes constructed, followed by a small but non-significant further deterioration over the ensuing six months. Nevertheless even eight months later, trained children continued to perform closer to the level of 9 year-olds than to control children.

These results clearly are encouraging. Whereas untrained children show little comprehension as to why such roadside locations are threatening and regularly make dangerous choices, children who have undergone a short program consisting of only six training sessions show greatly accelerated understanding of the problem and produce a far greater proportion of safe routes. Therefore, it would seem reasonable that such training be encouraged as an important element in road safety education.

Unfortunately, there are problems associated with implementing practical training programs. To train children individually is clearly time-consuming and labor-intensive, and it is hard to see how this could be accommodated within the resources that are available in most countries. Even though good results were obtained after only six 30-min training sessions, it is still hard to see how any of the agencies currently involved—such as road safety officers, teachers or the police—could possibly cope with such a burden. This raises by far the commonest objection to proposals for practical training, namely "it would be a good idea but is financially impracticable". We have therefore devoted some effort to considering how such techniques could be implemented more economically.

GROUP TRAINING OF ROAD SKILLS

One obvious economy would be to redesign the training so that children could be trained in groups rather than individually. Of course, group training might not be as effective as individual training. Nevertheless, the benefits might still be sufficient to justify its introduction. Moreover, there is evidence from other studies that children's conceptual development can sometimes be accelerated where children cooperate in solving problems, particularly where the children are at different stages of conceptual development (Howe, Tolmie & Rodgers, 1990). It may be that the development of road safety concepts can be promoted in this way—just as the development of scientific concepts apparently can. For this reason, evaluating the effectiveness of group training is worthwhile (see Thomson et al., 1997, for a review of interactive group learning approaches).

This study was kept as similar to the previous one as possible, except that children were trained in groups of five. This number corresponds to what we regarded as the maximum that would permit all individuals to participate actively in the process. In the course of each session, each child was asked to solve a problem with the other children being asked individually to comment on the suggestions. Thus the children were as active as possible, although without the same degree of individual attention as in the previous study. As before, children were trained either at the roadside or using the model. Pre- and post-tests were again conducted with individual children in order to evaluate the effectiveness of training, except that in this case it was not possible to run post-test 3. More details can be found in Thomson et al. (1992).

The results of the study are shown in Figure 2. Once again, it is clear that the children in both groups benefited significantly from training, with many more safe routes being constructed than before training. As before, those trained on the model constructed as many safe routes as those trained entirely at the roadside.

At the same time, comparison with Figure 1b will show that the overall improvement following training was less marked than in the individual training study, with group-trained children constructing only 36% safe routes as compared to 70% in the individual group. Interestingly, however, the gains made by group-trained children appear much more robust. In fact, there was no deterioration at all over the two month period following training, in marked contrast to the individual study. We cannot say with any certainty why group training should produce a more stable performance. One possibility has to do with the pattern of errors produced by this group. Whereas children in both studies became more aware of the dangers posed by obstructions and started to select safer sites, we were much less successful

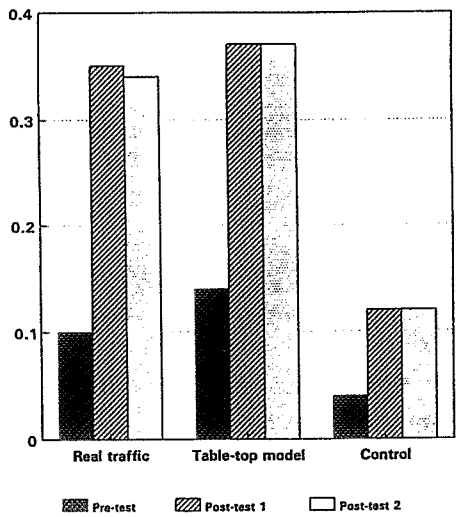

Figure 2. Mean proportion of safe routes constructed by control versus group-trained children using two training methods.

in teaching group-trained children to adopt appropriate strategies at junctions. This effect was increased by children's natural reluctance to take detours (which would normally be longer at junctions). When junctions are omitted from the analysis, the pattern of results is much more like that obtained in the individual study. It may be that this aspect of training requires particular attention, especially in the context of group training.

EFFECTIVENESS OF PARENTS AS ROAD SAFETY TRAINERS

It is apparent that group training has potential and efforts directed at examining how to maximize the effectiveness of this approach seem merited. At the same time, notwithstanding the improvements that can be induced as a result of only three hours of training, it seems likely that even this modest investment of time would be beyond the scope of current resources. This raises a crucial question that runs throughout the whole of road safety education, but is especially potent where time-consuming roadside training is advocated: who might realistically be expected to undertake such training?

Currently in the U.K., responsibility for road safety education lies primarily with specialist road safety officers and, to a lesser extent, with the police who visit schools on an intermittent basis. However, these officers do not have the resources to undertake extensive training themselves. Their role lies in providing advice, expertise and material resources to others. This, of course, means that the frontline work must be undertaken by someone else.

An obvious candidate is the school which, after all, is responsible for most other aspects of children's education. Currently, there is wide variation between schools in what they do in relation to road safety, though most operate without a clear policy on the issue (Singh & Spear, 1989). Within the U.K. it seems likely that this situation will change, though it remains unclear what form increased attention to road safety education will take. It certainly seems unlikely that practical methods will be introduced on any scale, although it is possible that some work with models might feasibly be undertaken and it is likely that some schools will undertake occasional forays out of the school in the form of Traffic Trails. Such occasional activities still fall short of what is being proposed here, however. They also fall short of what is likely to be required in order to significantly impact on the development of pedestrian skills in children.

Of all the groups that have something to contribute to road safety education, it is parents who are most often seen as bearing primary responsibility for safety training—a view apparently held by parents themselves (Sadler, 1972). There is no doubt that parents have far more opportunities to train children than anyone else and it seems foolish to ignore this "resource" when considering children's road safety education. Particularly where labor-intensive practical methods are advocated, the role that parents might play could be crucial.

Unfortunately, there is little point in merely exhorting parents to train their children and then hoping for the best. Although they are naturally more concerned about their children's safety than anyone else, many parents have little idea what to teach or how to go about it. Even where a fair degree of direction is given, as in the traffic clubs that have been set up in a number of countries, membership tends to be biased with relatively small numbers from

the more vulnerable sections of the community. Some means of increasing parental involvement is clearly desirable.

An approach that has been attempted in the Netherlands has been to set up a parent/child training program through the kindergarten and junior primary school rather than through autonomous traffic clubs (Rothengatter, 1981). Parents attend evening sessions in the school where they receive advice and guidance from specialist teachers and observe appropriate practice on video. They then undertake a training program, supported by resources that spell out in detail what they should be doing with their children at each stage and why. Monitoring and backup is provided so that parents have a source of support when difficulties arise.

This approach offers several important advantages. First, it ensures that a large number of parents will come into contact with the scheme. Second, the package focuses upon clearly defined problems known to be associated with accident risk. Third, it offers a systematic program of behavioral training that parents can understand and implement. Finally, the approach helps to break the ice between parents and the school in general—a desirable objective in itself.

The central question is, how effective are parents in training road safety skills? The Dutch approach has produced encouraging results (Rothengatter, 1984), although the training did not cover as wide a range of skills as we would like to see introduced and certainly does not include safe route finding. Since safe route planning demands substantial conceptual advancement in children, it is not obvious whether parents would prove equally successful in such training. Moreover, in the Dutch program children are individually trained by their own parent. Unfortunately, this means that the biases referred to above are not eliminated: the only children to benefit are those whose parents were willing to participate.

Therefore, we have extended the approach by enlisting parent volunteers who train *other people's* children in small groups. This has the effect of ensuring that *all* children in a class receive training, whether or not their own parents are able to make the required commitment. This raises another question, how successful are parents in undertaking such group training?

To examine this, we asked 10 parent volunteers to undertake the group training program described above. Parents and children all came from an area of Glasgow suffering substantial economic and social deprivation, one facet of which was a particularly high child accident rate. The training program was similar to that previously employed except that the children were trained in groups of three, which we felt represented a more realistic number for the parents to deal with. In addition, we adjusted the method so that the first two training sessions took place at the roadside and the remaining four on the model. This seemed a judicious combination given our earlier findings on the effectiveness of the methods. As before, the children were removed from their class in groups of three and were given six training sessions over a three week period.

Volunteers were selected with the help of the school principals and were given a one-day training course in the school. In the morning session, an introductory discussion was followed by a practical session in which parents watched an experienced trainer teach children using the model. Each parent was then given hands-on experience of working with children while being observed by the others. Each of these sessions was followed by

discussion of the problems and issues that arose. In the afternoon, a similar format was adopted, except that this time the sessions were held at the roadside. Parents also received a short booklet for reference purposes. Throughout the subsequent training period, research staff provided a backup support service so that parents could discuss any difficulties that arose.

The effectiveness of parental training is shown in Figure 3. It can be seen that marked improvements were obtained following training. Children trained by parents constructed a significantly higher number of safe routes than control children at post-test, and these gains endured until post-test 2. Indeed, inspection of Figure 3 reveals that parents were just as effective as the highly skilled trainers who had been employed in the previous study. Even allowing for the smaller number of children per group used in the parent-training mode, this is an impressive result. Moreover, while individual differences between parents exist, the majority achieved substantial changes in children's judgements following training. Children who showed little improvement all scored relatively highly before training began, leaving less room for improvement. This suggests that the effectiveness of training is not highly dependent on the individual characteristics of trainers. Nor do any special "qualifications" seem necessary: all volunteers were ordinary parents whose main qualifications were interest in the children and being parents themselves. This suggests that many people have the ability to help children improve their traffic judgements, provided they clearly understand what

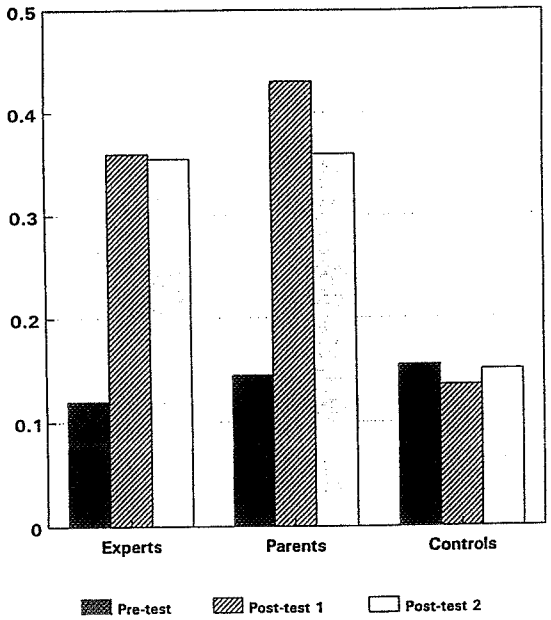

Figure 3. Effectiveness of parents versus expert trainers in improving safe route planning in 5 year-old, group-trained children.

they are supposed to be doing and why and have access to a limited amount of professional support.

CONCLUSIONS

In general, road safety education is based on a very restricted analysis of the skills needed to cope with the traffic environment (Thomson, 1991). Although excellent analyses of the pedestrian task have been available for some time (Vinje, 1981; van der Molen, 1981), educational strategies in most countries do not seem to be based on such analyses. Instead, attention is grossly focussed on the acquisition of knowledge and attitudes or the learning of general-purpose strategies (such as the British Green Cross Code) that fail to develop many essential pedestrian skills. Here we have described one such skill. Whilst poorly developed in young children, and almost certainly rendering them vulnerable on the road, the skill appears to be amenable to training. Much more research is needed, however, both to define the range of skills required by pedestrians and to find appropriate methods for promoting their acquisition. Attention should also be directed towards the practical problems faced by road safety professionals who might wish to implement such training on a large scale.

Acknowledgment: An earlier version of this paper was presented at the Fourth European Conference on Developmental Psychology, Seville, Spain in September, 1992.

REFERENCES

Ampofo-Boateng, K. & Thomson, J.A. (1990). Child pedestrian accidents: A case for preventive medicine. *Health Education Research: Theory and Practice, 5*, 265–274.

Ampofo-Boateng, K. & Thomson, J.A. (1991). Children's perception of safety and danger on the road. *British Journal of Psychology, 82*, 487–505.

Ampofo-Boateng, K., Thomson, J.A., Grieve, R., Pitcairn, T.K., Lee, D.N. & Demetre, J.D. (1993). A developmental and training study of children's ability to find safe places to cross the road. *British Journal of Developmental Psychology, 11*, 31–45.

Demetre, J.D. (1997). Applying developmental psychology to children's road safety: Problems and prospects. *Journal of Applied Developmental Psychology, 18*, 263–270.

Howe, C., Tolmie, A. & Rodgers, C. (1990). Physics in the primary school: Peer interaction and the understanding of floating and sinking. *European Journal of Psychology of Education, 4*, 459–475.

Molen, H.H. van der. (1981). Child pedestrians' exposure, accidents and behavior. *Accident Analysis and Prevention, 13*, 193–224.

Rothengatter, J.A. (1981). *Traffic safety education for young children*. Lisse: Swets and Zeitlinger.

Rothengatter, J.A. (1984). A behavioral approach to improving traffic behaviour of young children. *Ergonomics, 27*, 147–160.

Sadler, J. (1972). *Children and safety: A survey amongst mothers*. London: H.M.S.O.

Sandels, C. (1975). *Children in traffic*. London: Elek.

Schagen, I. van (1988). Training children to make safe crossing decisions. In J.A. Rothengatter & R.A. de Bruin (Eds.) *Road user behaviour: Theory and research*. Maastricht: van Gorum.

Sargent K.J. & Sheppard D. (1974). *The development of the Green Cross Code*. Report 685, Transport and Road Research Laboratory.

Singh A., & Spear M. (1989). *Road safety in schools and colleges*. Report 133, Transport and Road Research Laboratory.

Thomson, J.A.(1991). *The facts about child pedestrian accidents*. London: Cassell.

Thomson, J.A., Ampofo-Boateng, K., Pitcairn, T.K., Grieve, R., Lee, D.N. & Demetre, J.D. (1992). Behavioral group training of children to find safe routes to cross the road. *British Journal of Educational Psychology, 62*, 173–183.

Thomson, J.A., Tolmie, K.A., Foot, H.C. & McLaren, B. (1997). *Child pedestrian accidents and the aims of road safety education: A review and analysis.* Report to the Department of Transport, London: H.M.S.O.

Vinje M.P. (1981). Children as pedestrians: Abilities and limitations. *Accident Analysis and Prevention, 13*, 225–240.