

CHILD DEVELOPMENT AND THE AIMS OF ROAD SAFETY EDUCATION: A REVIEW AND ANALYSIS

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EXECUTIVE SUMMARY

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1. Background

Pedestrian accidents are one of the most prominent causes of premature injury, handicap and death in the modern world. In children, the problem is so severe that pedestrian accidents are widely regarded as the most serious of all health risks facing children in developed countries. Not surprisingly, educational measures have long been advocated as a means of teaching children how to cope with traffic and substantial resources have been devoted to their development and provision. Unfortunately, there seems to be a widespread view at the present time that education has not achieved as much as had been hoped and that there may even be quite strict limits to what can be achieved through education. This would, of course, shift the emphasis away from education altogether towards engineering or urban planning measures aimed at creating an intrinsically safer environment in which the need for education might be reduced or even eliminated. However, whilst engineering measures undoubtedly have a major role to play in the effort to reduce accidents, this outlook is both overly optimistic about the benefits of engineering and overly pessimistic about the limitations of education. At the same time, a fresh analysis is clearly required both of the aims and methods of contemporary road safety education. The present report is designed to provide such an analysis and to establish a framework within which further debate and research can take place.

2. Setting objectives

No educational programme can expect to succeed unless it is founded on clear and explicitly-stated objectives. Without these, the programme would be unfocused and evaluation impossible. Unfortunately, this basic requirement has not always been well served by road safety initiatives in the past. Many programmes set themselves only the most general of aims, such as 'reducing accidents'. Such aims are perfectly laudable but are far too broad to be functional as educational objectives. Where programmes do set more fine-grained objectives, the majority are concerned with improving children's *knowledge* about traffic or instilling good *attitudes* towards safety. Implicit in such programmes is the assumption that changes in knowledge or attitudes will lead to changes in actual traffic *behaviour*. However, this confounds a secondary objective (improving

knowledge) with a primary objective (improving behaviour). Whether the one leads to the other is an empirical question requiring demonstration. In fact, the evidence suggests that there is no direct link between knowledge and behaviour at all, raising serious questions about the validity of much traditional road safety education.

Deciding how to set concrete objectives, then, remains a fundamental problem in road safety. We believe the most scientific way of doing this would be to provide a detailed analysis of the pedestrian task, breaking it down into the component skills and strategies required to deal with the various problems encountered in traffic. Understanding the skills and strategies needed to interact with traffic would seem an obvious starting-point for the development of educational objectives. For example, if it could be demonstrated that children lack the skills needed to tackle a particular road task, then an appropriate objective might be to teach those skills. If unable to benefit from such training, for example until a certain stage of psychological development had been reached, it might still be possible to develop a more limited strategy suitable to the skill level of younger children. In the extreme case, it might be necessary to recommend that the child should not tackle certain road tasks at all. However, all such decisions should be based on solid empirical data concerning the skills that children possess at different ages and on whether acquisition of such skills is possible.

The argument being made is that pedestrians require a range of fundamental skills in order to interact safely with traffic. They must also learn to deploy these skills strategically at the roadside. While a definitive taxonomy is probably not possible, we believe the following are among the most critical psychological skills involved in road behaviour. It should also be noted that many tasks will require the deployment of several underlying psychological abilities at the same time.

Detecting the presence of traffic: the detection of traffic involves a range of basic processes including selective attention; visual search; resistance to distractibility; co-ordination of visual and auditory information; and the perception of crossing locations as safe or dangerous (in terms of the opportunities they afford for detecting approaching traffic).

Visual timing judgements: this requires the pedestrian to determine a vehicle's direction and rate of movement so that accurate time-to-contact judgements can be made. Such judgements provide information about the time available for crossing.

Co-ordinating information from different directions: the pedestrian rarely has to deal with traffic approaching from a single direction: thus, timing and other judgements must be made in relation to vehicles approaching from two or more directions. This requires the ability to divide attention; to hold information in memory; and to co-ordinate and integrate this information.

Co-ordinating perception and action: this involves the ability to relate the time *available* for crossing to the time *required* to cross. The latter will vary according to characteristics of the individual's own movement as well as to factors such as the width of the road. Such knowledge

about movement capability must then be calibrated to visual information about the time available for crossing so that realistic safety margins can be set and other decisions made.

3. Skill development in children

Even crossing a simple road, then, requires competence in a range of primary perceptuo-motor and cognitive skills. If these skills are not properly developed, the pedestrian's crossing decisions will almost certainly be inadequate. From an educational point of view, it is therefore vital to know how these skills develop in childhood and what level of skill can be expected in children of different ages. It is also essential to know whether baseline performance can be improved through education or training and, if so, at what age intervention is most likely to be effective.

3.1 Potential for training

The evidence reviewed in the report demonstrates clear developmental trends on a wide range of psychological skills related to traffic behaviour. However, it also suggests that many of these skills are considerably more advanced in even young children than has previously been assumed. Moreover, the evidence strongly suggests that many of them may be amenable to training, provided that appropriate training methods are employed. This outlook stands in marked contrast to a widely-held view in the road safety field that children are inherently incapable of dealing with the traffic environment until they have reached a certain level of cognitive development, typically the Piagetian stage of concrete operations. We argue that such a view is based on early and somewhat misguided interpretations of Piagetian theory, which considerably underestimated the abilities of the young child.

3.2 Behavioural training

Consistent with this, there is a substantial literature specifically within the field of road safety, demonstrating the success of training a variety of road crossing skills, provided this is carried out in a meaningful context that closely simulates the road environment. For example, recent studies have demonstrated significant improvements in children's ability to make roadside timing judgements (Lee *et al.*, 1984; Demetre *et al.*, 1992); find safe places to cross (Ampofo-Boateng *et al.*, 1991); plan safe routes (Thomson *et al.*, 1992); cross at parked cars (Rothengatter, 1981); and cross safely at junctions (Rothengatter, 1981). Furthermore, such training can be successfully employed with very young children. Whereas pre-eminent classroom techniques such as the Green Cross Code cannot even be recommended for use with children under seven years of age (on account of the verbal skills that they require), when taught *behaviourally* such strategies can lead to significant improvements in the roadside judgements of children as young as four years (Rothengatter, 1981). By contrast, evaluation of knowledge-based approaches has provided little evidence to suggest that they are effective in improving children's roadside judgements.

As stated above, the neglect of practical training aimed at promoting children's traffic skills stems in part from early interpretations of Piagetian theory, according to which young children's traffic decisions are limited by their age and stage of cognitive development. However, contemporary developmental theory views Piagetian models of development as considerably more flexible than was previously thought. Indeed, the major bodies of developmental theory share a number of features which convincingly explain why practical training approaches are successful and why knowledge-based approaches are not.

4. Developmental theorists

4.1 J.J. Gibson

Although not strictly a developmental theorist, the work of J. J. Gibson has made major contributions to understanding of the development and acquisition of perceptuo-motor skills. In Gibsonian terms, the pedestrian task is essentially a perceptuo-motor problem rather than one of higher-order interpretation and cognitive construction. Gibson's theory of perception states that, through evolutionary pressure, the visual system has become attuned to salient temporal information in the optic array specifying *directly* the time-to-contact of approaching objects or surfaces, thus eliminating the need for cognitive construction based on information about speed and distance. Furthermore, for Gibson, perception is ultimately bound to action, and environmental events are perceived in terms of the potential for action which they afford. Thus, the developmental task is one of attunement and refinement of the visual system to temporal information in the optic array and the actions which such information affords. One major implication of this is that perceptual judgements and motor responses can only be learned in the context in which they occur, or at least in close analogues of them. Perceptuo-motor learning is thus a bottom-up process, progressing from learning in specific contexts to more generalised conceptions. Practical road safety training thus works because it provides the opportunity for this process to take place.

4.2 Piaget

This general pattern of learning is also implicit in the hugely influential work of Jean Piaget. For Piaget, learning proceeds from context-bound actions (beginning in infancy with reflexes) towards increasingly generalised conceptual understanding. The key mechanism of change is the child's co-ordination of initially separate pieces of knowledge about different events, which occurs as they seek to understand and resolve conflicts between their expectations and actual experience. For example, if the child found that it took longer than expected to cross an unfamiliar road, s/he might then notice that the road was also wider than those previously encountered. In this way, co-ordinating information about different events allows them to perceive the more general relationships between road width and crossing time. This Piagetian emphasis on learning as a bottom-up process of construction from specific actions in specific contexts bears clear similarities to Gibson's account of the development and acquisition of perceptuo-motor skills. It also stands in

marked contrast to the practice in many road safety programmes, where knowledge is taught at a general level in the belief that this will then transfer to the many specific situations to be faced at the roadside.

4.3 Vygotsky

The idea of learning as a bottom-up process introduces the work of L. S. Vygotsky, widely regarded alongside Piaget as the other great theorist in developmental psychology. For Vygotsky, all thought is the mental equivalent of action and has its origins within action. For example, counting the number of books on a shelf is the mental analogue of the developmentally earlier task of physically moving the objects into a row while counting. The second point of importance in Vygotsky's theory is that all organised action takes place in conjunction with those who have already mastered it (e.g. the child counting with an adult). This introduces the crucial Vygotskian notion of the *zone of proximal development (ZPD)*. The ZPD is a psychological rather than a physical space, referring to the difference between that which the child can achieve alone and that which s/he can potentially achieve whilst working with a more competent other. The ZPD is thus the space within which learning occurs and learning itself is a process of *internalising directed activity*. For Vygotsky, then, learning is necessarily grounded in a *social context*, whereas Piaget conceived of learning as being largely a process of internal construction within the individual (albeit one which could be socially motivated). However, in common with Piaget, Vygotsky considered learning to be a bottom-up process with complex activities building upon simpler ones, with the range encompassed by the zone of proximal development advancing as learning progresses.

Developmental theory, then, almost with one voice argues for the natural progression of understanding from action to concept. It follows that pedestrian training methods will be most effective when they operate in accordance with this progression rather than when they work against it. From this point of view, practical training methods are successful because they begin at the correct point in the developmental sequence. Knowledge-based approaches are much less successful because they do not.

5. Rate of development

There remains the important question of the age at which training should begin. Previously, Piaget's stages of development have been interpreted as representing biological constraints on the rate of development. That is, a child would not be able to perform a given task until the appropriate level of cognitive development had been reached. Such assertions led researchers such as Sandels (1975) to argue that children below the age of 8-9 years must be inherently unsafe pedestrians. In fact, as mentioned earlier, the cognitive requirements of the pedestrian task may be less than has been assumed, and the basic perceptuo-motor skills ought theoretically to be within the capabilities

of even young children. More importantly, Sandels' argument is based on a misconception of the significance of stages in Piagetian theory. Given the bottom-up nature of the process of construction, it is more appropriate to view Piaget's stages as emergent characteristics of the developing child rather than overarching constraints. The Piagetian stages map out what might be a typical progression in the average child in the absence of educational intervention and are now regarded as considerably more elastic from a timing point of view than was previously supposed. Indeed, a child may perform at several different Piagetian stages at one and the same time, depending on the nature of the tasks and other factors. The interpretation of developmental stages as rigid, agebound categories precluding educational intervention is certainly unwarranted. The real strength of Piagetian theory is now regarded as lying in its account of the *process* of development rather than in any indication of the *timing* of specific developmental changes. There is nothing in this account to suggest other than that practical training should be successful with children as young as 4 years of age, providing it offers the right kinds of experience.

6. Generalisability of learning

In devising any training programme, a major issue to be addressed is the extent to which we can expect abilities learned in one context to generalise to others. This issue is a topic of much debate in contemporary developmental psychology but, on balance, the evidence suggests that there is a marked tendency for knowledge to be compartmentalised. Transfer from one task to another is possible, but the tasks must bear functional similarities to each other. Such correspondences must also be salient for the learner. Current road safety programmes which assume that children will spontaneously extend understanding gained in one context (e.g., the classroom) to behaviour in another (e.g., the roadside) are therefore poorly supported both by theory and by empirical evidence. The implication is that it would be better to focus on promoting development from scratch in the context in which the learning will be used - i.e., at the roadside or something closely analogous - than in general discussions about what one might or might not do while sitting round a table.

7. The social context of training: interactive learning

Developmental theory provides clear indications, then, as to why practical training carried out in a meaningful context has proved to be more successful than classroom based methods. It also suggests that, so long as the focus is on promoting appropriate action in close analogues of the road environment, training could easily begin with children as young as 4 or 5 years of age. In addition to this, contemporary extensions of Piagetian and Vygotskian theory also provide a framework for the development of appropriate training methods, utilising what has become known as *interactive learning* (i.e., the learning that takes place through social interaction).

7.1 *Peer collaboration*

As noted above, for Piaget it is conflict between ideas and experience that provides the impetus for conceptual advance, by necessitating resolution of the conflict. This points to the potential role of peer discussion in learning, particularly when children work together in a group. In such cases, the group becomes a forum for the exchange of ideas as to how the task might be solved and, because peers typically share the same communicative style and are less inhibited about talking with each other, this usually permits a fairly full airing of different views. During such exchanges, there is thus a strong probability that children will be exposed to ideas that are different to their own and that internal cognitive conflict will be created. The subsequent personal resolution of this conflict results in development. There has been much research in recent years investigating the effects of this kind of peer collaboration. The evidence not only supports the general principle that such learning is effective, but also suggests that it has particular impact on *conceptual* advance (Rowe, Tolmie and Rogers, 1992; Tolmie, Howe, MacKenzie and Oreer, 1993).

7.2 *Peer tutoring*

By contrast, the Vygotskian emphasis on the role of guided action has been applied to a different interactive learning technique, that of peer tutoring. Peer tutoring refers to a dyadic interaction in which one partner, who is the more competent, tutors the other, less competent partner. The asymmetry of this relationship meets the basic condition for establishing the zone of proximal development. Research into the processes and outcomes of peer tutoring indicates positive effects on learning in line with the predictions of Vygotskian theory, particularly as regards the opportunities it affords for structuring the activity of the less competent partner. This evidence also suggests that peer tutoring is best suited to the development of skills, as opposed to reasoning or problem-solving tasks (Damon, 1984). However, there are clear signs of limitations in children's role-taking abilities, their ability to tailor verbal directions, and their sensitivity to the needs of others (e.g. Peterson, 1972) which limit the effectiveness of peer tutoring. For these reasons it is possible that adult-child interaction, when it operates along similar lines, may hold more promise for road safety training with younger children. There are considerable parallels between peer tutoring and this form of adult-child interaction since, as Rogoff (1986) points out, the interaction remains one of guided participation and is as much a step away from direct instruction as peer tutoring is.

In the context of road safety education, then, it seems likely that adult-child interaction has the potential to make concrete the skills involved in safe road crossing and thus fulfil an important and effective role in any training programme. Peer collaboration could be applied to fill a complementary role in the development of conceptual understanding of the traffic environment and

the deployment of skills, although this would entail careful task design to ensure that group dialogue was channelled along productive lines (see Tolmie *et al.*, 1993).

We suggest that interactive learning techniques hold considerable promise in the context of road safety education. Moreover, there is a growing literature which clarifies how such techniques might be applied most effectively. Whilst it remains necessary to identify precisely how we might capitalise on them in the specific context of road safety, studies of adult-led group training of children to find safe crossing places provides an existing example of the benefits of interactive learning methods. Such a training procedure has been found to produce significant improvements in children's judgements, making them behave like older, more experienced pedestrians (Thomson *et al.*, 1992). Few other studies appear to have tackled the development of road safety understanding in this way, but the early signs suggest that it holds considerable promise.

8. Conclusions

In this report we argue that children need a range of fundamental psychological *skills* in order to interact with traffic, together with the ability to deploy these *strategically* in different traffic situations. We argue that viable objectives in road safety education would be to operationally define such skills and strategies and devise appropriate training procedures whereby they might be improved. If successful, such training would yield direct and measurable changes in children's actual behaviour in traffic, not merely changes in what they can *say* about traffic when questioned by adults. Whilst a long-established tradition in road safety asserts that many of these skills cannot be improved through education until a particular stage of development has been reached, we challenge that view and argue that it is inconsistent with modern research in psychology or, indeed, with the majority view among developmental psychologists. In addition, recent studies that have attempted to improve children's performance on a range of clearly-defined pedestrian skills have produced empirical evidence that such skills can be accelerated, providing appropriate training is given. The critical aspect would appear to be that the training should *be practical* in nature. Contemporary educational approaches arising out of the work of major theorists such as Piaget and Vygotsky provide further ideas as to how the benefits of practical training might be maximised by adapting techniques from the field of interactive learning. Such approaches deserve to be explored in the effort to derive educational interventions capable of leading to tangible improvements in children's ability to cope with the traffic environment.

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