Pedestrian safety: the role of research

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INTRODUCTION

In nearly every country people are grappling with the many problems of motorization which increasingly dominate their lives. In some 70 years the transport scene has been revolutionized and the desire for unrestricted personal mobility expressed by the growing ownership of private transport has brought with it many problems not least of which is road safety. Because road accidents have grown up in a transport context they tend to be regarded as inevitable penalty of personal freedom and their dispersal into many incidents each with only a few casualties tends to diminish public appreciation of their overall magnitude. Throughout the world some 1 million people die every 4 years in road accidents and for the young adult road accidents are the major cause of death in many countries; road accidents rank therefore as a public health problem of epidemic proportions. The vast majority of road accidents stem from human failure but the consequences of these failures can be prevented or mitigated by various means; by education and training, by better highway design, by safer operational techniques and by improving vehicle safety.

Historically, mechanically powered road vehicles began primarily as public transport, to be followed as roads improved by smaller private vehicles owned initially by wealthy citizens. Throughout these early days the road user on foot became more and more disadvantaged; the introduction of private powered vehicles reinforced the difference in status between vehicles borne road users and those on foot. Duff [1] has reminded us that the conflict between pedestrians and road traffic is not new. 250 years ago the pedestrians of London were in trouble. Swift in 1710 wrote in the Tatler:

"We are very glad to watch an opportunity to whisk across a passage, very thankful that we are not run over for interrupting the machine that carries in it a person neither more handsome, wise, nor valiant than the meanest of us".

When hackney carriages first appeared there were many accidents because pedestrians refused to give way to them. As the flow of vehicles became greater and more dangerous pedestrians had to give way but occasionally their anger would get the better of them and they would overturn a coach and break its wheels. Not only were pedestrians impeded in their passage along the streets, they were often killed or injured by being crushed against the houses.

It is also interesting that the most modern concepts of providing for pedestrian safety in towns, shopping precincts, elevated pedestrian walkways and subways are amongst the oldest. In 1500 Leonardo da Vinci proposed a scheme for ground level pedestrian ways with the vehicular traffic running in tunnels. A sketch of his proposal is in the British Museum. In the same year The Rows in Chester, an upper level pedestrian market with shops in arcades, was completed. The seventeenth century Pantiles in Tunbridge Wells is an early example of a pedestrian precinct.

During the first half of the twentieth century few concessions were made to the road user on foot except for those that interfered only slightly with the flow of vehicular traffic or were needed to deal with various major problems; it is presumably not a coincidence that 'pedestrian' in the English language also means 'prosaic', 'dull', 'uninspired'.

Over the last 25 years in the well-developed countries increasing attention has been given to pedestrian safety but the idea of the pedestrian as a second-class citizen has lingered on both in general attitudes and in road user behaviour. This is so notwithstanding the fact that a substantial proportion of people today are both users of private vehicles and pedestrians.

Attempts to derive a basis for striking a balance between vehicle users and pedestrians have been generally unsatisfactory; the comparitive value of time delays during a journey on foot or in a vehicle has been assessed, but the significance of interactive delays overall in economic or social terms has hardly been touched. Outstanding and consistent over recent years has been the high proportion of road casualties that are pedestrians with fatalities approaching half of the total in certain countries and perhaps 80,000 in number annually, worldwide. It is encouraging that in some countries pedestrian casualties have not increased pro rata with the increase in motorization but the problem remains a major one and there is no obvious reason why the situation should change radically unless fresh initiatives are taken.

In most well-developed countries the pedestrian safety problem is predominantly an urban one but there is nevertheless concern for the safety of pedestrians on rural roads. Of the various age groups children and elderly people are over-represented in pedestrian acci-

dents and therefore merit special consideration.

Another major group of road accident casualties is that of car occupants. Their future safety has received considerable attention through the international car safety programme piloted by the United States of America [2] and the nature of the countermeasures is such that substantial reductions in casualties can be forecast with confidence provided these measures are incorporated and used in future passenger cars. The international nature of trade in, and usage of, cars is such that in practical terms these measures can be implemented only by international regulations, most of them at government level..In the vehicles field in Europe considerable progress has been and is being made to establish uniformity of standards, primarily to facilitate trade but with improvement in safety well to the fore [3].

Greater safety for pedestrians is not so readily described either in terms of effective countermeasures or in the incentives for concerted international action. It is perhaps partly for these reasons and partly for those mentioned earlier that improvements in pedestrian safety are hard-won and sometimes seem to be disappointing. It has often been said that there has been little research into pedestrian safety, but this statement could be misleading. Substantial reviews under the auspices of the Organisation for Economic Co-operation and Development (OECD) [4] and NATO Committee on the Challenges of Modern Society (CCMS) [5] have quoted many references to research studies carried out in various countries. Just recently the International Conference on Pedestrian Safety [6] held in Israel discussed a wealth of research into pedestrian safety which has been carried out worldwide or is currently in progress. It would therefore be more appropriate to say that despite the pedestrian safety work already carried out, a great deal more effort is required if a substantial impact is to be made on the problem.

Turgel has described the involvement of international bodies in the road safety field [7]. Since 1968, the Road Research Programme of the OECD has been concerned with providing a substantive scientific and technological basis for governmental decisionmaking on the most urgent road transport problems. Of particular interest are the efforts of the Road Research Programme toward the formulation, planning, and implemention of common strategies for road safety. Various groups of experts have been assembled and symposia have been held to provide a broad and thorough assessment of the options available for combating road accidents. The options studied include an array of specific measures and techniques regarding accident prevention and victim protection.

The creation of the OECD Road Research Programme came about as a result of the similarity of the main problem areas encountered by each of the Member countries [1] during an era of expanding road transport facility development and increasing user demand for these facilities. The programme is aimed at assembling and interpreting, on an international basis, road research results which are often fragmentary and, to a certain extent, diffuse. It is also enables practices and techniques proven successful in one country to be brought to the attention of other countries.

Government policymakers have to strive for a road transport policy which takes into account economic growth factors and the contribution of technology in general while maintaining a balance relative to the negative side effects of roads and traffic, such as accidents, congestion, and deterioration of the environment, and the consumption of limited natural resources. The Road Research Programme strives to provide a mechanism to ensure the rational use of the participating countries' research potential in view of the international dimension and similarity of road transport problems, and the need to optimize scarce natural road research resources.

In 1975 a combined OECD-ECMT group on pedestrian safety research was set up to study research needs in the field of pedestrian safety in relation to the policy orientation defined by the ECMT and other responsible international bodies; to recommend desirable research projects; to co-ordinate research activities between Member countries and exchange appropriate information; and to submit the results of this research to the OECD Steering Committee for Road Research and in due course to the ECMT Road Safety Committee and other interested international organisations.

Apart from basic research, which it would like to see intensified, particularly with regard to methodological questions and those relating to the cost/benfit analysis of the various political or administrative measures, the joint Group is concentrating on the following priority areas for international co-operative research:

(i) technical improvements to the pedestrian's road environment (pedestrian crossings: location, form, signs, signals and markings, lighting, etc.);

(ii) road safety education;

(iii) information and education campaigns on the theme of pedestrian safety using the mass media.

The aim of the group was to identify as soon as possible pedestrian safety measures which had been scientifically validated and could be implemented quickly, and to identify research needs in pedestrian safety which could lead to early implementation of measures for the reduction of accidents and casualties to pedestrians.

The work of the Group to-date has been published in the form of a summary report and three sub-group reports [8]. The work of this Group excluded areas that were the subject of other major activities such as the influence of alcohol and drugs or of vehicle measures for pedestrian safety. Considerable use has been made of the work of the Group in preparing this paper.

A FRAMEWORK FOR CONSIDERATION OF PEDESTRIAN SAFETY

One of the complexities of road safety is that the problems to be solved are usually multi-factored and thus rarely susceptible to simple single answers. On the other hand they often involve interactions between road users which can be used to advantage in the interests of greater safety. Errors or difficulties of one road user can often be countered and an accident avoided, by compensating actions on the part of other road users or by compensating features of the highway system.

It is important therefore to recognise that the best chances of improving pedestrian safety do not depend solely on pedestrians alone; other road users, the road environment, various educational and social factors are all of crucial significance to pedestrian safety as are their interactions.

The main principles of a framework for road travel may appear to be similar to those applicable to other forms of transport for example to rail travel. Similarities exist in that the system hardware, including vehicles, is subject to regulation to ensure minimum standards of standards of safety and conformity in essential respects [4] (Table 1). But the road situation is very different from the other major modes of travel in that they employ a high proportion of professional 'drivers' and at most critical points there is external surveillance and control of vehicle movements. Considerable progress has been made in recent years towards this approach in the road situation in order to define priorities at conflict points more precisely and to regulate the occupancy of road space more rigorously. Nevertheless the bulk of road

Table 1 - Framework for pedestrian safety

Field		Conflicts: Separation of conflicting elements	Conflicts: Improvement of conflict situation	Crash	Post crash
Road and Traffic		Space segregation e.g. pedestrian precincts Time segreation e.g. predestrian crossing facilities	road furniture crossings signs lighting speed control of vehicles	design and location of road furniture	emergency warning and aid
Human	Rider or Driver	Selection and licensing of drivers	Training & education Legislation and Enforcement Propaganda techniques Conspicuous clothing for pedestrians		
	Pedestrian	Regulation of pedestrian movements			
Vehicle		Modification or elimination of certain vehicles or vehicle features	Speed restraint Vehicle conspicuity	Redesign of vehicles for greater compatibility in pedestrian impacts	

users in this context are non-professional and there are in any case many conflict situations where priorities cannot be defined with any clarity. This is particularly so in the case of pedestrians and they are extremely vulnerable when in conflict with vehicles.

A consequence of the scale and non-professional character of most road movements is that breaches of road traffic law occur frequently and this situation is compounded by the inescapable fact that these breaches rarely involve the transgressor in an accident. As a Transport Minister once observed [9]:

"For most people and for most of the time, road safety is a matter of regulation, restriction and advice observed at least as much from fear of being caught as from any possible desire to be safe.

For relatively few there comes a moment of horror when the thing which "only happens to other people never to me" breaks into their lives, bringing with it death and injury, pain and misery".

In formulating road safety policy, in making international comparisons and in carrying out research it is essential to recognise the realities of the road situation and to maintain close links with what actually happens in practice.

The next part of this paper is concerned with these realities and how situations may be improved. Following the framework for pedestrian safety the road and traffic environment, the human component and the vehicle are considered in turn.

THE PEDESTRIAN'S ROAD ENVIRONMENT

Changes in the environment are the oldest form of pedestrian countermeasure to road accidents. For many years these were the only countermeasures, and are still by far the most important in terms of allocation of resources. Traditionally, environmental measures have fallen within the domain of the traffic engineer, but in recent years the influence of urban planning has been increasingly felt. Environmental measures are now used in a wider context, as there has been a move from the installation of isolated facilities to the consideration of entire schemes for pedestrian safety integrated within the urban framework. This latter has been termed the systems approach. Two manifestations of the contribution of urban planning to pedestrian safety are the rapid safety are the rapid growth in the numbers of pedestrianisation schemes in city centres, and the move towards designing residential areas with the needs and safety of pedestrians in mind.

It is possible to identify three philosophies or approaches to pedestrian safety which have been developed over the years. First is the traditional traffic engineering approach already referred to. The second is segregation, where the objective is to keep pedestrians and vehicles apart. The third, and most recent is the integration approach, where pedestrians and vehicles share common areas, whether in city centres under the so-called pedestrian priority or space sharing system, or else in residential districts.

The aim of all environmental countermeasures for pedestrians is to prevent injurious contact between pedestrians and vehicles, and each of the three philosophies attempts to achieve this in different ways. The traffic engineering approach aims to separate pedestrians and vehicles either in space, for example by providing adequate footways and installing refuges and guardrails as well as grade separated crossings, or in time, by means of controlled or uncontrolled crossings at grade. The segration philosophy sets out to provide systems within which pedestrians and vehicles have separate routes, and where the possibility of contact between the two is reduced to a minimum by planning and design. The third approach that of the integration philosophy, is quite different. Here the basic principle is to make pedestrians and drivers more aware of each others presence and to stimulate neighbourhood activities, whilst minimising conflicts and accidents by various design measures.

It is important to emphasize that the three approaches are not opposing alternatives, but should instead be regarded as complementary. There is no best option in absolute terms; the most satisfactory is the one which is most appropriate in the total context. It must also be acknowledged that the choice of option is often influenced or determined by factors other than safety; even with small schemes a balance must often be found between safety and amenity. Thus is it crucial that planners and others who influence the shape of the urban environment should be fully aware of the importance of pedestrian safety and of the measures which can be taken to improve it without detracting from amenity.

A further point which should be made is that as the different philosophies have evolved, there has not been an accompanying increase in knowledge. Thus most is known about the effects of traffic engineering measures, and least about the effects of the integration approach. This comes about for two reasons. Firstly, the object of many city centre schemes has been the improvement of amenity and the general quality of the environment; the evaluation of safety considerations has often been accorded only low priority. Secondly, residential areas generally have low accident rates, and changes are difficult to detect in the short term. The implication of this is that there is a need for both new research techniques, and for research on a wider scale than has usually been the case in the past if the new approaches to pedestrian safety are to be properly evaluated within an acceptable time scale.

Complete segregation

Urban planning can greatly reduce the number and nature of conflicts between pedestrians and motor vehicles.

The most obvious urban planning measure is the physical segregation of traffic categories, the environment being designed so that conflicts between pedestrians and other traffic are practically eliminated. Enforcement is minimised, for there is a clear comprehensible system determined by its design. In other words, physical design determines and encourages certain traffic behaviour patterns.

Two types of segregated areas may be defined where vehicles are not allowed. These are (i) pedestrian precincts and pedestrian streets which have a local interest and are often small in size due to access problems and (ii) pedestrian routes or networks which give access to various town or neighbourhood services or points of interest.

The basic principle of pedestrian schemes is that they should be designed to be more attractive than other parts of the system. In this way pedestrian usage will be maximised, and the overall level of safety thereby improved.

Pedestrian priority areas

Where complete segregation is not practicable areas may be defined where the needs of pedestrians are given priority, but where vehicles are allowed to enter under certain conditions. Dalby [10] has described a project in Oxford where vehicles and pedestrians share space on two of the city's main shopping streets, Queen Street and Cornmarket Street. At the time of the investigations traffic flow was of the order of 80-160 vehicle/h, of which about 70-80 were buses.

The speeds of buses were related to the concentrations of pedestrians in the area through which they were shortly to pass.

Table 2 - Accident statistics for Queen Street and Cornmarket Street

	QUEEN STREET			CORNMARKET STREET		
	Serious	Slight	Involving pedestrians	Serious	Slight	Involving pedestrians
1968	1	5	3	..	..	..
1969	4	1	4	4	10	13
	0	1	0			
1970	April -			4	18	16
	0	0	0			
1971	0	0	0	7	6	11
1972	0	1	1	1	4	4
	0	0	0	0	0	0
1973	August ********** ********** **********			January -		
	0	0	0	0	1	1
1974	0	0	0	0	0	0
				0	0	0
1975	0	0	0	February ********** ********** **********		
				0	1	1

- - - - introduction of access limitation during month stated
***** completion of kerbless surfacing during month stated
Source: *Thames Valley Police.*

Because of the pattern of behaviour there is produced around the moving vehicle a 'pedestrian-free space' with shape and dimensions related to the vehicle speed. The shapes and dimensions of the pedestrian-free spaces associated with the 3 speed ranges 5-8, 8-11 and 11-14 km/h, at the time when the street had a surface of 2-ft square paving slabs overall are shown in Fig. 1. The indications of 'emergency' and 'comfortable' stopping points (0.5 g and 0.15 g decelerations respectively) include an allowance for decision time. The location of 'comfortable' and 'emergency' stopping points well within the pedestrian-free spaces suggests the interaction between pedestrians and vehicles is such that a driver should have ample time to take action where a person in front of his vehicle fails to get out of the way for any reason.

The continual breakage of paving slabs under the wheels of the buses and goods vehicles led the Oxford City Council in 1975 to reconstruct that part of the public right-of-way originally the carriageway, and to provide it with a fine asphalt surface (Plates 1 and 2). The surveys already made were then repeated. It was found that there had been a modification to the pattern of pedestrian distribution in all but the most crowded conditions.

In times of less crowding, such as was found on days

other than Saturdays, and when there was no vehicle for some considerable distance down the street, pedestrians walked in the middle of the road as before. However, the presence of even a stationary bus led them to take avoiding action a good deal earlier than had previously been observed. The introduction of a contrasting section of surface had led to an increase in maximum bus speeds and a reduction in the numbers of people using the middle of the street when vehicles were nearby. It seems reasonable to deduce from this that the removal of apparent boundaries is desirable if there is to be improved space-sharing by pedestrians and vehicles. Thus it is advisable that any space-sharing scheme should have footways and carriageway at the same level.

There appear to be few problems in pedestrian priority areas where there are larger numbers of pedestrians but the position is not so clear in streets with few pedestrians. Such circumstances can occur in pedestrian priority streets designated as play areas for children. Where pedestrian numbers are likely to be small, the installation of items of road furniture, speed control humps, or modification of sight lines are all options available to prevent the free passage of vehicles.

In general, legislation to accord legal priority to pedestrians has been found to be neither feasible nor necessary in most countries, and the achievement of self enforcement through design freatures is the usual objective.

Integration of mixed traffic

In residential areas, the principle of segregation can again impose limitations on the numerous activities and contacts for which these environments are normally used. Thus, a need has arisen for a new approach to road safety in residential areas, based on integration

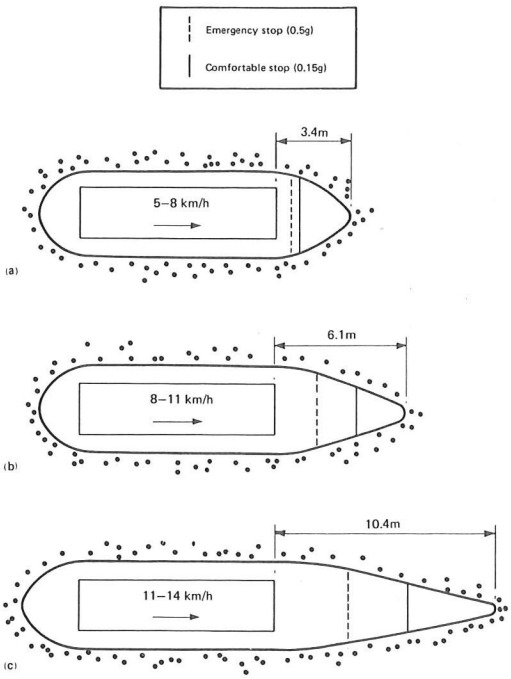
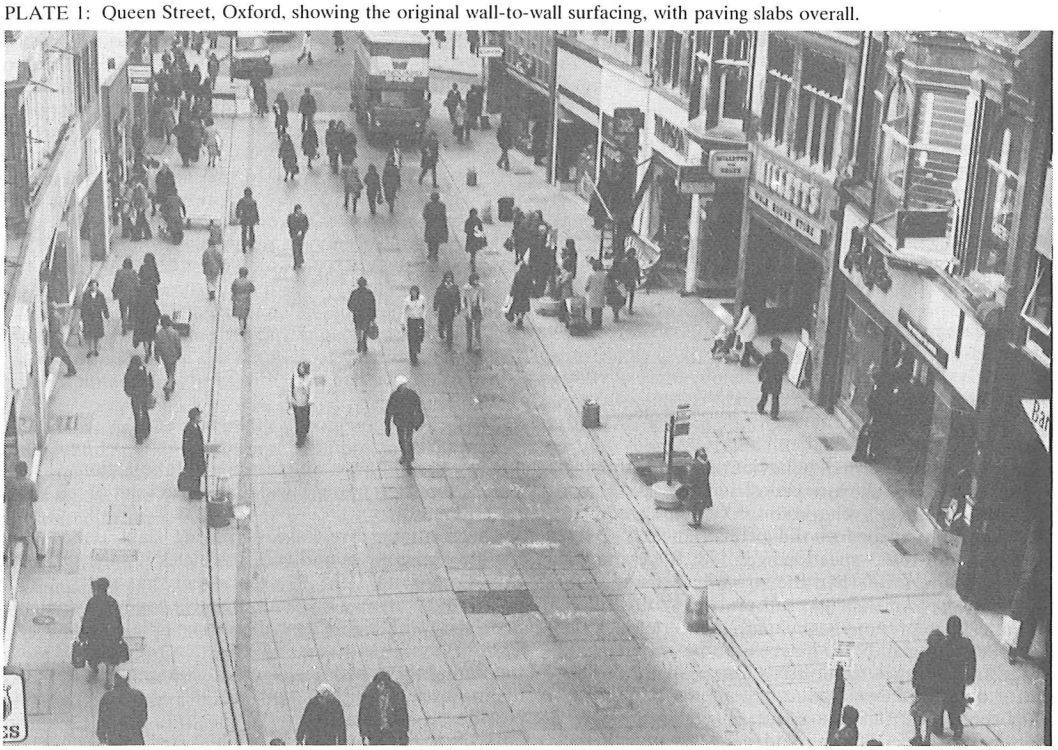


Fig. 1 - Distribution of pedestrian - free space around buses moving in a space sharing situation - Queen Street, Oxford

PLATE 1: Queen Street, Oxford, showing the original wall-to-wall surfacing, with paving slabs overall.



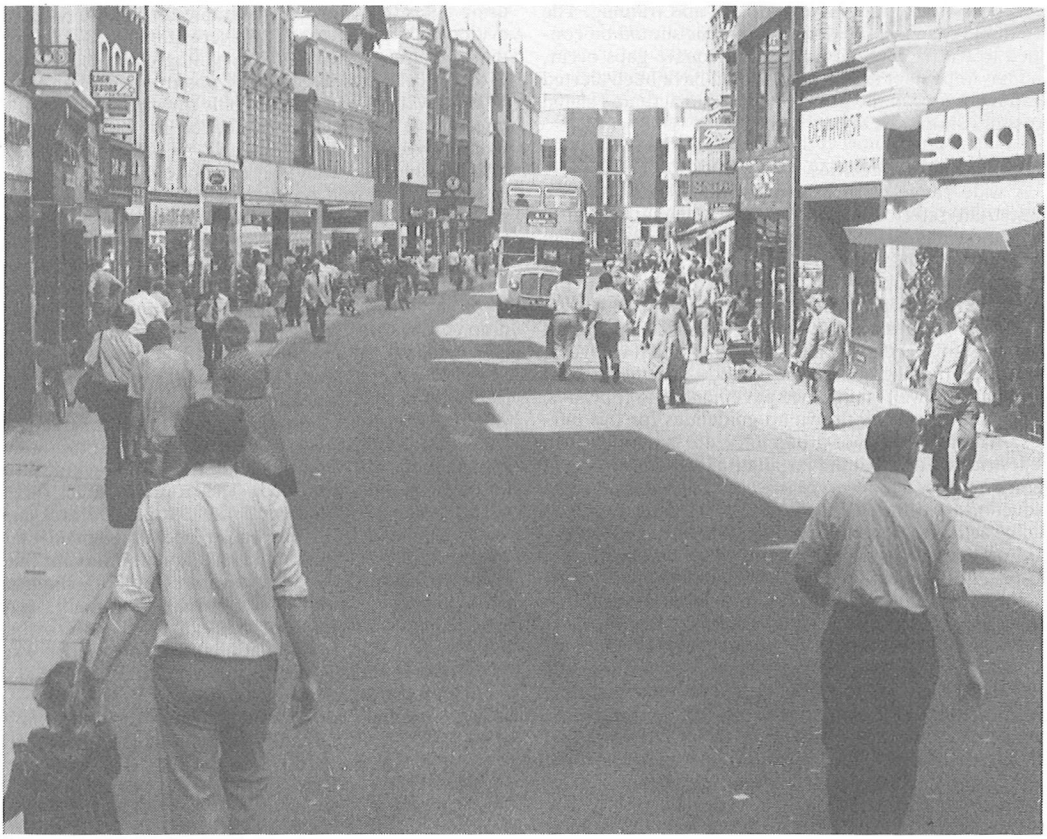


PLATE 2: Queen Street, Oxford, showing the modified central section

of mixed traffic. The benefits of physical segregation can also be built into such an integrated system.

A number of cities have made small-scale attempts to integrate traffic in a limited number of residential streets. Some larger scale applications are now being introduced, both in new developments, and as part of renovation schemes for old established areas; the examples of Delft and Emmen [11] in the Netherlands may be quoted.

The basic unit of such schemes is what is known as the residential court or yard. The function of a residential yard differs from that of a traditional street in that the same paved area can be and is used for various activities such as driving, playing, cycling, walking, and parking, but does not cater for through traffic.

The characteristics of a residential yard are that it is open to traffic, but in the absence of kerbs and pavements there is no demarcation of space in the traditional way between pedestrians and vehicles. Various design features are provided to slow traffic entering the area in order to protect pedestrians. The underlying principle is that the design and layout of the area should encourage traffic behaviour patterns which are optimal for safety.

While integration schemes are being considered or introduced in many countries, it should be noted that there has not yet been any full evaluation of the safety benefits of such schemes.

Pedestrian crossings

A pedestrian crossing at a particular location on the road gives the pedestrian a certain measure of legal and physical protection. Particular care needs to be taken with the design and location of the facility to ensure that pedestrians use it. The safest way to cross a road is by using a grade-separated facility such as a subway or footbridge.

At-grade crossings either of the zebra crossing type or light controlled also significantly reduce the risk of road crossing. However, the presence of the facility also introduces a more dangerous zone in its immediate vicinity. In the vicinity - say 20 m from the crossing - it is advisable to ban parking of vehicles, ban overtaking by drivers, and to discourage or restrict pedestrians from crossing. This applies to crossings away from junctions, but it would also seem useful to apply this recommendation to all crossings. Such areas should be clearly marked to road users and these markings may also be useful as guides to motorists that they should reduce speed on approach to the crossing. It may also be particularly useful in the case of zebra crossings as a guide to the pedestrian who may place not only himself but also vehicular traffic at risk if he steps on the crossing when the approaching vehicle is within this zone.

One of the major factors responsible for the good safety record of pedestrian crossings is the high usage rate. Potential safety benefits can therefore be increased if the particular crossing facilities form part of a pedestrian crossing elsewhere.

Light controlled crossings are the safest form of at-grade facility. In order to obtain a high level of usage, it is important that pedestrian waiting times are not too long. It is also desirable that there should be uniformity in the light control systems used.

Special provision is often made to protect children crossing roads near schools. Where there is heavy traffic on such roads adult wardens should be employed. Care

is recommended in their recruitment and training. The use of older school children as wardens should be confined to traffic conditions where adequate gaps occur, and it is important that drivers should have been alerted to the presence of the patrol. Pedestrian actuated signal crossings should be supervised.

Other pedestrian facilities

A wide range of measures is available to improve pedestrian safety apart from crossing facilities. Little evaluation has been made of the precise effectiveness of these measures, but it is clear that many of them are capable of making a considerable contribution to the pedestrian safety problem in urban areas.

A basic distinction can be made between technical measures and regulatory measures. In the first category, measures affecting pedestrians include the provision of adequate and well maintained pavements and footways. Some countries have drawn up guidelines for this purpose. The proper use of urban furniture is important to pedestrian safety, and the installation on wide streets of central refuges and reserves is a desirable measure. The reduction of vehicles speeds is another objective; this can be achieved either by modification of the street layout, particularly at intersections, or by the placing of obstacles to prevent the rapid passage of vehicles. Traffic control measures can have an influence on pedestrian safety, and the general level of lighting of the road system in another factor which must be considered.

The effects of regulatory measures have also been examined. Several studies have shown that one way streets are beneficial to pedestrian safety. Parking regulations are particularly relevant to the problem of child pedestrian safety. Speed limits in urban areas, both general and local, can play an important part in protecting pedestrians.

In most well-developed countries the pedestrian safety problem is an urban one. But on rural roads vehicle speeds are often high thus making the judgement of gaps in the traffic difficult and allowing little time for detecting pedestrians by drivers, or oncoming vehicles by pedestrians. Where possible separate space should be provided for pedestrians but when this is not possible they should be encouraged to walk facing oncoming traffic and to make themselves as conspicuous as possible especially at night; the provision of roadside lighting and well-lit crossings can greatly aid the safety of pedestrians at night where the scale of the problem merits it.

ROAD SAFETY EDUCATION

It is attractive to hypothesize but less easy to obtain rigorous proof that road safety can be improved by road safety education, i.e. that by gaining acceptance of the teaching in practical terms behaviour will be favourably influenced in critical situations which may otherwise develop into accidents. For this approach to have prospects of success it is necessary to know what constitutes safe behaviour and how it may best be taught.

Reference has already been made to the special problems of rural roads which have no footpaths but the major problem relates to situations beginning with the pedestrian walking on a footpath or pavement. Conflicts with vehicles occur when the pedestrian attempts to cross the road or steps into the road for some reason. In road safety it is essential to distinguish between behaviour that people normally do, behaviour that may be achievable by various means and behaviour that exceeds the innate abilities of many people or of critical groups such as young children. Far too often it has been assumed that young children should be trained to use adult techniques and that this can be achieved by using educational material suitable for adults. It is also evident that parents tend to overestimate the ability of their children, especially very young children, to cope with vehicular traffic. Since it is possible to influence the safety of very young children only through their parents, informative campaigns are needed for parents telling them why children are not able to perform as adults in traffic and also what they can do to increase the safety of their children on the roads both by supervision and training. Information needs to be given for example, about children's limited vision and audition, and their limited ability to anticipate and predict future events.

Theoretical training given to children needs to be reinforced by practical training exercises in real traffic conditions. This practical training should be carried out by both parents and teachers. Traffic clubs as used in Scandinavian countries are an effective way of integrating both theoretical and practical training and of involving parents. Adequate training in road safety for teachers is required e.g. by courses, journals, conferences and seminars, and suitable material for teaching purposes must be developed. The training of children should be frequent and continuous. It is important that teachers should be given regular encouragement. One way to do this is to distribute at frequent intervals, material that is designed to be of interest to both children and teachers e.g. road safety journals, and road safety calendars for use in the classroom. School crossing patrols (both children and adults) are an effective way of protecting children on routes to and from school and merit consideration for use on a larger scale.

A conceptual framework of road safety education is given in Fig. 2. A considerable amount of work has al-

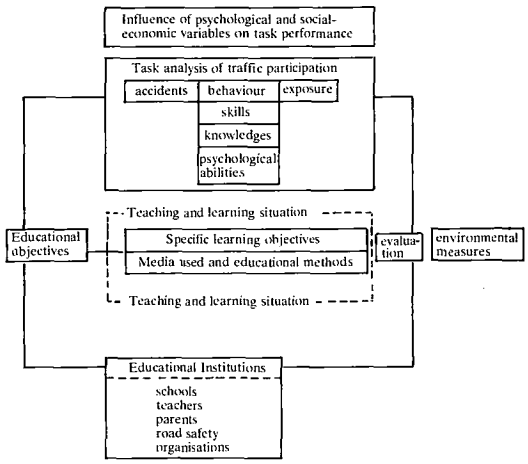


Fig. 2 - Conceptual framework of road safety education

ready been carried out on various aspects of this framework and studies of the problems facing children on roads generally fall into one of three classes; analysis of accident statistics, studies of the social background or personality characteristics of accident involved children, such as those by Backett and Johnston [12[and, less commonly, direct observation and experiments on children typified by the work of Sandels [13[.

Accident statistics are not in themselves indicative of the relative risk for children of a particular age group when making a road crossing. This is because such data do not take account of the number of road crossings made and the lack of a reliable measure of this leads to difficulties. The social, environmental and individual factors which affect the likelihood of a child being on the roadway are also little understood.

If behaviour leading up to the accident is to be analysed special studies are needed. Such a study was carried out in 1972 with the co-operation of the Hampshire Constabulary [14]. However, detailed studies of behaviour are also needed in order to identify and formulate educational objectives.

Video tape recording of childrens' road crossings and interview data have been used in a mathematical framework to relate accident statistics to the mean number of roads crossed per day by children of various ages in Nottingham [15].

It would seem that risk of accident during a road crossing decreases with age from 5 to 11 for both boys and girls and that the accident statistics may underestimate the greater risks run by younger children in road crossings. The limited data available also indicate that the greater number of accidents to boys aged 5 to 7 years may not be due to their greater exposure at least as far as purposeful crossings are concerned. Reasons must therefore lie in differences in behaviour, skills, exposure during play and perhaps behavioural changes during play near roads.

Time lapse photography was used by Grayson [16] at sites near four schools, two primary and two secondary, to obtain records of 1790 road crossings by children and adults. The results showed that children differed from adults not only on individual items of behaviour, but also in the crossing strategies they displayed. Adults tended to make their assessment of the road situation before reaching the kerb with the apparent aim of eliminating or minimising delay at the kerb. Their behaviour was often far from satisfactory (in some respects the opposite of what children are taught) which could influence some children to copy them and consequently be endangered since the children would be less able to cope with the resulting situation. Examples of this are that adults were more likely than children to start to cross before the road was clear and were more likely to cross at an angle.

Other studies aimed at elderly pedestrians have shown that their behaviour is similar in some respects to that of children, ie. they are more likely to stop at the kerb, they have longer delays, and they make more head movements than do younger adults.

Behavioural studies are valuable in that they can identify aspects of behaviour which may need to be improved and such improvements can be taken as indicative of the success of educational measures.

Without doubt, the ultimate goal of road safety education is the reduction of accidents, and most intermediate objectives have been derived from this point of view. Nevertheless, educators sometimes specify objectives concerning road user education in a broader sense. Examples of such objectives are: traffic participation without fear, compliance with traffic rules that are not necessarily related to traffic safety and traffic participation as an example of good citizenship. Many international conferences have been held that have given recommendations about the specification of educational objectives including the ECMT, Council of Europe and the Group of Experts on Road Traffic Safety of UNESCO [17]. The latter have made the following recommendations:

"To be effective, road safety education must be provided on a systematic and continuing basis in pre-school establishments and primary and secondary schools and knowledge must be built up step by step".

It is essential that the methods used for road safety instruction should be the same as those used for other subjects on the school curriculum.

Road safety instruction should not be treated separately, but should be an integral part of a child's education, so that it continues to have the maximum educational impact instead of remaining at the level of purely formal teaching of the rules of the highway code.

Road safety instruction should therefore also be included in other branches of study e.g. technical subjects and natural sciences; ethics and the social sciences; and also physical education. It would be useful to refer for this purpose to the example provided by the Czechoslovak authorities.

These considerations should not dissuade school authorities from providing road safety instruction as a subject on its own for a certain number of hours".

Printed material on road safety education for teachers in the form of posters, journals, manuals and booklets are produced in many member countries but little research has been carried out to discover what effect this has had on teachers attitudes to, knowledge about, amount done, and methods used, for teaching road safety.

In the UK two types of road safety curricula are currently being evaluated. One is concerned only with road safety, the second combines road safety with other aspects of health education to form a general curriculum on health education. Both schemes are currently being piloted, and data on teachers' attitudes, usage of materials, and amounts of teaching done and what the children learn are being collected.

In general, printed material seems to be an effective method of informing teachers about and encouraging them to do road safety teaching particularly if it is distributed regularly to teachers. In some countries this is done, e.g. United Kingdom - a safety journal and pictorial learning aids, Austria - a road safety calender, Netherlands - two illustrated road safety journals for children with teachers' notes.

MASS MEDIA COMMUNICATIONS FOR PEDESTRIAN SAFETY

There are many different channels for mass media communications: newspapers, radio, television, magazines, books, audiotapes, films, pamphlets, brochures, posters, stickers, and even personalized mail if it is forwarded in bulk.

The development, as well as evaluation of any mass media communications programma may be succinctly described by means of a flow diagram described in an OECD report (Fig. 3).

In contradistinction to the period up to approximately the late 1960's, recent developments in mass media communications for safety have shown a marked increase in the number of programmes which are evaluated on their effects [18]. There is at present much more widespread awareness that running unevaluated programmes for the promotion of road safety is useless from the point of view of building expertise in accident prevention, whether they save lives or not. Although such campaingns might seem to serve other purposes, for instance of a public relations nature, it is obvious that accident prevention measures ought to be examined on their ability to prevent accidents.

The OECD report on road safety campaigns [19] had this to say about the need for scientific evaluation of mass media communication efforts:

"From the available literature it becomes readily evident that the amount of scientific information on safety communications is rather limited indeed and that it contrasts sharply with the social importance of the issues involved as well as with the total number of campaigns launched in various countries at different times. However, if there is one thing that emanates clearly from the experience hitherto obtained, it is that the area is characterised by many serious problems, both with regard to the design

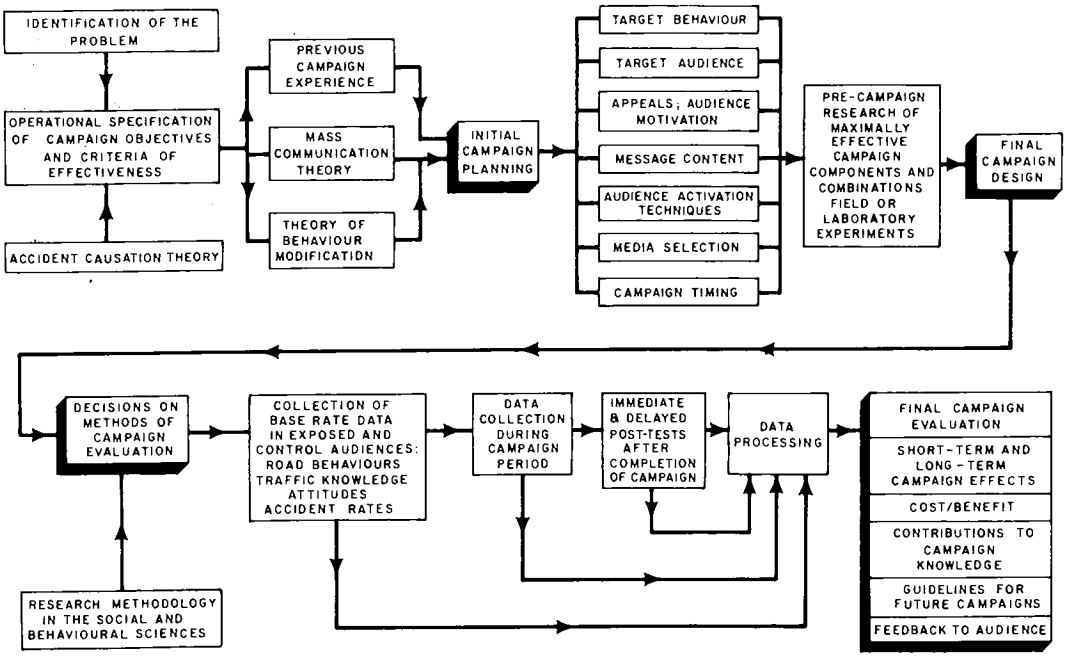


Fig. 3 – Diagram of safety campaign design and evaluation

of safety publicity campaigns, as well as concerning the accompanying research efforts dealing with the assessment of campaign effectiveness.

Perhaps one of the most likely and blatant blunders made in the evaluation of traffic safety campaigns is to mistake the amount of public and official interest generated by the campaign for its true effectiveness. The success of a safety campaign cannot be assessed by the number or magnitude of newspaper articles, letters to the editor, comments in parliament or small-talk between friends and neighbours and similar forms of public or official reactions triggered by the campaign efforts, nor by the flattering congratulations extended to those who organized campaigns for their commendable efforts. The energy of a fire does indeed depend upon the fire, not upon the amount of smoke. The true effectiveness of a safety campaign is its power to actually reduce accident tolls and to increase the frequency of those road behaviours which are compatible with safety.

That changes in behaviour on the road and reductions in accident rates are the only meaningful criteria for campaign success may appear obvious enough, if one is truly interested in the promotion of traffic safety rather than in curtains of smoke which cover up the real issues. And yet, in the recent past many a safety campaign has been evaluated in ways which betray this fundamental conceptual error".

Thirty different mass communication efforts aimed at the promotion of pedestrian safety have been reviewed [20]. Mass publicity was accompanied by changes in enforcement in six of these, and by both enforcement and physical changes in two cases.

Behavioural measures of effect appear to be the most commonly applied. These were used in seventeen of the twenty-two programmes involving mass media publicity only, and in all seven of the programmes combining mass media and enforcement activity. Dependent variables taking the form of extent of message recall was used only once, changes in knowledge four times and changes in attitudes twice. Very few studies involved more than one type of measure of effect.

The studies involving mass media only and using behavioural indices as a measure of effect showed significant influence upon behaviour with few exceptions. Thus, there can be no question that mass media communication is capable of modifying pedestrian and driver behaviour.

Changes in accident rates were examined in less than one-third of all studies reviewed. Two of the three mass media only programmes, which were evaluated on their ability to reduce accidents, showed clear and positive results. One of these reduced pedestrian accident rates, namely the British Green Cross Code [21]. This programme embodied very careful and detailed preparatory research, which was conducted to give the Green Cross Code its eventual format.

The Green Cross Code replaced the so-called 'kerb drill', a behavioural routine for crossing the road. The priorities of safe behaviour were determined, the new instructions were lengthier and hopefully would be used to convey principles of safety instead of rote learning of a behaviour repertoire. They were intended for children seven years or older and aimed at teaching children to *judge* when it is safe to go across. The Green Cross Code contains the following instructions:

1. first find a safe place to cross, then stop
2. stand on the pavement (sidewalk) near the kerb
3. look all round for traffic and listen
4. if traffic is coming let is pass, look all round again
5. when there is no traffic near, walk straight across the road
6. keep looking and listening for traffic while you cross.

These instructions were primarily intended for children over 7 years old, but it was felt that it could be useful also to youngsters between 5 and 7, provided

that a special teaching effort were made. Some seven million brochures explaining the Code were distributed. The total media expenditure was £570,000 covering television, procedures, posters, and announcements in movie theatres. It was calculated that the average member of the audience had five opportunities to see the publicitiy on television and fourteen opportunities in the press.

Effect evaluation took place on three levels, roadside observations, knowledge and accident reductions. All showed the success of the Code. Applying conservative criteria, an eleven per cent drop in accident rate was arrived at, with a chance probability smaller than .01. The greatest reductions in accidents was observed between the ages of 5 and 9, the target audience, but decrements in adult pedestrian casualties were also identified.

It is important to note that the Green Cross Code programme showed a positive return, even if the effects had dwindled or extinguished after completion of the programme proper.

THE INFLUENCE OF ALCOHOL IN PEDESTRIAN ACCIDENTS

The risk of a driver being involved in an accident increases with the level of alcohol in the driver's blood (BAC) and rises dramatically at the higher levels of impairment. Early studies demonstrated impairment of task performance and later studies demonstrated the causal link with risk of involvement and with the higher severities of accident.

A great deal of the data apart from the classical research of Borkenstein has come from drivers involved in accidents or from post-mortem data on road users who have died from their injuries. These data generally show high levels of blood alcohol in young drivers and generally high levels in the late evening, but they provide no information on the levels of blood alcohol present in drivers generally. This wider information is necessary if effective countermeasures are to be designed and implemented and random surveys of drivers have been carried out in several countries to provide this information.

In the case of pedestrians there has to date been little firm evidence about the significance of blood alcohol in respect of accident involvement though there is information of the levels for those killed in road accidents. In recent years the proportion of fatalities above 200 mg alcohol/100 ml of blood was similar for driver and pedestrian fatalities but at the lower levels of proportion of pedestrians at each level was less than that of drivers.

Just recently a study has been completed in the UK [22] which determined the blood alcohol distribution of adult pedestrian fatalities in a large urban area and by comparing it with the BAC distribution of a control sample of non-accident-involved pedestrians, established the role of alcohol in the aetiology of such fatalities.

The accident sample comprised all fatal adult pedestrian accidents that occurred within the West Midlands Metropolitan County (population 2.8M) during the period 1 January 1969 to 31 December 1975. Data on the BACs of adults ($\geq$ 15 years) who died within 12 hours of the accident were obtained from coroners' records. Further data on the pedestrian and the accident were obtained from police records.

The control sample was matched in terms of the location, time of day, and day of week of the accident and the sex of the pedestrian. Accidents which occurred during the period 1 January 1969 to 31 December 1973 constituted the retrospective sample and were visited on the same day of the week nearest to the anniversary of the accident. Fatalities which occurred during the period of the fieldwork (1 January 1974 - 31 December 1975) were controlled within a month, again on the same day of the week as the accident.

Pedestrians obviously engaged is essential services, such as policemen, postmen, milkmen, etc, were not approached. No such people were involved in fatal accidents.

During the period 1 January 1969 to 31 December 1975, 794 adult pedestrians died as a result of traffic accidents in the West Midlands Metropolitan County. They comprised 5.1 per cent of the national total during that period.

Out of the total, there were 344 cases in which the BAC of the accident victim was known and at least one corresponding control interview was obtained. Of the remaining fatalities, 319 died more than 12 hours after the accident and there were 69 cases in which the BAC of the accident victim was not measured despite his dying within 12 hours. A further 62 cases were not controlled mainly because of the absence of pedestrians passing the site at the appropriate time.

A total of 1,118 pedestrians were interviewed, a mean of 2.9 interviews per site visited. The gross refusal rate was 18.4 per cent but that figure included many people who were genuinely in a hurry. In the vast majority of cases, once a pedestrian had stopped, he or she completed the interview and provided a breath sample.

Alcohol-related accidents, particularly those involving high BACs, tended to occur mainly in the late evening. The highest incidence was in the 2300-0259 hours period when 70.2 per cent of the accident group had BACs $\geq$ 80 mg/100 ml and 50.9 per cent had BACs in excess of 150 mg/100 ml. The comparable figures for the control group were 18.8 per cent and 3.1 per cent respectively. During the day, the incidence of alcohol amongst both the accident and control groups was comparatively low (Fig. 4).

The BAC distributions of both the male accident and control groups were significantly higher than those for the females ($p < 0.001$). For males 47.4 per cent of the accident group had been drinking (BAC $\geq$ 10 mg/100 ml) and 28.9 per cent had BACs in excess of 100 mg/100 ml, compared with 14.7 per cent and 7.3 per cent respectively for the females.

In the male control group, 33.1 per cent had been drinking and 6.9 per cent had BACs in excess of 100 mg/100 ml. For the female control group, the corresponding figures were 6.6 per cent and 0.2 per cent respectively.

Alcohol has a major role in fatal pedestrian accidents. The study showed that at BACs above 120 mg/100 ml, the relative risk of accident-involvement increases rapidly. The data suggested that the effects of alcohol upon male pedestrian accident experience were not significant below 120 mg/100 ml. At 120-159 mg/100 ml, the relative risk of accident was over three times that of a sober pedestrian and, at higher BACs, the risk was fourteen times greater. A similar analysis for female pedestrians established that the relative accident risk for the 120 + mg/100 ml group was over 36 times that of a sober female pedestrian.

Alcohol is undoubtely one of the most serious problems in relation to road safety and the impairment of drivers is a major threat to pedestrian safety, quite apart from the risk to pedestrians who are themselves impaired. The major beneficial effect that can be produced by legislation directed at drivers who drive after drinking has been demonstrated in several countries; unfortunately the initial benefits tend to decline as the perceived risk of detection by police is found to be less than expected and as publicity related to the legislation declines. In the case of pedestrians legislation of similar severity to that imposed on drivers cannot be readily

adopted. Its deterrent effect would in any event be small since a much greater deterrent is the high risk of death or serious injury to any pedestrian involved in a road accident. But some pedestrians under treatment for their physical injuries might with advantage be referred for treatment of drinking problems.

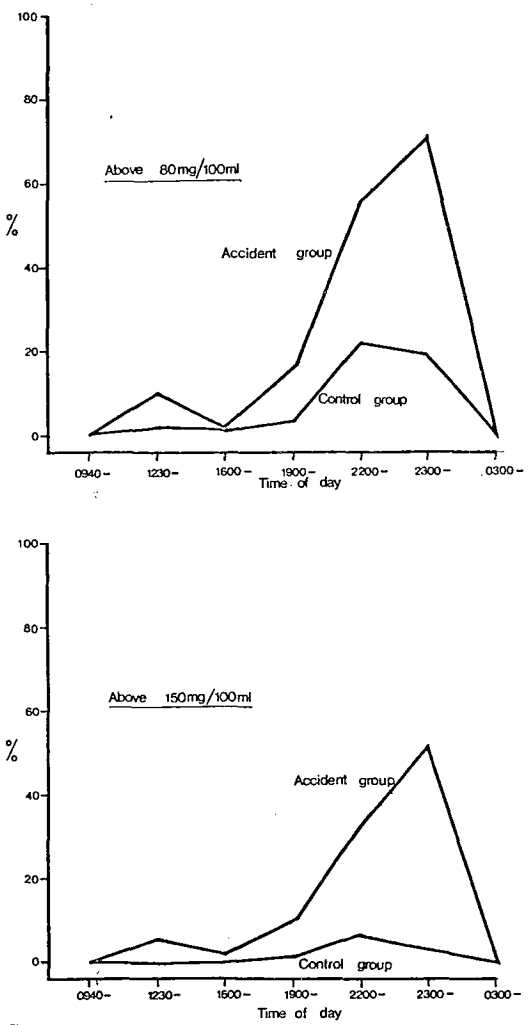


Fig. 4

BAC distributions by time of day for males and females combined

VEHICLE DESIGN TO ENHANCE PEDESTRIAN SAFETY

The majority of pedestrian injuries are inflicted by cars and apart from regulations preventing sharp projections on the exterior of them, little attempt has been made until recently to mitigate pedestrian injuries by vehicle re-design.

Over the last five years growing attention has been given to the problem [2], [23], [24], [25], [26] and [27]. It is now evident that valuable improvements in pedestrian safety can be gained by adopting suitable frontal designs. The two major objectives are to prevent the pedestrian being seriously injured in the primary collision with the car and to prevent the pedestrian being flung down into the road by the initial impact or subsequently. This can be achieved by retaining the pedestrian on the bonnet of the car [28] (Plate 3). It has been shown that it is much more difficult to meet these objectives for a child than for an adult and that the problem becomes rapidly more difficult at the higher impact speeds. This emphasizes the need to limit vehicle speeds in areas of high pedestrian concentration and to plan the road environment so that drivers have the maximum opportunity of slowing down before striking a pedestrian when this is unavoidable.

Harris [29] has suggested that pedestrian accident injury may be reduced by cars that are designed to satisfy the following conditions:

1. The severity of primary impact is reduced by matching the collapse characteristics of the front of the car to the appropriate human tolerance loads.
2. An adult pedestrian should be picked up and retained on the bonnet over as wide a range of impact speeds as possible without being projected over the roof or wings to the ground.
3. A child should be picked up into the bonnet or bonnet front rather than knocked forward to the ground.
4. The head should impact a suitably designed energy absorbing bonnet top rather than the more rigid windscreen surround. Some features of vehicles design that contribute to these conditions are:

A low mounted energy absorbing bumper with a yield of at least 100 mm; this also ameliorates lower limb injury, moving the impact to below the adult knee.

An energy absorbing bonnet leading edge with a yield of at least 150 mm and preferably much more.

Bonnet and wings with controlled vertical collapse characteristics.

The height of the leading edge of the bonnet has conflicting requirements, it needs a low bonnet front for projecting a child on to the bonnet and a high bonnet front for reducing the frequency of adult head impact with the windscreen surround. A long bonnet also reduced this latter possibility.

It may no longer be appropriate to talk of the bumper as an independent component of the car but rather to consider an overall frontal design of vehicle which has the necessary characteristics to satisfy impact requirements in both car-to-car and car-to-pedestrian collisions.

Compatible designs cannot be fully exploited by individual manufacturers and new international vehicle regulations will be needed for harmonisation of the future vehicle fleet.

RESEARCH NEEDS

Pedestrian safety research is carried out in many countries but it has not often been possible to identify with precision the benefits obtained from specific safety measures. This is because of the difficulty of carrying out evaluation in terms of accident or casualty savings. When similar measures are applied in different countries the results frequently seem to differ due to the difficulty of making valid comparisons and to differences in the background against which the measures are applied. One notable difference lies in the different legislative frameworks that exist.

There is therefore urgent need to develop internationally accepted techniques for the assessment of pedestrian safety schemes and to identify the legislative differences between countries and their influence on particular safety measures.

Older and Grayson [30] have recently published a comparison of pedestrian and vehicle flows and pedestrian casualties collected from busy streets in the cities of Vienna, Copenhagen, London and Tel Aviv.

There was no evidence in the data presented in this

PLATE 3: Experimental front-end No. 2b retaining adult on bonnet at 16 km/h.

PLATE 4: Experimental front-end No. 2a picking up child at 16 km/h.

paper of any large overall differences in risk to pedestrians crossing busy roads in each of the four cities, the differences within cities being far greater than those between cities. In fact it is a little surprising that, with the differences in detail in the ways in which some of the data were collected, the four comparable risk values on common sections lie within a range of ± 11 per cent of a common value. It might appear that, at least in the conditions studied, no city was markedly better than the others in its handling of the pedestrian safety problem.

However, it is important to note that this conclusion is based on a comparison of risks in the sections of road common to all cities. While the risks on these sections were similar, the four cities differed in the proportions of their total pedestrian flow found on the common sections, as follows:

Vienna 52%, Copenhagen 47%, London 70%, Tel Aviv 23%.

It should also be remembered that the common sections did not include signalized crossings with pedestrian signals near intersections which proved to have the lowest relative risk in those cities which had such crossing facilities.

While differences between the common sections of the four cities were relatively small, greater variability was found when all sections of the road were considered. A possible explanation of this can be found in relating the amount of pedestrian flow to various sections of the roads.

The low level of overall risk in Tel Aviv can largely be attributed to the heavy concentration of pedestrian flow on to the low risk signalized crossings. Although the usage of crossings in Vienna was low, this was offset by lower risk levels in the vicinities of crossings. Copenhagen and London both had high risk measures near crossings compared with the other two cities.

As far as relative risk is concerned, a detailed comparison of the risk of crossing at recognised crossing places and near road intersections showed more similarity than difference between the cities. The pattern of low risk on crossing places with high risk on the adjacent sections was common to all four cities and the relative risk levels on crossings were similar.

Due to the variability of the data it is difficult to clearly rank the crossings with respect to safety but there is a trend indicating that the order of crossings (from safe to less safe) was:

1. Crossings with pedestrian signals at signalized intersections.
2. Crossings without pedestrian signals at signalized intersections.
3. Crossings with pedestrian signals at non-signalized intersections.
4. Crossings without pedestrian signals away from intersections.

Pedestrian crossing facilities at signalized intersections maintained an overall benefit to safety even when the adjacent high risk areas were combined with them, that is, they contributed to safer lengths of road. Crossings where there was no signal control only produced a marginal improvement in safety in most cities over the length of road including the adjacent sections. In the latter case presumably an improvement would occur if pedestrians were persuaded or forced to use the facility rather than cross the adjacent lengths of road.

This leads on to a consideration of whether the use made of crossings in the four cities is a reflection of the legal regulations governing such use. Austria has a law requiring pedestrians to use crossings if there is one within 25 m. Denmark has a law requiring use of the crossing if it is nearby and there is sufficient traffic present. No specific distance is mentioned. In the United Kingdom there is no law requiring pedestrians to use crossings, or to observe light signals. In Israel the responsibilities of the pedestrian are set out in detail, including an obligation to use crossings where these are provided.

The regulations in force in Austria were not reflected in the proportion of pedestrians using crossings in Vienna, which was in fact the lowest of the four cities even when the immediate effect of number of crossings was allowed for. Under similar conditions it would appear that more use was made of the Copenhagen crossings than those in London which may be partly due to the difference in regulatory measures. It would also appear that the strict regulations controlling pedestrian behaviour in Israel were much more effective in encouraging use of signalized than of unsignalized crossings.

The OECD Special Research Group [8] has identified detailed research needs under the headings of the pedestrian's road environment, road safety education and the mass media (Appendix).

DEVELOPING COUNTRIES

This paper has mainly discussed the situation obtaining in Europe and North America but much of the material is applicable to the urban areas of less well-developed countries and certain countries with multi-racial societies. However there are important differences and these differences may well require different approaches and solutions.

Jacobs has studied the general road accident situation in developing countries [31], [32], [33], [34] and Oldendaal [35] has studied pedestrian behaviour in the heterogeneous society of the Republic of South Africa where there are four main population groups with widely differing cultural backgrounds, socio-economic structures, degrees of literacy, beliefs, values, etc. These differences are not only confined to the four groups, but also exist within each of the particular groups.

Uken [36] has pointed out that in 1975, 44 per cent of all road fatalities on South African roads were pedestrians. Out of these some 55 per cent were Black males. Unlike most developed countries where the young and the aged are overpresented in pedestrian accidents, one is here faced with the middle-aged group. The 18 to 49 year age group, in fact, constitutes 72 per cent of Black male pedestrian fatalities. Put differently, the Black male pedestrian of the 18 to 49 year age group, constitutes about one-fifth of all South Afican road deaths.

It is evident that considerably more effort is required to tackle the pedestrian problem in developing countries if it is to be at all comparable to the scale that is being deployed in the developed countries.

CONCLUDING NOTE

Pedestrian safety is today a matter for concern in most countries on account of the relatively high level of casualties and the difficulty in identifying worthwhile measures that have the prospect of making substantial improvements in the situation.

It is not for lack of government attention or of research in the well-developed countries that this situation exists but rather that the problem is one of great complexity and the more effective of available measures are costly to implement or not generally acceptable. Road safety is a major public health problem and as the numbers of deaths from disease and illness falls the proportion of those due to road transport becomes of increasing significance suggesting that it merits a greater share of national resources.

Unfortunately, the knowledge of effectiveness that could have been derived from the wealth of pedestrian safety schemes which have been applied, has not been

fully realized. However, current international activities which link research more closely to policy formulation in the pedestrian safety field show promise of improving the effectiveness of international endeavours.

Greater prominence needs to be given to pedestrian safety in the planning and redevelopment of urban areas. There is a continuing need to clarify the shape and significance of the various legislative frameworks that apply in different countries because these may profoundly affect the general suitability and success of individual safety measures that have been sucessful in some countries.

Above all there is a need to carry out rigorous scientific assessments (in terms of accidents and casualties) of the benefits of new pedestrian safety measures as they are applied.

Most of the pedestrian safety research carried out to date has taken place in well-developed countries but most of the findings are applicable also to less well-developed countries. There are however, some important differences that emphasize the need for pedestrian safety research in these countries to deal with the special problems that arise.

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FOOTNOTE

1. Austria, Belgium, Canada, Denmark, Finland. France, the Federal Republic of Germany, Greece, Iceland, Ireland, Italy, Japan, Luxembourg, the Netherlands, Norway, Portugal, Spain, Sweden, Switzerland, Turkey, the United Kingdom and the United States.

APPENDIX: DETAILED RESEARCH NEEDS (OECD SPECIAL GROUP)

The OECD Special Research Group has identified detailed research needs under the headings of the pedestrian's road environment, road safety education and the mass media.

The pedestrian's road environment

(i) Research is recommend on the needs of pedestrians in urban areas, and particularly into the factors which influence their choice of routes.

Aim: better location and assessment of policy and design, for pedestrian precincts and networks.

(ii) Research is recommended to determine the risks to pedestrian at different parts of the road networks in urban areas.

Aim: assessment of overall levels of risks and the rational design of traffic management countermeasures; monitoring of pedestrian safety.

(iii) More research is needed on criteria to be used in the

implementation of pedestrian segregated areas, pedestrian networks and space sharing schemes.

Aim: to produce guidelines for engineers and planners.

(iv) Research on design measures aimed at reducing vehicle speeds, both in pedestrian zones and in residential areas.

Aim: identification of optimal and acceptable features to avoid proliferation of measures and the introduction of possibly hazardous ones.

Road Safety education

(i) Further research is needed to define the requirements of safe pedestrian behaviour through task analysis for children of different ages.

Aim: to identify and define training objectives which are appropriate for children at different stages of development.

(ii) Research is needed to determine the best methods by which training objectives can be attained, and also on the optimal amount and frequency of training.

Aim: to achieve the most efficient use of educational resources.

(iii) More research is require on the best way of integrating the training efforts of parents and teachers.

Aim: to develop more specific and effective educational countermeasures.

Mass Media

(i) Research is recommended on the rationalisation and evaluation of the legal responsibilities of drivers and pedestrians in Member countries.

Aim: to enable mass media programmes to be based on clearly defined requirements for behaviour.

(ii) Further research is needed into the design features of mass media campaigns, and evaluation must be an integral part of all such programmes.

Aim: to increase the effectiveness of mass media campaigns.

(iii) More extensive and informative data on pedestrian accidents is needed in all Member countries.

Aim: to increase understanding of the pedestrian safety problem; to assist in the rational selection of target audiences and target behaviours.