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Staysafe 48

PEDESTRIAN SAFETY
IV. Child pedestrian safety in New South Wales

Report No. 22/51
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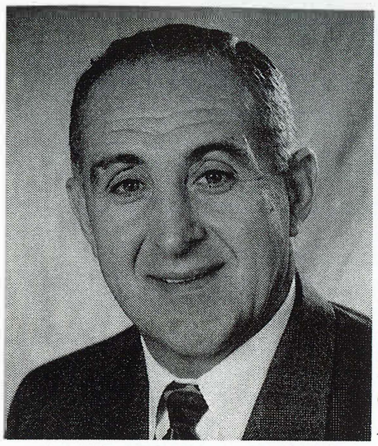

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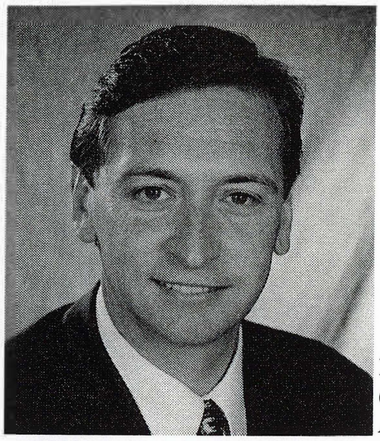

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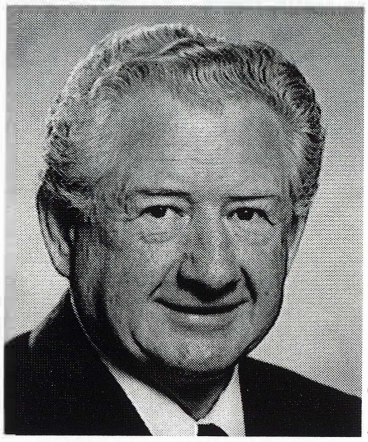

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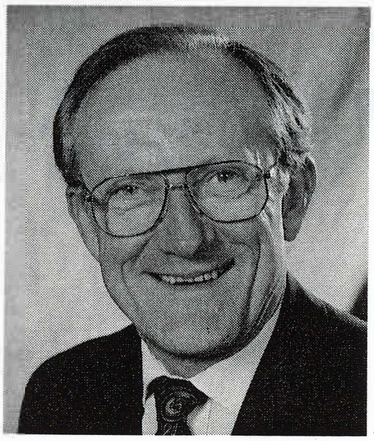

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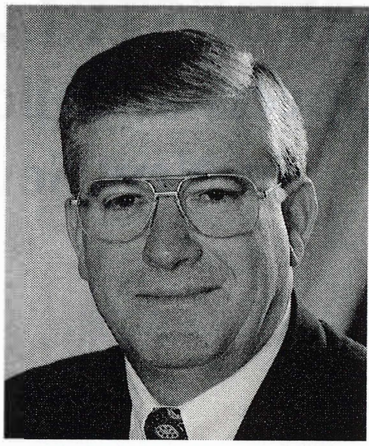

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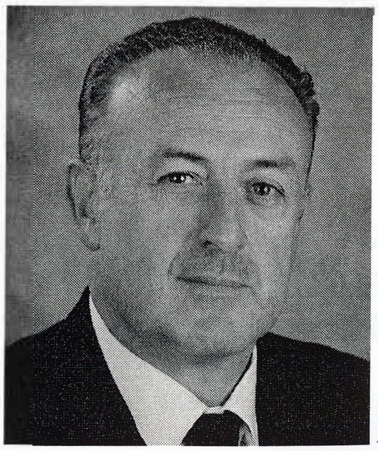

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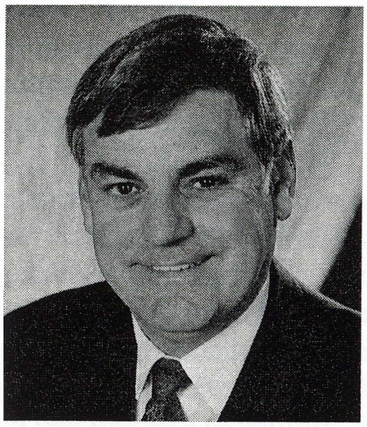

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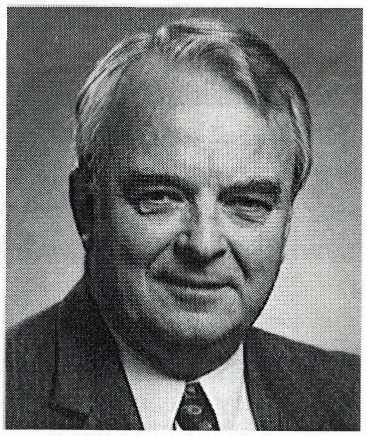

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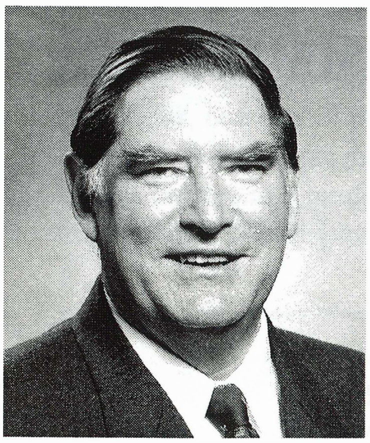

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Committee Officer	Dr Paul Adams
Assistant Committee Officer	Ms Cory de Vega

CHAIRMAN'S FOREWORD

Paul Gibson MP, Member for Londonderry
Chairman, STAYSAFE
Joint Standing Committee on Road Safety

The road safety situation in New South Wales radically improved during the early 1990s, but has remained plateauxed or stagnant since 1995. We must continue the search for more effective policies, more effective programs and more effective legislation to control inappropriate and injurious behaviour on our roads and to promote good behaviour.

Pedestrian safety, particularly the safety of children during travel to and from schools, was a low profile area of road safety until the then Minister for Roads, the Hon. Wal Murray MP, decided to introduce 40 km/h speed limits around schools a the start of the 1990s, and the STAYSAFE Committee launched a general inquiry into pedestrian safety matters several years later. Research to date clearly indicates that the bulk of road crashes involving children as pedestrians occur in places other than established crossings. Such road crashes are characterised by drivers running down children as they attempt to cross roads from one footpath to another, in situations where a driver's view is often obscured by parked cars and attention is strained by the demands of manoeuvring within traffic. Curiously, these crashes are termed "pedestrian 'dart out' crashes" by road safety workers, and the driver's role in the causation of a crash is minimised or neglected.

The successful promotion of child pedestrian safety is extremely complex matter. The STAYSAFE Committee has examined the available literature and investigated current practices, and concludes that no single answer or direction can be postulated in the quest to protect our children from danger on the roads. What is required is a concerted and co-ordinated approach to both the training and awareness of drivers and the education of children in the correct use of the roads.

Like most issues of child safety, the protection of children on our roads is a collective responsibility. It involves us as parents and carers, educators, policy makers, media commentators, and most crucially as vehicle drivers, in the diligent attention to teaching our children pedestrian skills, leading behaviour by good example, and by exercising care behind the wheel.

The STAYSAFE Committee's investigations demonstrate that the structures and knowledge required to protect our children already exist. But our road rules, our studies of childhood behaviour, our school programs and the best will in the world are not sufficient in themselves. Two significant factors make this so. The first is the recognition that very young children will not always behave in a predictable manner, despite the best education. A myriad of factors ranging from cognitive development and the ease with which children can be distracted, to peer pressure and their desire to do what is "cool" will affect their response to their pedestrian environment. The second factor is motor vehicle drivers. The sad fact borne out by the investigation undertaken for this report is that many drivers do not heed road rules and act inappropriately to physical deterrents designed to slow vehicles near areas such as schools and playgrounds. Further, and more disturbing, research shows that many drivers still harbour the belief that "it won't happen to me", and simply do not acknowledge the possibility that a child pedestrian may act in an unpredictable or imprudent manner and take action to adjust their driving style accordingly.

The STAYSAFE Committee believes that the contribution of these two driver-related factors must be acknowledged, and that the most sensible response to this reality should be likewise twofold, namely refinement and reiteration.

The techniques employed in the education and training of both children and adults must be both constantly examined and refined, and constantly reiterated to all parties, in order to be as successful as possible. This must be a community effort involving the co-ordination of legislators, educators, parents, academics and drivers, and as such, can only be enforced by the will of all those affected to make it succeed. It may seem to the reader trite to infer platitudes from the academic data which makes up a large portion of both this report and the earlier STAYSAFE 26 (1994) into school child pedestrian safety around buses, but the STAYSAFE Committee can reach no other conclusion than this: The problem of child pedestrian safety must be approached jointly, and diligently, by all members of our society, not left to parents and educators alone.

The safety of our children, on the road as in any circumstance, is a broad concern which cannot be addressed on a legislative or academic level alone. The STAYSAFE Committee will continue to monitor the status of education programs and academic research in this field and will report again to Parliament if necessary.

Acknowledgments

A significant aspect of the STAYSAFE Committee's operation is the bipartisan manner in which the Committee members conduct their inquiries and deliberations. I am grateful for the hard work of my colleagues, be they Government Members, Opposition Members, or from the cross bench.

The STAYSAFE Committee has been ably served by its Director, Mr Ian Faulks, Committee Officer, Dr Paul Adams, and Assistant Committee Officer, Ms Cory de Vega.

I wish also to acknowledge the work of Mrs Cheryl Samuels, a Commonwealth Parliamentary officer who prepared this report during her placement with the STAYSAFE Committee.

I commend this report to Parliament.

Paul Gibson MP

EXECUTIVE SUMMARY

Nationally, one or two children die each day as a result of an accident—one of these children each week will have died as a result of a pedestrian-vehicle crash.

STAYSAFE's major inquiry into pedestrian safety has the aim of undertaking a comprehensive review of pedestrian safety, in order to examine the trends in pedestrian road crashes and the adequacy of existing planning to reduce pedestrian injury.

Of particular concern is the safety of children as pedestrians. This issue was considered by STAYSAFE in its first report into pedestrian safety (STAYSAFE 26, 1994) dealing with the issues associated with school child pedestrians around buses. Research available to STAYSAFE during that phase of the inquiry indicated that young children, particularly those of primary school age, run a high risk of involvement in pedestrian crashes. As children get older, the risk of serious or fatal injury in pedestrian crashes declines.

This report examines more general issues of child pedestrian safety, including the nature and causes of injury to child pedestrians, the behaviour of children when crossing a road, the behaviour of parents accompanying children, the behaviour of drivers and their attitude to child pedestrians, education strategies for improving behaviour, the role of the road environment and vehicle design in child pedestrian crashes and the reporting of pedestrian crashes.

A major issue identified by STAYSAFE has been the failure of the Roads and Traffic Authority to disseminate relevant research findings on children and road safety. In fact, STAYSAFE identified several major studies which appeared to have been suppressed for periods of up to 6 years before being uncovered during STAYSAFE's inquiry—that these studies documented information showing the Roads and Traffic Authority's road safety education program in a poor light may have be a significant factor in the suppression. STAYSAFE was not impressed by the response of the Roads and Traffic Authority in attempting to place a publication date on these reports (1994) two years earlier than their actual date of publication in 1996.

Although a reasonable body of evidence relevant to the New South Wales child pedestrian situation has been identified during this inquiry, there is a lack of coordination of statistics and analysis between the many participating organisations and academics. STAYSAFE considers this a limiting factor in the effort to save the lives of child pedestrians and recommends in this report that a serious attempt be made to glomerate available resources. This task would most appropriately be led by the Roads and Traffic Authority, or perhaps the injury prevention section of the Department of Health.

Other recommendations arising from this report focus on, among other things, expanding the amount and variety of road safety education campaigns around such matters as speed reduction near school zones, parking in school zones, awareness of the types of pedestrian crossings available, and the increased provision of pedestrian bridges.

RECOMMENDATIONS

RECOMMENDATION 1: The Roads and Traffic Authority and other agencies with a responsibility in the area of child pedestrian trauma should review their archives and active files for the previous 10-15 years to determine if there are further documents and research reports addressing issues of child pedestrian trauma that should be publicly released. (Paragraph 2.12)

RECOMMENDATION 2: The Roads and Traffic Authority monitor the appeal process in the case of <u>Scrase -v- Jarvis & Others</u> (1998) Australian Torts Reporter 81-471, and assess the effect of the judgement in <u>Scrase</u> on legal liabilities associated with child pedestrian behaviour, particularly in terms of safe travel to and from school. (Paragraph 3.26)

RECOMMENDATION 3: The Roads and Traffic Authority to develop a program of public education and awareness to ensure that motorists are aware of their legal responsibilities to pedestrians, particularly child pedestrians. (Paragraph 3.28)

RECOMMENDATION 4: The Roads and Traffic Authority ensure that there are appropriate educational materials to assist parents in teaching their children about road safety, and in particular, materials that address child pedestrian safety issues in situations commonly experienced by children (travel to and from school, pedestrian movements associated with buses and other public transport, pedestrian safety in local streets, and pedestrian safety in shopping precincts). (Paragraph 4.52)\

RECOMMENDATION 5: The Roads and Traffic Authority, in consultation with other agencies and jurisdictions as appropriate, undertake a major workshop focussed exclusively on child pedestrian safety, and, as part of this workshop, examine the various educational initiatives to address child pedestrian trauma as part of the development of a road safety strategy for the 2001-2010 period. (Paragraph 4.79)

RECOMMENDATION 6: The Roads and Traffic review its policy regarding the use of 'Blinky Bill' or cockatoo-type pedestrian facilities using pedestrian-activated flashing amber lights, particularly in the vicinity of schools and in situations where a school operates with split sites. (Paragraph 5.12)

RECOMMENDATION 7: The Roads and Traffic Authority:

(a) **review the school pedestrian bridge program to ensure that appropriate locations for these pedestrian bridges are identified;**

(b) **and ensure that advertising on the pedestrian bridges does not become overwhelming, thereby contributing to traffic and environmental problems.** (Paragraph 5.17)

RECOMMENDATION 8: The Roads and Traffic Authority review its criteria for the installation of pedestrian facilities to:

(a) **include the identification and description of new types of pedestrian facilities;**

(b) **identify the types of facilities appropriate for different road users (i.e., children, the elderly, etc.).** (Paragraph 5.21)

RECOMMENDATION 9: The Roads and Traffic Authority ensure that the different types of pedestrian crossing facilities and their uses are included as part of road safety educational programs and in publicity associated with safe driving and safe road use. (Paragraph 5.23)

RECOMMENDATION 10: The Roads and Traffic Authority undertake research to determine the understanding of New South Wales motorists of the requirements of pedestrian crossings, particularly children's crossings. (Paragraph 5.24)

RECOMMENDATION 11: The Roads and Traffic Authority:

(a) **review existing research knowledge concerning the effect of signage and road markings in both providing advance warning of pedestrian facilities and in delineating the facilities; and**

(b) **undertake such research as is required to better understand the effect of signage and road markings in both providing advance warning of pedestrian facilities and in delineating the facilities.** (Paragraph 5.25)

RECOMMENDATION 12: The Roads and Traffic Authority ensure that the management of the implementation of the Safer Routes to School program should include an evaluation timetable that will allow for some of the critical issues associated with the program to be examined in a timely manner. (Paragraph 6.13)

RECOMMENDATION 13: The Roads and Traffic Authority ensure that the development of the school facilities component of the Traffic Engineering Manual includes a review of the policies and guidelines for School Zones and the School Crossing Supervisor Scheme, as well as the development of the Safer Routes to Schools program guidelines. (Paragraph 6.14)

RECOMMENDATION 14: The Roads and Traffic Authority, in consultation with the Local Government and Shires Associations and the Institute of Municipal Engineering Australia, develop and promote a training program for roads, education and local council staff in the conduct of road safety audits, including pedestrian safety audits. (Paragraph 6.16)

RECOMMENDATION 15: The Roads and Traffic Authority to continue to examine how the issue of speeding in school zones might be better addressed, including:

(i) speeds during school hours but outside the standard school children travel hours;

(ii) increased public education and awareness campaigns of the 40 km/h speed limits. (Paragraph 6.31)

RECOMMENDATION 16: The Roads and Traffic Authority, in conjunction with the Department of School Education and the school sectors, review the previous response to the feasibility of requiring schools to incorporate reflective thread or other materials into the design of the clothing and accessories of school children. (Paragraph 6.37)

RECOMMENDATION 17: The Roads and Traffic Authority to conduct a specific research review into the impact of vehicle engineering on child pedestrian crashes, particularly with regard to the size of vehicle and the use of bull bars. (Paragraph 7.8)

RECOMMENDATION 18: The Department of Health, the Roads and Traffic Authority and the Motor Accidents Authority ensure that one of the first projects to be undertaken by the Centre for Injury Risk Management should be to collect and analyse statistical information from police, insurance, health care, and road data sources regarding child pedestrian injury, so as to gain a better understanding of the interaction between the driver, the car, the environment and the pedestrian. (Paragraph 8.12)

CONTENTS

1

THE NATURE OF THE PROBLEM OF CHILD PEDESTRIAN ROAD TRAUMA

Child pedestrian road casualties - Children 0 to 4 years of age - Children 5 to 16 years of age - Young adults aged 16 to 19 years - Where and when do child pedestrian accidents occur? - The Roads and Traffic Authority education programs and resources - The scope of this report

1.1 Traumatic injury is the single largest cause of death and illness in childhood in Australia. Death due to injury accounts for just under half of all paediatric deaths; and a quarter of all injury deaths in children are as a result of a transport accident.

1.2 In 1995, 2,017 persons were killed in Australia as a result of a road crash, and of those who died, 398 were pedestrians (Federal Office of Road Safety, 1996a). While pedestrian fatalities and hospital admissions decreased substantially during the 1980s, in line with a general reduction in road deaths overall (see Appendix A : Statistical summary of pedestrian crashes in Australia), there is now concern that both the New South Wales and Australian road tolls have stagnated or plateauxed.

Child pedestrian road casualties

1.3 Between 1989 and 1994, 195 children aged 5 to 12 years were killed crossing or walking beside roads in Australia. A further 4,500 children were admitted to hospital as a result of being struck by a car and it is estimated that over 10,000 children received minor injuries. (Federal Office of Road Safety, 1996c).

1.4 The Federal Office of Road Safety recently undertook an investigation into pedestrian fatalities among children of primary school age and noted that although no clear trend has emerged for child pedestrians, an upswing has been noted among pedestrian casualties in general in 1995. The investigation concluded, however, that using our roads as a pedestrian poses a significant health risk for young children (Federal Office of Road Safety, 1996c).

1.5 Of the 398 pedestrians killed in Australia in 1995, 54 were children aged 0 to 16 years. Fourteen of these children were killed in New South Wales (see Table 1: Pedestrian casualties in New South Wales by degree of casualty in 1995). Figures for child fatalities in New South Wales for the period January to August 1996 show a slight decrease over the same period in 1995, although the ratio between ages 0 to 4 and 5 to 16 has changed, with higher fatalities among younger children (see Table 2: Number of pedestrian fatalities in New South Wales, January to August 1996).

Children 0 to 4 years of age

1.6 Pedestrian crashes for children less than 4 years of age are a minor cause of death, with only 3 killed in New South Wales in 1995 and 107 injured as a result of a pedestrian crash (see Table 1: Pedestrian casualties in New South Wales by degree of casualty in 1995).

1.7 The majority of pedestrian crashes involving the 0-4 years old age group occur during the day and within close proximity to the child's home, with a higher incidence on weekends.

1.8 An accident on private property would not be included in the Roads and Traffic Authority's data base for these statistics. Examples would include the car park of a shopping centre or the driveway within the property boundary. If, however, the accident occurred on a part of the driveway within the road reserve (i.e., including the footpath) it would be recorded.

1.9 As can be seen from the data supplied from the Roads and Traffic Authority below, a total of 38 children were pedestrian casualties (serious injury and other injury) in incidents in a driveway between 1993 to 1995. None of them were fatalities.

	Pedestrian injured		
AGE	**0-4 yrs**	**5-16 yrs**	**Total 0-16 yrs**
1993	6	7	13
1994	5	4	9
1995	4	9	13
Total	15	20	35
Average	*5*	*6.67*	*11.67*

Children 5 to 16 years of age

1.10 Eleven children aged 5 to 16 died as a result of a pedestrian crash in New South Wales in 1995 with 683 injured (485 were minor injuries) [Roads and Traffic Authority, 1995]. A study in the Netherlands by Van der Molen (cited in Antill, 1994b) found that boys are involved in accidents up to twice as often as girls, the difference being the largest around the ages of 5 to 7 years of age. However this difference disappears gradually after the age of 10. Similar figures can be found in New South Wales where, in 1995, 493 boys and 311 girls under the age of 16 were either killed or injured in a pedestrian crash (Roads and Traffic Authority, 1996).

Table 1: **Pedestrian Casualties in New South Wales by Degree of Casualty in 1995**

	0-4	5-16	17-20	21-25	26-29	30-39	40-49	50-59	60-69	70+	Unknown	Total pedestrian casualties
Killed	3	11	4	10	6	13	10	14	14	42	3	130
Seriously injured	36	198	84	90	37	83	77	72	79	152	20	928
Other injured	71	485	216	238	123	289	214	174	132	210	74	2226
Total	**110**	**694**	**304**	**338**	**166**	**385**	**301**	**260**	**225**	**404**	**97**	**3284**

Source : Roads and Traffic Authority, August 1996

NOTE: The crash statistics recorded by the Roads and Traffic Authority are confined to those road crashes which conform to the national guidelines for reporting and classifying road vehicle crashes. The main criteria are:

the crash was reported to police
the crash occurred on a road open to the public
the crash involved at least one moving vehicle
the crash involved at least one person being killed or injured, or at least one vehicle being towed away.

Table 2: Number of Pedestrian fatalities in New South Wales January to August 1996

Period	0-4	5-16	17-20	21-25	26-29	30-39	40-49	50-59	60-69	70+	Unknown	Total
Jan-Aug 1995	1	8	3	7	6	10	7	10	10	32	2	96
1996*	3	5	9	5	5	9	8	6	10	33	0	93
Difference	**2**	**-3**	**6**	**-2**	**-1**	**-1**	**1**	**-4**	**0**	**1**	**-2**	**-3**
August 1995	0	1	1	1	0	2	2	0	2	2	1	12
1996*	2	1	2	1	0	2	1	0	2	1	0	12
Difference	**2**	**0**	**1**	**0**	**0**	**0**	**-1**	**0**	**0**	**-1**	**-1**	**0**

* Preliminary figures
Source : Roads and Traffic Authority, September 1996

1.11 In a study of pedestrian casualties involving children in early school years, the Federal Office of Road Safety (1996c) noted that:

> "With the commencement of their schooling from age five or six, children begin to undertake independent pedestrian travel and increase their exposure to road injury or death... From the age of seven years, casualties tend to decrease as children become more familiar with the skills required to cross a road. However the number of road casualties increases again from the age of eleven years, presumably when the amount of travel connected with the transition to high school and independent social activities begins to increase." (p. 4).

Young adults aged 16 to 19 years

1.12 Young adult drivers and passengers figure significantly in road trauma: 1,804 young adult drivers and 1,186 passengers aged between 17 to 20 years were road crash casualties in 1995 (Roads and Traffic Authority, 1996). Trauma associated with being a driver or passenger clearly represents the greatest risk to this age group. However, when compared statistically to other pedestrians, a serious risk also exists for young adults when crossing a road. Indeed, proportionately per head of population, the involvement of males aged 17 to 20 years in pedestrian crashes is second only to the over 80 year olds with 184 males and 120 females killed or injured in 1995 (see Table 1: Pedestrian casualties in New South Wales by degree of casualty in 1995).

1.13 Studies into pedestrian injuries in comparison to other forms of childhood trauma indicate that pedestrian crashes remain the main cause of serious injury to children in Australia. In evidence, Ms Michelle Maxwell, Manager, Child Safety Centre, Royal Alexandra Hospital for Children, commented:

> **Ms MAXWELL:** "The statistics we have for 1994, the last calendar year, show that pedestrian-related injury ranked ninth in terms of the injuries that we saw coming into the children's hospital, representing 1.7% of all injuries. We had 4,190 children's injuries that were seen at casualty in the accident and emergency department, and 72 of those were related to child pedestrian injuries. But as I earlier mentioned, if you look at the admission rate, 56 of those 72 children were admitted to the children's hospital, so that represents around 77%. It is a very high admission rate when you compare it to the admission rates for other injuries." (Minutes of Evidence 19 June 1996, p. 28).

1.14 An exposure study by the Monash University Accident Research Centre found that in Victoria in 1989, 179 cases of child pedestrian injuries (under 15 years of age) were recorded in the emergency departments of three large Melbourne hospitals. Of these 179 children, 4 died and another 81 (45%) were injured severely enough to require admission. Up to three injuries were recorded for each child. Of the total 319 injuries recorded, the majority were to the head: face, skull and intracranial (45%), followed by the lower limb (29%) and the upper limb (14%):

> "When compared with the 17% admission rate for all injuries presenting to [the Victorian

Injury Surveillance Systems] the relative severity of pedestrian injuries is obvious." (Drummond & Ozanne-Smith, 1991, p. 26).

1.15 Similar findings were reported by Mr Steve Jones, Project Director of the West Australian Child Pedestrian Injury Prevention Project:

"Pedestrian injury is the main cause of injury death of children in Western Australia. We have 3.2 per 100,000 child pedestrian injury deaths per year in WA. Just as a comparison we are slightly higher than the rest of the country and quite a deal higher than both the United Kingdom and the United States...The injuries are particularly severe for survivors of these conflicts and they have a great impact on families as well. The average hospitalisation for the 5 – 9 year old pedestrians who are victims is 30 days which is about four times higher than the next highest cause of hospitalisation which is burns. Some 80% of critically injured child pedestrians have severe head injuries and there have been a number of studies that show about 85% of these children are still suffering quite severely from their injuries for up to twelve months after the accident. Recently, it has been determined that the direct cost per child victim is approximately $100,000 which is quite substantial. It is about $109,000 for a rural injury and $104,000 for a metropolitan injury." (*Roadwise*, Volume 8, No. 2, p. 3).

1.16 The Motor Accidents Authority noted in evidence before STAYSAFE that the cost of child pedestrian claims is higher than the average claim under its scheme. Ms Kathleen Hayes, a rehabilitation adviser with the Motor Accidents Authority, stated:

Ms HAYES (MOTOR ACCIDENTS AUTHORITY): "From our own claims register to date there have been 74,923 claims made under the motor accidents scheme from July 1989 to March 1995. Of these claimants, 8,230 were injured as pedestrians. Of this group, 233 were under five years old, which is 3%, and 1,131 were between five and 16 years of age. Pedestrian claimants under 17 years accounted for 1.8% of claims, but in fact cost 3.8% of total claims costs." (Minutes of Evidence 19 June 1996, p.34).

1.17 STAYSAFE sought advice as to the primary social costs of child pedestrian trauma but was informed by KIDSAFE that more work needs to be done before that question could be answered fully:

Mr THOMPSON (STAYSAFE) : "What do you think are the primary social costs associated with child pedestrian trauma? What factors do you think are relevant? Do you think these social costs can be meaningfully quantified?"

Ms GOWDIE (KIDSAFE): "The social costs are fairly obvious. A child aged seven or eight—which is a fairly common age group to be involved in pedestrian accidents, if the injury is severe enough—suffers a lifelong disability which the child may or may not cope with well psychologically. Once again, as Ms Maxwell said earlier, I do not think the work has been enough to be definitive. When you are looking at the elderly pedestrian, though, you are looking at a disability which may last for 10, 15 or 20 years. But a four-year-old or five-year-old could be disabled for the next 70 years, with the accompanying social and every other kind of cost." (Minutes of Evidence 19 June 1996, p.35).

Where and when do child pedestrian accidents occur?

1.18 The Federal Office of Road Safety analysed child pedestrian fatalities for the period 1989 to 1994 and found in general there was nothing particularly threatening about the conditions at the time of the pedestrian fatality and that the deaths predominantly occurred mid-block in daytime during fine weather on dry straight roads. Table 3: Number of fatal collisions in 1992 involving pedestrians aged 5 to 12, by road type and speed limit at site of collision highlights the location of fatal pedestrian crashes in 1992. These crashes generally occurred on low speed minor urban roads with posted speed limits of 60 km/h or less. The Federal Office of Road Safety noted, however, that a disturbing number occurred on arterials and urban areas (Federal Office of Road Safety, 1996c).

1.19 Children are also at risk when playing on residential streets, kerbs and in drive-ways. In his submission to STAYSAFE Dr Michael Henderson noted that:

> "...many vehicle-to-pedestrian collisions do not occur on public roadways, especially where children are concerned, and thus never appear in official road crash data. Figures are weak in Australia. A recent carefully-conducted study in Virginia revealed the astonishing fact that non-traffic collisions accounted for almost 50 per cent of all child pedestrian motor-vehicle collisions. They occurred in alleyways, commercial parking lots, driveways at home, private roads, and private parks and mobile home sites." (Submission PED 192, p.2)

1.20 In New South Wales, a large proportion of child pedestrian accidents occur at times when children are most often crossing roads, that is between the hours of 2:00 p.m. and 6:00 p.m. on weekdays. Indeed, the month of January, which is traditionally the period of the summer school holidays, generally records the lowest number of casualties.

1.21 Overseas research demonstrates that many accidents take place when children aged 6 to 8 years play in the street—that is, on the road, at the kerb or on the footpath, when children cross roads—which may include dashing out onto the road, or when children walk to and from school (Van der Molen, cited by Antill (1994 a)).

1.22 As can be seen in Table 4: Activity of pedestrians aged 5 to 12 years at time of fatal collision, 1989 - 1994, the number of deaths that occur on the way home from school is nearly four times higher than the number that occur on the way to school. However, an analysis by the Roads and Traffic Authority of child pedestrian crashes in 1992 indicated that only 14% happened within 200 metres of a school.

1.23 An Australian study by Wheatley and Cass found that 17% of children's fatalities involved

Table 3: Number of fatal collisions in 1992 involving pedestrians aged 5 to 12, by road type and speed limit at site of collision

	60 km/h	75-80km/h	90+KM/H
Urban arterial	5	2	1
Urban highways	1	0	1
Other urban roads	15	2	0
Rural highways	0	0	2
Other rural roads	0	0	2
All fatal collisions	21	4	6

Source: (Federal Office of Road Safety, Monograph 8, 1996, Table 1)

Table 4: Activity of pedestrians aged 5 to 12 years at time of fatal collision, 1989 - 1994

Journey to school	7%
Journey home from school	27%
After school daytime activities	31%
Other activities on schooldays	12%
Activities on non school days	23%
All fatal collisions	**100%**

Source: (Federal Office of Road Safety, Monograph 8, 1996, Table 3)

Table 5: How children aged 8 - 12 years usually travelled to school

Response	Parents	Children
Car	68%	66%
School bus	27%	27%
Walking alone	22%	19%
Walking with friend of same age	20%	24%
Walking with parent	19%	14%
Walking with older child or sibling	13%	12%
Public transport	7%	7%
Bicycle	4%	7%
Walking with younger sibling	2%	3%
Walking with other adults	1%	1%

Note: the percentages represent the numbers of parents or children giving each response. As multiple responses were allowed, the columns do not add up to 100%

Source: Antill, 1994 (b), Table 12, p. 26)

an unsupervised child, aged 10 years of less, who was negotiating traffic in order to cross a road (cited by Antill, 1994 b, p. 2).

1.24 A survey by the late Dr John Antill, Associate Professor, School of Behavioural Sciences, Macquarie University found that:

> "Boys and older children were more likely to cross roads on the way to or from school without an adult or older child present. While parents generally felt their children crossed the road safely, their confidence lessened considerably when their children were with other children. Safe road crossing was seen to increase with age." (Antill, 1994 b, pp. iv-v)

1.25 Antill (1994b) found that while children under 8 were generally not allowed to travel to school alone or with a friend, a different picture emerges for those aged 8 to 12 (see Table 5: How children aged 8-12 years usually travelled to school). Parents and children aged 8-12 participating in the survey were asked 'Does your child (do you) need to cross any roads on the way to or from school without an adult or older child?' The answers indicated that approximately 64% of boys and 45% of girls aged 8 to 12 years cross roads on the way to or from school without an adult or an older child being present. The proportion of children crossing roads unsupervised was one out of every two for 8 and 9 years olds, rising to three out of four 11 year olds:

48% for 8 years old, or 3rd class
48% for 9 years old, or 4th class
57% for 10 years old, or 5th class
73% for 11 years old, or 6th class

1.26 The Federal Office of Road Safety (1996c) found that collisions leading to serious casualty during the journey home from school typically involved younger children than those occurring during the journey from school:

> "One possible explanation, which remains conjecture at this point, is that parents who accompany very young children to school are relying on a greater degree of independent travel for the journey home by these children, with unfortunate results." (p. 2).

1.27 STAYSAFE suggests that it is likely that for many school children the journey to school is linked with the travel of parents or carers to the workplace. However, the journey from school is not strongly linked with return from work, thus giving rise to independent and unsupervised travel by the children. If this is the case, it is disturbing, particularly given the Roads and Traffic Authority's advice to parents that children under the age of 10 years should not be allowed to ride bicycles on roads without adult supervision. In their submission to this inquiry, the Roads and Traffic Authority conceded that this advice should be extended to include children as pedestrians (Roads and Traffic Authority, Submission PED 67, p.14).

The scope of this report

1.28 This report follows on from STAYSAFE 26 (1994), which looked at the safety of school children around buses. As is the usual practice for STAYSAFE, the scope of the report is broad and covers such issues as the characteristics of child and adult behaviour affecting pedestrian safety; road safety education programs; the road environment; speed; vehicle engineering; the reporting of pedestrian injury arising from road crashes; and most importantly the need for co-ordination between the various agencies with responsibility for child pedestrian safety.

1.29 Many of the issues relating to general aspects of child pedestrian safety were already canvassed in the STAYSAFE 26 (1994) report concerning the safety of school children around buses. In the main, these matters will not be revisited in detail, but where appropriate

STAYSAFE will comment on the response to the findings and recommendations made in the earlier report. As has been documented in a number of recent reports, the initial response by the Roads and Traffic Authority and other agencies to the STAYSAFE 26 (1994) was not encouraging, however with the passage of time it has become clear that STAYSAFE's interpretation of the community's feelings and the community's needs for better and safer child pedestrian movement was correct. At the end of 1998, it is now the case that a number of STAYSAFE's major findings about child pedestrian trauma have been accepted, including the need for lower passing speeds in the vicinity of buses picking up or dropping off school children, the need for a Safer Routes to School program in New South Wales, and the need for better police enforcement of school speed zones. However, as will be discussed in this more general report, there remain a number of findings and recommendations concerning school child pedestrian safety that have not been accepted, sometimes for the most obscure and illogical of reasons.

1.30 STAYSAFE is mindful of the comment by the Federal Office of Road Safety (1996), that further significant improvement in child pedestrian fatalities is unlikely unless:

> "... strong action is taken, and until then one can continue to expect each year about 25 to 30 deaths and 600 to 700 serious injuries among Australian pedestrians aged 5 to 12." (Federal Office of Road Safety, Monograph 8, 1996, p.4).

1.31 STAYSAFE is aware that significant decisions regarding child pedestrian safety have taken place during the course of this inquiry, and are continuing to take place. In some instances, STAYSAFE has made recommendations for action that reflect processes already under way. STAYSAFE has sought to acknowledge these actions, where announcements have been made or are pending.

2

ROAD USER BEHAVIOUR—CHILDREN AND PARENTS

Child pedestrian behaviour - New South Wales studies of child pedestrian behaviour

2.1 An interesting feature of the general trend on road deaths in New South Wales over the last three decades is that while deaths among vehicle occupants and among motorcyclists reached a peak in the late seventies and early eighties and then started a decline, deaths among pedestrians have fallen at a steady and stable rate over this same period. For the vehicle user categories it is arguably the case that attitudes and behaviour changed at around the time of the respective peaks, in association with ongoing improvements in passenger car design and traffic engineering. While it would be unsafe to draw any major conclusions from this observation without substantial validation, a passing comment does seem appropriate, and that is that given the assumption that traffic engineering improvements have brought about improvements in pedestrian safety over this period, it would seem to follow that there have been no behavioural changes (either among drivers or pedestrians) with an individually significant influence on pedestrian deaths (Dr Henderson, Submission PED 192, pp. 1-2).

2.2 According to research conducted in the United Kingdom and the United States of America, about 95% of crashes can be linked to specific road user characteristics as a factor implicated in the crash occurrence. Manstead (1991) notes that:

> "In other words, the vast majority of the accidents occurring on our roads seem to be the result of the way people behave on the road, rather than engineering or environmental factors. If road user behaviour is such an important factor in accident causation, psychologists should be able to shed some light on the processes that give rise to such behaviour, and thereby identify how one might go about reducing this annual carnage on the roads." (p.21)

2.3 STAYSAFE raised the issue of the behaviour of children, motorists and parents around school buses in STAYSAFE 26 (1994), and noted that this seems to be a source of concern. When researching that report, STAYSAFE found that surprisingly little detailed information was available at that time about the behaviour of school children. STAYSAFE is pleased to note that this situation is slowly being redressed, with several studies undertaken into behavioural patterns both of children and adults, in the context of road safety.

2.4 The purpose of this chapter is to summarise this research.

Child pedestrian behaviour

2.5 When considering the behaviour of children around school buses, STAYSAFE 26 (1994) referred to a review of the literature on child pedestrian crashes that was undertaken by Struik, Alexander, Cave, Fleming, Lyttle and Stone (1988) which identified a number of specific behaviours that seemed to be associated with increased risk. Struik et al. concluded that a child's experience and behaviour on and around a road are essentially governed by the age-related development and maturation of the child physically and cognitively and catalogued the following specific behaviours:

- 'darting out' or running from the footpath into a moving line of traffic
- playing in local streets near home
- stepping out into a moving line of traffic from behind obstacles such as parked cars and
- paying little attention to the crossing situation, or otherwise careless crossing.

2.6 Struik et al. (1988) also identified other characteristics of the child pedestrian that predisposed the child toward an increased risk of being involved in a collision with a passing vehicle:

- the child's small stature makes it difficult for the child to be seen by motorists
- children have limited physical development
- children have limited perceptual development, particularly related to peripheral vision
- children cannot identify the direction of sound or judge distance accurately
- children's cognitive capacities regarding the demands of moving traffic are subject to development and maturation
- children have a limited understanding of possible pedestrian-vehicle interactions
- children tend to see traffic as a series of discrete independent events rather than as dynamic ongoing movement.

2.7 Subsequently, several studies undertaken in Australia and overseas have supported this research, and these studies are discussed in the following sections. STAYSAFE notes that many of the studies discussed in these sections remained unpublished, and therefore unknown and uncited for prolonged periods. STAYSAFE used the opportunity of its annual review of the road safety situation in New South Wales to ensure that the studies were eventually released (see, in particular, STAYSAFE 31, 1996, for a critical review on the policy apparently adopted by the Roads and Traffic Authority to discontinue the publication of publicly funded road safety research).

New South Wales studies of child pedestrian behaviour

2.8 Several studies of road user behaviour involving pedestrian safety issues have been undertaken in New South Wales under the sponsorship of the Roads and Traffic Authority since the late 1980's. However, these studies were not released publicly until STAYSAFE uncovered them during this inquiry. A number of these reports had, in fact, sat 'on the shelf' for periods of up to 6 years; perhaps because the studies documented information showing the Roads and Traffic Authority's road safety education program in a poor light. STAYSAFE was not impressed by the response of the Roads and Traffic Authority to the discovery of the reports, which was an attempt to place a publication date on these reports (1994) two years earlier than their actual date of publication in 1996.

2.9 The studies uncovered by STAYSAFE are very important for a proper assessment of the problem of child pedestrian trauma. For example, Antill surveyed parents of children aged 5 to 7 years to determine their concerns about road safety, the safety of their local area, their road safety attitudes and behaviours, what they taught their children about road safety, their understanding of children's limitations in traffic, and their willingness to participate in road safety programs (Antill, 1994a). Antill also surveyed children aged from 8 to 12 years and their parents in order to assess the feasibility of introducing a road safety education program aimed at parents of this age group (Antill, 1994b). Antill pointed to research undertaken in European countries which revealed that 30% to 50% of child pedestrian crashes involved visual obstacles—usually parked cars, with percentages highest for children aged under 6 years (Van der Molen & Weightman, cited by Antill, 1994a). A United Kingdom study found that 82% of child pedestrians injured while crossing the road admitted to running across the road, and as many as three out of five of the children began crossing without looking. Research indicated that children under 8 years old know a reasonable amount about road traffic, but were distracted by play or friends (Grayson, Limbourg & Gerber, cited by Antill, 1994a). There is some question as to the ability of children below the age of approximately 10 years to cross the road safety, as it appears that they do not have the judgment to handle many pedestrian situations adequately (Antill, 1995a).

2.10 In terms of older children, Antill (1994b) pointed to a number of research findings. Zwahlen which found that 6 to 13 year olds are much more unreliable than adults in estimating distances between themselves and any oncoming traffic, whereas Salvatore found that age influenced the ability of children of 5 to 14 to judge speed, with girls aged 11 to 14 tending to over-estimate the speed of oncoming vehicles in comparison to boys. Heraty believes that an explanation as to why boys have a higher rate of accidents than girls is that they mature later than girls, and as a consequence boys take a longer time to make the transition from the mechanical process of safe road crossing taught in schools to the adult methods that involve a broader appreciation of the total traffic situation. Antill's recommendations in relation to road safety education programs aimed at overcoming these risk factors are discussed in later chapters of this report.

2.11 In another study uncovered by STAYSAFE, Ball, Braithwaite and Low (1990) surveyed 2,231 Year 6 students in order to assess changes in student's knowledge, attitudes and reported behaviours regarding the passenger pedestrian and cyclist road safety topics following exposure to the 'Street Sense' road safety program. The survey found that students seemed confused as to the correct advice to offer others when it comes to crossing a road. A majority advised that children should not 'cross between parked cars' (71%) or 'run across the road quickly' (89%) and that they 'should look both ways when using a pedestrian crossing' (76%). However, there was some confusion among students with a minority advising other children to 'step onto the road and look both ways' (46%) and to 'walk straight across the road and not in a crooked line' (58%). Ball et al. noted that the comparison between the sexes suggests that girls are more likely to follow the rules than boys. In the survey, 3% claimed they 'never' and 38% 'sometimes' chose the safest place to cross the road. Students also reported that they sometimes play ball games with friends on the footpath (29%), looked for vehicles when walking past driveways (27%) and ran rather than walked across the road when it is raining (26%). Again, it was noted that male students are more likely to engage in unsafe actions in all pedestrian behaviour than are females (Ball et al., 1990).

2.12 Given the discovery of these reports by STAYSAFE during the inquiry, and given their importance in understanding the nature of child pedestrian safety in New South wales, STAYSAFE recommends that the Roads and Traffic Authority and other agencies with a responsibility in the area of child pedestrian trauma should review their archives and active files for the previous 10-15 years to determine if there are further documents and research reports addressing issues of child pedestrian trauma that should be publicly released.

RECOMMENDATION 1: The Roads and Traffic Authority and other agencies with a responsibility in the area of child pedestrian trauma should review their archives and active files for the previous 10-15 years to determine if there are further documents and research reports addressing issues of child pedestrian trauma that should be publicly released.

Western Australian studies of child pedestrian behaviour

2.13 There are also studies from other Australian States and Territories. The Western Australia road safety in schools project (RSISP) is a three-year project with the goal of minimising the harm associated with all forms of road usuage by encouraging children to think in the traffic environment and to be aware of the consequences of their actions. The Centre for Health Promotion Research, Curtin University undertook a literature search in conjunction with this project and came to similar conclusions as those already mentioned (Cross et al., 1995).

2.14 An interesting additional factor found in this study was that social class is also an important factor in child pedestrian crashes:

- Children in single parent families were more likely to have injuries in the first five years of life than those living with two parents; and
- Children living in low income neighbourhoods were subject to increased risk of severe injury from both unintentional and intentional causes

Table 6: Behavioural frequencies by road class

	ARTERIAL ROADS	LOCAL ROADS
Did not stop	13%	57%
Did not look	24%	36%
Did not monitor traffic	66%	72%
Crossed indirectly	6%	21%

Source: Drummond & Ozanne-Smith (1991), Executive Summary

Table 7: Types of fatal collision involving pedestrians aged 5 to 12, 1989 - 1994

	% of fatal collisions
Near side collision where child emerges from in front of a parked vehicle	22%
Other near side collision with child entering the roadway	31%
Far side collision with child entering the roadway	36%
Child walking with/against traffic	6%
Child on footpath, median or driveway	1%
Other	3%
All fatal collisions	**100%**

Source: Federal Office of Road Safety Monograph 8, 1996, Table 2

Victorian studies

2.15 The Monash University Accident Research Centre undertook a traffic exposure study of the behaviour and crash involvement risk of child pedestrians and bicyclists. As part of that study Drummond and Ozanne-Smith analysed non-police reported fatalities for Victorian child pedestrians and found that:

> "Of the 93 pedestrian deaths..., 71 occurred as the child darted out or attempted to cross the road. Of these 71, 10 emerged from behind parked cars, and 4 from behind stationary buses. Another 2 were killed when they stepped off the median strip.
>
> Of the 7 children killed while playing on the roadway, 2 were riding tricycles.
>
> The age distribution of pedestrian deaths in this study was: 0-4 years 31, 5-9 years 43, 10-14 years 19. These figures represented 18, 35 and 20 per cent of injury deaths in these age groups respectively." (Drummond & Ozanne-Smith, 1991, p. 24)

2.16 Table 6 (see previous page) summarises observations made by Drummond and Ozanne-Smith (1991) about behavioural frequencies of Victorian children involved in pedestrian crashes.

Federal Office of Road Safety studies of child pedestrian behaviour

2.17 The Federal Office of Road Safety undertook a detailed review of child pedestrian crashes in 1992 and found that in 24 out of 28 cases, the child appeared to have been solely at fault. The child's actions leading to the collision commonly displayed a lack of awareness of prevailing traffic conditions. In two of these cases the child was disobeying signs or lights at pedestrian crossings. In the cases where the driver was at fault, excessive vehicle speed was a major causal factor (Federal Office of Road Safety, 1996).

2.18 The Federal Office of Road Safety also analysed the 195 child pedestrian fatalities which occurred between 1989 and 1994. As Table 7 (see previous page) demonstrates, about half of the deaths were the result of near side collisions with a child entering the roadway. The Federal Office of Road Safety noted that this type of event typically presented little chance for avoidance by the driver of a vehicle travelling at 60 km/h. In many of these cases, the child emerged from in front of a parked vehicle (Federal Office of Road Safety, 1996).

Other studies of child pedestrian behaviour

2.19 Associate Professor Taplin provided STAYSAFE with a summary of recent research into child behaviour and road safety education, together with a framework for the prevention of crashes involving child pedestrians. A copy of his full submission appears at Appendix B: Research relevant to child pedestrian safety, and includes an annotated bibliography of recent research.

2.20 Associate Professor Taplin began with an explanation of Piagetian theory which was the dominant explanation of child behaviour up until the early 1980s. The Piagetian theory talked about progressive stages through which children passed in their understanding. Professor Taplin noted that many recent researchers have criticised Piagetian theory because it concentrated on what the child cannot do rather than what he can do—a tendency which he believes is sometimes seen in talk about children's understanding of road safety:

> **ASSOCIATE PROFESSOR TAPLIN:** "..... since the early 1980s we have seen two significant changes in the way in which we understand the process of development. Some of those changes had to do with the kinds of underlying processes which are necessary for the performance of any complex cognitive task, like crossing a road. The other significant change is that development proceeds not in a highly organised, synchronous way; we see evidence of development in some areas of the child's understanding while other areas seem to lag behind. What may be responsible for that in part is opportunities to learn. That is, if you give the children a chance to learn they may indeed show some understanding which was previously considered to be beyond their reach." (Minutes of Evidence 19 June 1995, p. 8)

2.21 A more extensive extract of the transcript of Associate Professor Taplin's account of Piagetian theory appears in Appendix C: Piagetian Theory.

2.22 These changes in the way in which child development is examined was also mentioned by the NRMA, in response to a question from STAYSAFE as to whether specific characteristics make a child pedestrian more at risk than his or her peers:

> **The Hon. A. B. MANSON (STAYSAFE):** "Has the NRMA taken any action to promote examination of this issue?"
>
> **Mr HIGGINS:** "Not directly. The STAYSAFE 26 report cited some work by Struik, who looked at the physical characteristics and some of the more tangible reasons for children being more susceptible to accidents. I offer an explanation regarding why more work has not been done in the area of personality traits and psychology testing regarding accident-prone people: that type of research is probably no longer in vogue with current education philosophy. Back in the 1960s and 1970s children were frequently pigeon-holed before they reached the age of 10 years relating to career paths to which they were best suited. At the conclusion of those decades it was apparent that we had done more harm in limiting the development of those children, and that type of research is out of vogue. I am not suggesting that it has no place in this issue, and good reasons may exist why this issue should be examined more closely. I simply suggest a reason why more research of this type may have not been seen." (Minutes of evidence, p. 36)

2.23 When asked for his view—rather than that of Piaget—of the implications of the theoretical advances for our understanding of child behaviour within a road-based transport system such as that in New South Wales, Associate Professor Taplin replied that child behaviour on the roads is a complex issue:

> **ASSOCIATE PROFESSOR TAPLIN:** "One approach is to attempt to analyse the task of crossing a road by its component parts—that is, it is not just a simple task; it is a large problem which we need to break down into a number of smaller problems. When we break it down into those component skills we do what is called a task analysis. We can then begin to identify which of these component skills might be within the reach of a child at a particular age or stage and which ones are not within their reach and need to be developed later." (Minutes of Evidence 19 June 1996, p. 11)

2.24 Associate Professor Taplin added that:

> **ASSOCIATE PROFESSOR TAPLIN:** "The behaviour of crossing a road can be analysed into a sequence of steps: (a) a search process in which the individual attends to environmental cues relevant to the safety of a crossing; (b) the detection of oncoming vehicles (including their speed, distance, and direction) plus the width of the road to be crossed, etc; (c) the process of judging or evaluating this information and deciding when to cross; and (d) the act of crossing itself. While children need to learn to perform all of these steps, it is inadequacies on the first step that is suggested to be the most frequent cause of unsafe behaviour by child pedestrians. For example, in one study in which accident victims were interviewed, it was found that 39% of the children did not pause to search at all before crossing and that 60% did not see the vehicle that hit them.".

2.25 Associate Professor Taplin noted that Dutch psychologist Vinje had identified the following component parts in the task of crossing a road: recognising the parts of the road; staying on the side of the road; stopping while watching; detection of oncoming traffic; judgements about the meaning of the information received; making a decision to cross; route planning; selection of a safe place to cross and of a safe place to stand; crossing at a place with pedestrian lights; and priority rules.

> **ASSOCIATE PROFESSOR TAPLIN:** "As you can see, some of the things ... include skills which might well be achieved by preschool children—children who are three or four years of age. In other cases, the skills would be likely to develop in the early primary school years. In some cases, they may be even later developing skills. Unless we analyse this complex behaviour of road crossing by its component parts, we will always come up with the wrong answer. It will always be only half right or even less than that if we give a global response. That is one approach that can be taken to the issue of road safety as it applies to

children. It is related back to the theory of child development. I think that is a valid way to proceed; it is the way in which many researchers have sought to go. If you carefully examine the literature you will see that that is exactly what they are doing in individual studies. In other words, they are focusing on a specific task rather than the totality of it." (Minutes of Evidence 19 June 1995, p. 12)

2.26 Associate Professor Taplin also provided an alternative research methodology which, he believes, leads to similar conclusions:

ASSOCIATE PROFESSOR TAPLIN: "This strategy examines the types of accidents that have occurred where child pedestrians have been involved. It then looks at the reasons for these accidents in the light of contemporary theory of the behaviour of children. To give you an illustration of that research, I refer you again to my written submission.

...This approach looks at the kinds of errors children appear to have made or which have been made by someone in the course of neglecting a road system and which have regrettably led to an accident. The research then considers whether we can understand what might be the cause of that error of judgment or behaviour and whether we can prevent that by some form of intervention." (Minutes of Evidence 19 June 1995, pp. 12–13)

2.27 Ms Stacey Williams, Team Leader, Early Childhood Road Safety Education Program, Institute of Early Childhood, Macquarie University Williams, added to Associate Professor Taplin's comments, saying:

MS WILLIAMS: "The most important belief held in the early childhood field about children in the 1990's is that each child is an individual and skills and abilities will develop at different rates for each child. Although many texts will identify ages at which development should occur, these should only be considered as milestone dates as they vary for each individual child...Some of the skills of children which change rapidly during the childhood years are their sensory skills—their sight, hearing, smell, taste and touch; their cognitive development, their ability to solve problems; their social skills such as their interaction with others; their physical skills, their gross and fine motor development; and their emotional development, such as self-control. The rates at which these skills will develop will depend both on each child's mental capacity and his experience." (Minutes of Evidence 19 June 1995, p. 8)

2.28 Dr Kay Bussey, a senior lecturer in child psychology at Macquarie University, presented STAYSAFE with her perspective on aspects of child development:

Dr BUSSEY: "My research has a very different focus from a Piagetian perspective. Basically that perspective is interested in looking at children's understanding and knowledge of the world around them—looking at their knowledge of traffic rules and their knowledge of a variety of different issues. From my perspective, which is basically a social cognitive theory perspective, one of the basic tenets is that what you know will not necessarily be translated into practice. We look at individual person factors in terms of knowledge of rules, ability levels, and all kinds of things that are intrinsic to the individual, but how you actually behave in a specific situation will be dependent on a number of other factors, including the particular situation that you find yourself in.

What we know from a lot of our studies with young children is that some of them in some instances will demonstrate a great deal of knowledge about a particular topic, but then you ask them to perform that particular behaviour and they do not do very well. Sometimes you get the reverse. Sometimes they are quite competent at carrying out various tasks but they cannot explain in a cognitive way what they are doing. The difference between the Piagetian attack and the kind of approach that we take is that it is important to look at not only what the children know about and tell you about, but also what they do under particular environmental factors. We are interested in understanding the processes that lead to children behaving in a particular way in a particular situation.

We are also interested in how this knowledge is constructed, and we have quite an elaborate model to look at the ways in which children learn societal information. There are three major modes through which this occurs, that is, through direct instruction—children are informed of various rules of society or whatever; children are also given interactive experience at doing different kinds of things. You do not just instruct a child, "This is how you walk across the road." You need interactive experience in terms of how to put these ideas into place and get correct feedback so that you can make sure you can do the task adequately. Also, modelling plays an important role in young children learning any societal rule. It is all very well and good for parents to say, "Now don't you go and tell me any lies" but turn around themselves and tell a white lie in the next instant. For children to learn societal rules there has to be consensus between what parents practise and what they preach. We look at all aspects, which are the direct tuition, the interactive learning and the modelling aspects." (Minutes of Evidence 17 July 1995, pp. 4-5)

2.29 When asked to elaborate on the implications of her theoretical studies for our understanding of child behaviour within a road-based transport system such as that in New South Wales, Dr Bussey replied:

Dr BUSSEY: "There are a number of issues. I do not want to underestimate the importance of Piagetian or any other theoretical contributions to studying these

> important topics, but it is very important initially to know that children do have knowledge of road rules and things of that kind. They have to start off with those issues before they can come to implement them. From my theoretical perspective what stands out is that you simply cannot focus on the child in isolation in a vacuum and say let us go in and have an educational program, teach the children the rules and, lo and behold, they will go out and look to the left and to the right. It simply will not work like that. The problem is very complex and requires a multifaceted solution." (Minutes of Evidence 17 July 1995, p. 6)

2.30 Research evidence from Dr David Livesey's laboratory in the Department of Psychology at Sydney University suggests that children aged four or five years may know the appropriate rules for behaviour but may be unable to inhibit or restrain themselves behaving inappropriately. Dr Livesey has also pointed out that children seem to be highly variable in their ability to retrain such inappropriate behaviours and that the age of the child is not a good predictor of this inhibitory capacity. Dr Bussey commented:

> **THE HON. A. MANSON (STAYSAFE):** "What does [Dr Livesey's] evidence suggest for education programs for child pedestrian safety?"
>
> **Dr BUSSEY**: "As I said in response to other questions, you can teach children a lot of these rules, but their ability to regulate their behaviour is another issue. In some of our studies children will be told they are going to come in shortly to play a game, that the mickey mouse stand is behind them but they are not to look at it. They are told not to look at it, to stay there for a couple of minutes and then they can play. A two-and-a-half to three-year-old child cannot wait two or three seconds before looking around. Their ability to resist these kinds of temptations or distractions is limited. The ability to monitor behaviour or regulate it improves dramatically during the years two and a half to five. Children are starting to develop regulatory competence between two and a half to three years of age, but there are massive gains particularly between the ages of three and four. There is great difficulty when children see that Mum has gone to the other side of the road, and all they want to do is get across to her. They do not think at that point about all the other things necessary to do in that situation. They are focused on the one issue. They find it difficult to self-reflect and monitor their behaviour, and so off they go. (Minutes of Evidence 17 July 1995, pp. 8-9)

STAYSAFE notes that Dr Bussey's comments provide a commanding example of the problems faced in developing appropriate safe pedestrian behaviour in children (and underscores the fallacy under which many drivers assume that children will behave safely as pedestrians on the roads).

2.31 As part of the Roads and Traffic Authority research program, Pettit undertook a review of the relevance of child development theory and research to children's competence as road users. Her review was commissioned by the then Road Safety Bureau and completed in 1993. However, the review was not published at that time. Although Pettit completed her review in 1993, it was only after strong pressure from STAYSAFE that the review was publicly released in 1996 (STAYSAFE notes the anomaly of the publication entry, which listed the review as 'Research Note RN7/94', implying a publication date of 1994). As STAYSAFE considers Pettit's review to be a significant paper for research and planning purposes, a copy appears at Appendix D: Children's competence as road users. Pettit concluded that:

> "...young children do not have the ability and understanding to behave safely as pedestrians or cyclists, but often too much is expected of them. Research in child development indicates that it will take many years before they develop the necessary competence."

2.32 Pettit (1996) believes that research on impulsivity is highly relevant to the various processes of problem-solving in traffic:

> "Children frequently act impulsively in traffic without making the necessary judgement and decisions, apparently failing to realise that there is any threat to their safety."

She noted a claim by Sandels that many pedestrian crashes involving children could be related to their greater impulsivity compared to adults and went on to discuss Vinje's hypothesis that impulsivity in children aged 4 to 8 years would lead to unsafe road crossing practices. Pettit concluded, however, that tests such as those used by Vinje do not allow conclusions to be drawn about impulsivity as such, but point, rather to the narrower concept of distractibility as a factor involved in some inappropriate, unsafe behaviour in traffic:

> "Research and theory on a dimension described as 'impulsivity-self control' indicate that this is a many-faceted construct relating to many different types of situations where control of thoughts, feelings or actions is required. The development of self-control depends not only on innate factors such as the maturation of the nervous systems and characteristics of temperament (probably genetically influences), but also on appropriate experience.
>
> ...There would appear to be an urgent need for well designed studies assessing children's impulsive behaviour and relating this to their problems. It is important to analyse the concept of impulsivity very carefully and consider all of the other aspects of impulsivity that, in addition to distractibility, are likely to be specifically relevant to the traffic context...It is also important to know which factors within a traffic context are likely to promote children to act impulsively, and how these vary among individuals."

2.33 In response to a question from STAYSAFE about its current activities in the area of road safety, particularly issues associated with child deaths and injuries resulting from road trauma, the Motor Accident Authority replied:

> **Ms HAYES:** "There is one project [which] is funded at Westmead Hospital, where we are looking specifically at the effects of a child's death on members of the family. That is in fact a three-year study and it is not even half way through, so I do not have anything specific to report on that yet.
>
> However, there are two interesting things that have come out of it so far. One of them is that of the people who are to be interviewed as part of this research program, it is typically the parents of older children who are prepared to take part

in the interviews. Parents of younger children are not so interested in taking part. I am sure that could be for a variety of reasons, but the researchers intend to go back to those parents at the end of the research program and perhaps find out why they were not interested in being involved. The other thing is that they have sort of taken a lot of comments made by parents at the time of the first interview and all parents have had many things to say about the police, the hospital system, the coronial system and the method of autopsy, all of which I think will probably lead to a great deal of improvement in the way that information is given to parents at the time of the child's death and how that situation is handled. I am prepared to leave some details of that study and also an informal progress report that we have had from that organisation so far." (Minutes of Evidence, 19 June 1995, p.29-30)

2.34 In response to a question from STAYSAFE concerning how children cope with traumatic injury and the processes that children go through in adjusting to injury and its consequences, the Motor Accidents Authority replied:

Ms HAYES: "I do not think the research has really been done on that, apart from the Westmead study which is occurring at the moment and will, as I have earlier mentioned, give us greater insight into that. All I can comment on is what has happened at the children's hospital and the large number of people that are actually required to care for these children. Up to 30 health professionals, etc., are involved in the care of one child. That is not only a medical cost but also a social cost, I suppose, in terms of the child and interacting with other people. That is about the only comment I could make." (Minutes of Evidence, 19 June 1995, p.30)

Parent behaviour

2.35 Dr Bussey believes that the degree of explanation which accompanies a rule and the manner in which it is taught and regulated by parents are important factors in a child's behaviour. She referred to a school of thought and research called 'social referencing' which has found that:

DR BUSSEY "The child's history and the continuity and consistency of its parenting is very important to the effectiveness of instruction at the kerb side....We now believe that, even for children of two and a half to three years of age, the more the parents start to back up their commands, 'Don't do this' or 'Do this' with some kind of explanation, the better it is for long-term compliance, so that the child understands the basis of what is said and starts to take it on board itself rather than being externally regulated by that particular situation... Consequently, children with that history will be better able by age four to regulate their behaviour, and to listen to and comply with parental requests, in a particular situation such as at the kerb side." (Minutes of Evidence 17 July 1995, p. 3)

2.36 Dr Bussey added that:

> **DR BUSSEY:** "It is very important when Mum and Dad are about to cross the street holding the hands of their children that they use these exercises at that time to teach their children: "No, we are not going to cross now because this car is coming. Now this one is coming. Now we are going to cross". Even though a child will not understand everything said, it will realise it is valuable to wait until the traffic has gone and to recognise what they need to look for. Children have difficulty assessing oncoming speed and other factors that have to be looked at. In any learning situation the more the parent spells out, in a way the child can understand, what is involved in the task or activity, and highlight it to the child, the more likely is the child to be aware of what is involved in the issue and therefore able to regulate its behaviour. There are two factors. Developmentally there are things we cannot push, but within that some kids will learn these issues far quicker than others, and a lot of that will be related to the kinds of parenting practices the child has experienced." (Minutes of Evidence 17 July 1995, pp. 8-9)

2.37 Antill (1994a) agreed that parents play a key role in the development of their children, citing Cross et al.'s (1995) findings that parental attitudes, interests and behaviour tend to be copied by their children. Unfortunately, as the following section will show, some parents send a contrary message to their children by failing to act as a good role model. Antill also cites research by Jolly, Camiller, Rhyammar & Berglund, and Rothman & Freeman which indicates that a number of adults, particularly parents, are poor models of road safety behaviour as they may lack appropriate road safety knowledge and skills. They may also endorse incorrect road safety practices or not recognise themselves as important models for young children (Antill, 1994a, 1994b).

2.38 STAYSAFE sought a response from Associate Professor Taplin to the following example of a real life incident:

> **Mr JEFFERY (STAYSAFE):** "I was interested in your comment about the behaviour of children and their response to traffic rules. Yesterday at 4.30 p.m. I was travelling in Sydney. I was turning to the left. Three children were walking with a woman. Two of the children walked across the road with the woman, but the other one was coming along probably 50 yards behind. The lights had changed. The woman turned around and yelled, "Come on." It is also parent behaviour linked with child behaviour. It was not the child's fault; it was definitely the mother's fault. There could have been an accident."
>
> **ASSOCIATE PROFESSOR TAPLIN:** "Your observation is confirmed by the evidence. I refer you to the first page of my written submission, which is headed "Summary of Major Findings on Child Pedestrian Safety". I refer you to point 3, which outlines Dutch research. It states:

> While young child pedestrians are safer when accompanied by a parent or older person, the evidence shows that parents sometimes do not monitor their children's behaviour completely and that adults often themselves do not set very good examples for children to follow.

That is your point. We have a parent with three children, but one of them is not being monitored properly." (Minutes of Evidence 19 June 1995, p. 13).

2.39 STAYSAFE 26 (1994) noted that there was considerable evidence which indicated that the behaviour of some parents or carers at bus stops was likely to increase the risk of a school child pedestrian becoming involved in a crash. In particular, the situation where a parent or carer remained on the opposite side of the road to the bus stop and waited or called for school children to come across unaccompanied after alighting from a school bus was the subject of strong concern.

2.40 Unfortunately, this behaviour is not only limited to parents at bus stops but extends to those who drop off and collect their children at school.

2.41 Mrs Valerie Moorhouse, President of the Helping Our Pedestrians Everywhere group, highlighted that this is a serious problem:

> **Mrs MOORHOUSE**: "I only comment on what we have witnessed ourselves. We are still seeing children dropped off on the wrong side of the road and parents sending them across the road to school. We are seeing drivers screech their wheels around the schools rather than slowing down to the 40 km/h limit. We are seeing children called across to the other side of the road by their parents who are waiting on the wrong side of the road. We are seeing parents and children at traffic lights going against the do not walk sign. In a case like that, we usually take the initiative and tell the parents that they are doing the wrong thing by the child. This is not getting us very far."
>
> **The Hon. J. H. JOBLING:** "What sort of reaction do you get? Are they pleased, unhappy or resentful?"
>
> **Mrs MOORHOUSE:** "One chap in particular who did this had a baby in a pram and was picking up a child from school. He said, "I don't care." I said, "If you don't care, did you think about asking the child if it wanted to be killed because you did the wrong thing?" He nodded and walked away. I do not know whether it sank in." (Minutes of Evidence 19 June 1995, pp. 16-17)

2.42 It is clear from the evidence presented to STAYSAFE that children need good role models who, by their own behaviour, re-enforce the road safety education that the child has received from school programs and other sources. Dr Bussey summed up the problem when she said:

> **DR BUSSEY** "Every time you see transgressive behaviour and nothing happens

to the adults, you think you can do it." (Minutes of Evidence 17 July 1995, p. 6)

Summary and conclusions

2.43 Based on current research into child pedestrian behaviour it is clear that there is no definitive age at which a child can be expected to safely cross a road unsupervised, primarily because each child has a different developmental rate. It is also evident that children can be taught the necessary skills for road safety, however, there is no guarantee that they will apply these skills in every situation. Particularly for young children, there is a reasonable chance that the child will be distracted when crossing a road or stepping from a bus and, as a consequence, give no thought to the road safety actions that he or she should employ in that situation.

2.44 STAYSAFE believes that skill acquisition and behaviour are crucial to child pedestrian safety. In addition to teaching road safety skills, educators should also be addressing the question: how can children be taught to habitually use road safety skills, even when distracted?

2.45 STAYSAFE 26 (1994, see Recommendation 35) recommended that the Roads and Traffic Authority conduct and publish observational studies of the behaviour of school children in school zones, at bus stops, and as pedestrians prior to boarding a bus to travel to school or after alighting from a bus during their travel from school. The Roads and Traffic Authority replied that research of this type was already conducted by the Roads and Traffic Authority, or had been performed by its predecessor organisations, that is, the Traffic Authority of New South Wales and the traffic Accident Research Unit. The Roads and Traffic Authority dismissed the recommendation by stating that it was not expected that repetition would be fruitful in terms of increasing knowledge about children's behaviour. This response from the Roads and Traffic Authority does not seem to fit with evidence that it gave to STAYSAFE in the course of this inquiry. For example, in its submission, the Roads and Traffic Authority posed the questions: 'At what age are children ready to learn how to cross roads and at what age are children capable of performing this task safely?; and then proceeded to conclude that:

> "...there is not, at this time, a sound basis in the research for providing a definitive answer to these questions." (Roads and Traffic Authority, Submission PED 67, p.14).

2.46 STAYSAFE raised these ambiguity of the Roads and Traffic Authority's response to these questions about current knowledge and research with the Roads and Traffic Authority witnesses:

> **The Hon. A. B. MANSON (STAYSAFE):** "On page 14 of the submission the Committee received from the Roads and Traffic Authority it noted that two very important questions remain essentially unanswered. These questions were: at what age are children ready to learn about the pedestrian task of crossing the road; and, at what age can children be expected to be able to perform the task of crossing the road safely? From the perspective nearly 18 months down the track from when that submission was prepared, what comments can you make regarding

these questions now?"

Ms BLACK: "I think it is true to say that there has been no world-shattering study that would establish a definitive age for either of these things. I think Dr Taplin made that clear in his evidence this morning. Taking first learning about the pedestrian task, our whole approach has been that at the preschool age you can teach some aspects which are to do with the child needing to recognise that he is unable to cross the road on his own. So what we will teach children at that age would be that they need to hold an adult's hand and so forth. On the issue of when they are able to perform the task of crossing the road safely, I think there are a few key studies which I mentioned in my submission and one of which Dr Taplin referred to this morning. They would indicate the various components of the road crossing path at different ages. The most basic task of crossing is deciding where you are going to cross. The study which I referred to and which Dr Taplin referred to showed fairly clearly that up to the age of nine children are severely hampered in their ability to make decisions about where to cross the road safely. " (Minutes of Evidence 19 June 1995, pp. 42-3)

2.47 STAYSAFE notes the conclusions of Pettit (1993, see <u>Appendix D: Children's competence as road users: The relevance of child development theory and research)</u>:

"Throughout this review it has become apparent that there are many developmental aspects of children's understanding, personality characteristics, behaviour and skills that would be relevant to their behaviour m traffic. There are also individual differences, and possibly gender differences, that could be significant. However in the literature surveyed there are very many inadequacies and gaps in understanding; further analysis and research are required in order to provide further insight into factors likely to influence children's traffic behaviour act as an aid in increasing the effectiveness of road safety education for children and providing more effective protective measures.

The type of general research needed can be characterised under four headings, but the list below, with some examples of topics, provides suggestions only and is not intended to be exhaustive.

Research required on relevant general aspects of child development and also on gender and individual differences

Topics that require further research include the ability to locate sound, dynamic visual acuity, the nature of the development of self-control, the basis of risk taking, comprehension of posters and illustrated material, accuracy of judgment of one's own speed of movement, and perception of time to arrive.

Developmental research required on specific aspects of children's knowledge understanding and behaviour

Research is required on tasks directly relevant to traffic behaviour and road use. Such research would be designed to clarify the developmental bases and individual or gender differences influencing children's performance in many different traffic contexts and allow predictions to be made about their behaviour. Where possible, such research would need to be related closely to real situations rather than to small-scale laboratory tasks, simulated models, responses to black-and-white drawings and other more artificial tasks.

Examples of topics for this research would include a more refined analysis of children's concepts of danger in actual traffic situations, the efficiency of children's perception in traffic contexts, attention processes in traffic, visual perspective and role taking in traffic anticipation and prediction in traffic, comprehension of traffic signs, and signals and symbols analysis of factors involved in dart-out behaviour.

Research required for finding ways to educate children to behave safely and with greater understanding in traffic
There appear to be many possibilities for parents and teachers to take, in Committee-operation, a very active guiding and mediating role, rather than relying largely on classroom experiences with resource materials that are often ineffective. Research indicates that the transfer of learning from the classroom to real contexts may often be non-existent (e.g., Rogoff & Gardner, 1984; Rothengatter, 1981a, 1981b, 1984; Antaki et al, 1986). New research could focus, for example, on the role of adults in helping children to control impulsive walking children through an environment to guide their understanding of hazards to safety, with the aim of developing safe behaviour helping children to become more aware of their own attention processes and develop more effective strategies training children to anticipate and predict traffic movements and other relevant events

Research evaluating existing road safety training material and programs
Although there have been a variety of material and programs developed to foster road safety behaviour in children within Australia, there seems to be little or no attempt to evaluate the effectiveness of this material in increasing children's safe behaviour. Overseas research indicates that increases in traffic knowledge alone rarely correlate significantly with increases in safe behaviour. It is not appropriate, therefore, to concentrate only on outcomes for children's knowledge. Suggestions for research include the evaluation of instruction programs with analysis of the concepts involved the evaluation of published material and other media such as books, posters, kits and videoed and televised material the evaluation of games and toys with road safety messages produced by various toy manufacturers, such as puzzles, miniature town and street settings with vehicles, figures of people and traffic signs and also some toys such as strollers with safety harnesses investigations of children's actual understanding of learned road rules following road safety training, studies of children's actual behaviour at significant sites such as pedestrian crossings, traffic lights, school entrances, bus stops and sites where there is restricted vision."

2.48 There was a sense of frustration when STAYSAFE discovered that a substantive research and review work had been undertaken in the area of child pedestrians and road safety by the Roads and Traffic Authority, but it had either decided or neglected to publish its findings. In particular, the uncovering of Pettit's (1993) review of children's competencies for road use led to the confirmation of a number of recommendations that STAYSAFE had under consideration from its own independent inquiry.

2.49 STAYSAFE initially considered handing down an adverse finding relating to the Roads and Traffic Authority's child pedestrian research program with strong recommendations that the Roads and Traffic Authority immediately publish the research it had already funded. However, STAYSAFE adopted an alternative tactic of querying the existence of the unpublished reports as part of the annual review of the road safety situation in New South Wales in 1994 in questions directed to Mr Ray Taylor, then General Manager, Road Safety, of the Roads and Traffic Authority:

> "**Mr MILLS (STAYSAFE)**: "The list [of research publications] contained a number of reports into road safety education—RN1/94 through to RN 7/94. Have these reports actually been published?"
>
> **Mr TAYLOR:** "I do not believe they have been published. They are ready for publication and they are currently in discussion seeking release from the education sectors themselves."
>
> **Mr MILLS (STAYSAFE)**: "It depends on the Department of School Education?"
>
> **Mr GIBSON (CHAIRMAN):** "Why have they been listed as a publication?"
>
> **Mr TAYLOR:** "Because they are in readiness. The Committee asked for reports and publications. These are ones that we are preparing to present."
>
> **Mr GIBSON (CHAIRMAN):** "You have assigned a research number to them for 1994?"
>
> **Mr TAYLOR:** "They have been assigned a research number in the expectation of publication. If I am incorrect in that, I will certainly make sure. However, that is my recollection of where those particular reports are. You are referring to the earlier reports, the 1990 reports?"
>
> **Mr MILLS (STAYSAFE)**: "The reports RN1/94 through to RN 7/94."
>
> **Mr TAYLOR:** "Yes, that is my understanding about those reports." (STAYSAFE 31, 1996, pp.50-51)

2.50 As a result of this questioning, the Roads and Traffic Authority finally released the studies into child pedestrian road safety in 1996. These studies included:

> Ball, S., Braithwaite, J. & Low, B. (1990/1996). Road safety education: Attitudes and teaching practices of primary and secondary school teachers. Research Note RN 1/94. Haymarket, NSW: Roads and Traffic Authority.
>
> Antill, J. (1990/1996). Drinking and driving: The attitudes, knowledge and intended behaviour of adolescents. Research Note RN 2/94. Haymarket, NSW: Roads and Traffic Authority.

Antill, J. (1990/1996). Adolescents and road safety: Seat belts, bicycle and skateboard helmets. Research Note RN 3/94. Haymarket, NSW: Roads and Traffic Authority.

Ball, S., Braithwaite, J. & Low, B. (1990/1996). Children and road safety: Attitudes, knowledge and behaviour of 11 and 12 year olds. Research Note RN 4/94. Haymarket, NSW: Roads and Traffic Authority.

Antill, J. (1991/1996). Parents and road safety: Attitudes, knowledge and behaviours of parents of children aged 5 to 7 years. Research Note RN 5/94. Haymarket, NSW: Roads and Traffic Authority.

Antill, J. (1990/1996). Parents and road safety: Attitudes, knowledge and behaviours of parents of children aged 8 to 12 years. Research Note RN 6/94. Haymarket, NSW: Roads and Traffic Authority.

Pettit, F. (1993/1996). Children's competence as road users: The relevance of child development theory and research. Research Note RN 7/94. Haymarket, NSW: Roads and Traffic Authority.

2.51 It remains unclear, however, as whether the findings and recommendations arising from this research program have been considered and applied to road safety policies and programs, given that many of the studies dated from 1990 and 1991 and had, presumably, languished in the Roads and Traffic Authority's files until identified by STAYSAFE five years or more later.

3

ROAD USER BEHAVIOUR—MOTORISTS

The law relating to pedestrians crossing roads -

3.1 The behaviour of pedestrians cannot be considered in isolation, without taking into account the associated behaviour of vehicle drivers and riders with whom they may be involved in collision. As mentioned in the previous chapter, it has been documented that children have special problems coping in traffic. They are often impulsive, unpredictable and easily distracted. They do not fully comprehend the dangers of traffic and they not have the same ability of adults to make judgements about distance, time, vehicle speed, etc.. Motorists in the vicinity of children, principally around schools, need to take these factors into account and adjust their driving behaviour accordingly.

3.2 When STAYSAFE 26 (1994) examined the behaviour of children, parents and motorists around school buses it reported surprise at the behaviour of motorists given the established law regarding their legal liability and duty of care towards pedestrians.

The law relating to pedestrians crossing roads

3.3 The General Traffic (Pedestrian) Regulations 1937 provides for the regulation of a number of pedestrian activities, including use of a footpath (reg. 5), crossing the road (reg. 6); and crossing at a signalised crossing (reg. 6A) and a general duty of care (reg. 9).

3.4 Reg. 6 provides that:

6. Other than within a shared traffic zone, no person shall:

(a) cross the carriageway or any portion of the carriageway of any public street otherwise than:

(i) by a direct route at right angles to the general line of that boundary of the carriageway towards which he is crossing; or

(ii) within a marked footcrossing or children's footcrossing;

(b) if he is within 20 metres of a marked footcrossing or children's footcrossing on any public street, crossings the carriageway, or any portion of the carriageway, of such street except at such footcrossing: Provided that this paragraph shall not apply where the footcrossing is so located that it would be necessary for such person to crossings another carriageway to use it; ...

3.5 Reg. 9 provides that:

9. Every person upon the carriageway of any public street shall take due precautions to avoid a collision with any vehicle or horse upon such street.

3.6 If a person commits a breach of any of these regulations, then they are liable to a penalty not exceeding $200. The Roads and Traffic Authority has noted, however, that:

> "... it has been difficult to devise regulations which both address the pedestrian behaviour most relevant for safety, and which are enforceable." (Roads and Traffic Authority, 1995, p.20)

3.7 Motorists are obliged to act in accordance with the Traffic Act 1909 and the Crimes Act 1900 and related legislation and statutory rules. A motorist commits an offence if he or she drives a motor vehicle negligently, recklessly or dangerously (Traffic Act 1909 s.4(1)). If injury or death arise as a result of a motorist's actions, then provisions of the Crimes Act 1900 can apply. There is no distinction made by enactment or statutory rule between adult pedestrians and child pedestrians.

3.8 Draft Australian National Road Rules are being developed which will, when enacted, replace existing State and Territory Laws (see STAYSAFE 49, in preparation). Motorists and pedestrians will be obliged to act in accordance with these new rules. The basic tenet of these national rules is that motorists must give way to pedestrians at children and pedestrian crossings, in shared zones and when entering or leaving a road. In turn, pedestrians must not cross at a pedestrian crossing if they are facing flashing or steady red 'DON'T WALK' lights, symbols or discs.

3.9 The Roads and Traffic Authority has noted that:

> "Under common law there is a higher duty of care placed on a driver to avoid collision with a pedestrian. At marked foot crossings (zebras) drivers must stop if there is any likelihood that they will collide with a pedestrian and it is illegal for a vehicle to overtake another vehicle which is stationary at a crossing. There is no obligation for the driver to stop for a pedestrian who is waiting by the side of the road. However, special rules apply to children's crossings." (Roads and Traffic Authority, 1995, p.20)

3.10 Davis (1997) has provided a recent discussion of the general common law principles under the tort of negligence. The common law imposes a general duty of care on all persons to exercise 'reasonable care' to avoid acts, or omissions of actions, that might foreseeably result in an injury to another person likely to be affected by those actions. What is or is not 'reasonable care' varies according to the magnitude of the risk and the gravity of the harm likely to occur (<u>The Council of the Shire of Wyong -v- Shirt</u> (1979-80) 146 CLR 40, 47-48 per Mason J; See also the calculus adopted by Judge Learned Hand in <u>Conway -v- O'Brien</u> (2nd Cir 1940) 111, F 2d 611-612). Where a person's actions result in pure financial loss, without concurrent personal injury, the law has limited the availability of the negligence remedy to cases falling within recognised relationships of 'proximity' between the wrongdoer and the person suffering the loss. For example, no relationship of 'proximity' has been accepted as owed by schools to school children for purely economic loss (<u>Van Oppen -v- Clerk to The Bedford Charity Trustees</u> (1989) 3 All ER 389). But in cases where personal injury results the scope of the duty of care almost always extends to encompass all circumstances of foreseeable injury. An injury will be foreseeable provided the risk of injury is not far fetched or financial (The Council of the Shire of Wyong -v- Shirt (1979-80) 146 CLR 40, 47). In determining what risks may be 'reasonably foreseeable' courts expect the carers of children to take into account the propensity of children to expose themselves to risks not normally taken by adults:

> "that measure of care appropriate to the inability or disability of those who are immature or feeble in body or mind is due from those who know of or ought to anticipate the presence of such persons" (Glasgow Corp -v- Taylor [1922] 1 AC 44, 67, per Lord Summer).

The risk of injury will obviously vary depending on the age and experience of the child. In other words, persons responsible for the care of school children are required to take into account the immaturity, age and lack of experience of children of different ages and the possibility that they may do silly things that might expose them to unreasonable risks (Home -v- State of Queensland Ors (1995) ATR ¶ 81-343 at 62,434).

Duty of care and the reasonable person

3.11 As a starting point to assess what should be appropriate behaviour by motorists, STAYSAFE established the nature of the general duty of care of that a motorist could reasonably be expected to take when in the vicinity of child pedestrians. Although made in the context of motorists nearing a school bus, the following comments by Dr Saffron, a Roads and Traffic Authority witness, are indicative of what could be expected as reasonable behaviour when a motorist is travelling along roads where children are likely to be present, particularly on urban streets:

> **DR SAFFRON**: "Reducing speed is very important, and keeping a good look out, expecting there to be children and for children to do things that are extremely unexpected. I think too often people do assume that children will stay on the footpath, if they are on the footpath." (Minutes of Evidence, 20 December 1993, p.2)

3.12 STAYSAFE 26 (1994) reviewed a number of legal judgements relating to what a reasonable person would think was appropriate to ensure the safety of school child pedestrians and noted that there is no possibility of defining this reasonable person or person of ordinary prudence - the well known 'man on the Clapham omnibus' (attributed to Lord Bowen by Collins MR, McQuire -v- Western Morning News Co. [1903] 2 KB 100 at 109), or the 'man on a Bondi tram'. A commentary on the concept of the reasonable man was provided by Lord MacMillan:

> "The standard of foresight of the reasonable man is, in one sense, an impersonal test. It eliminates the personal equation and is independent of the idiosyncrasies of the particular person whose conduct is in question.... The reasonable man is presumed to be free both from over-apprehension and from over-confidence, but there is a sense in which the standard of care of the reasonable man involves in its application a subjective element. It is still left to the judge to decide what, in the circumstances of the particular case, the reasonable man

> would have had in contemplation, and what accordingly the party sought to be made liable ought to have foreseen." (Glasgow Corporation -v- Muir [1943] AC 448 at 457, cited by McTiernan ACJ in McHale -v- Watson [1966] 115 CLR 199 at 203).

3.13 The cases examined by STAYSAFE 26 (1994) did not deal with questions of criminal negligence; few cases of the criminal prosecution of drivers or pedestrians involved in a pedestrian-vehicle conflict were identified, and most involved extremes of behaviour that did not shed light in the question of what constitutes reasonable action by a pedestrian or a driver of a motor vehicle. Instead, the cases described and discussed in the following sections concern aspects of pedestrian behaviour where there had been a collision with a vehicle on the roadway and involve civil actions for damages taken under the tort of negligence. A review of a number of cases indicates that while there are limits to the extent to which pedestrians, when acting in disregard of their own safety, should expect a reasonably careful motorist to take action to avoid a collision, a motorist nearing a stopped school bus or a school bus that is either slowing to stop or which has just re-joined the road after stopping must reasonably expect that school child pedestrians will be in the vicinity and that they might emerge onto the roadway and into the vehicle path suddenly, with or without notice.

Crashes involving an adult pedestrian and a motor vehicle

3.14 In Adric -v- Bullock (1988) 7 MVR 285, which was an appeal to the Supreme Court of New South Wales, an adult pedestrian walking along the shoulder of the road toward a bus stop was struck by a motorist travelling in the same direction. The injured pedestrian sued the motorist for damages resulting from the injuries received in the crash. It was found that the pedestrian had stepped out onto the carriageway. Despite the fact that the pedestrian was in breach of the General Traffic (Pedestrian) Regulations 1937 reg.5(b)(i), the appellate judges per Samuels JA found that:

> "... the essential circumstance is that, as the defendant drove along taking no steps to protect herself and the pedestrian against what she must have appreciated was a possibility of hazard, the plaintiff stepped out onto the bitumen and was run over at a point about 3 or 4 ft from the gravel....
>
> His Honour's finding of negligence depended upon the defendant having seen a possible source of danger and having taken absolutely no steps to avoid it or to protect herself against it. She, I think, clearly must bear the greater share of the culpability since her departure from a standard of reasonable of care was greater than the plaintiff's. He was certainly careless in walking with his back to the traffic and in not taking care to see that he stayed on the gravel. However on any view of the evidence his incursion onto the bitumen was not of great extent and its causative potency was far exceeded by the fact that the defendant had taken no steps to keep clear of the plaintiff's erratic course." (at 287-288)

3.15 The driver, who had been found negligent, was assigned 80% of the responsibility for the damage caused, and the pedestrian, who was found to have been guilty of want of care for his own safety, was assessed as having contributed 20%.

3.16 STAYSAFE 26 (1994) also considered a number of other cases involving injury to pedestrians and apportionment of damages. In the main, these cases are resolved in the favour of the pedestrian who has been injured, and apportionments of contributory negligence of the order of 60-80% against the motorist involved are common outcomes.

Limits to reasonable care

3.17 STAYSAFE 26 (1994) noted, however, that there are limits to the extent to which pedestrians, when acting in disregard of their own safety, should expect a reasonably careful motorist to take action to avoid a collision. In Stewart -v- Camell (1984) 2 MVR 147, which was an appeal to the Supreme Court of New South Wales, an adult pedestrian was knocked down crossing a street that was busy with both moving and stationary traffic. It was found that the pedestrian had ran across the street to the centre line and then 'darted' between vehicles in a stopped line of traffic and into the path of a moving line of traffic. The motorist who struck the pedestrian had seen the pedestrian acting in apparent disregard for his own safety by commencing to run across the street, but had assumed that the pedestrian, on reaching the centre line, would not dart through the line of stopped vehicles and into the path of a line of moving vehicles. The pedestrian claimed that the motorist, having seen him in sufficient time to take action to avoid a collision, together with having seen him act in an unusual manner by starting to run across the street and also having admitted to have formed the view that he was intending to cross the road completely, should have take action to either allow him to cross safely in front of the vehicle or to slow down sufficiently to enable the vehicle to be stopped if a collision was imminent. The trial judge rejected the pedestrian's claim of negligence against the motorist. The Court of Appeal upheld the trial judge's decision, commenting:

> "... a reasonably careful driver would have concluded, as the respondent said he did, that no-one would be so 'silly' as to run in front of a moving line of traffic on outward bound traffic in a busy highway at peak hour.... Negligence implies a want of care to prevent foreseeable injury. There are limits on the extent to which irrational behaviour of pedestrians, in apparent disregard of their own safety, should reasonably be anticipated by a reasonably careful motorist. Those limits were reached in the facts of this case." (at 151)

3.18 Adric -v- Bullock and Stewart -v- Camell dealt with the behaviour of an adult pedestrian. What of the circumstance where a child pedestrian is involved in a collision?

Crashes involving a child pedestrian and a motor vehicle

3.19 STAYSAFE sought the opinion of the Roads and Traffic Authority on blame in child pedestrian crashes:

The Hon. A. B. MANSON (STAYSAFE) : "What do we know about what the drivers who have struck children pedestrians have actually seen or reported in the circumstances leading to the crash? Has anyone examined, for example, the coronial records of child pedestrian fatalities for the evidence from the police statement or the direct evidence of the driver as to the features of the crash scene concerned?"

Ms BLACK: "The Federal Office of Road Safety regularly does studies of the coronial reports on fatalities. It did a study a few years ago of, I think, 500-odd fatal pedestrian accidents. That included all age groups, not just children. The two driver characteristics which emerged as significant in the study were that the drivers involved in fatal pedestrian accidents tended to be younger than drivers involved in other types of fatal accidents. Also, fewer of the drivers involved in fatal pedestrian accidents were affected by alcohol than was the case in other types of fatal accidents. They were the only two significant driver factors reported from that study. On this issue, we have been doing a joint study with the health department involving children admitted to hospital after pedestrian accidents. In the study we endeavoured to get information from the drivers involved but that data proved not to be useful because of the small proportion of drivers who responded. It was a voluntary study, necessarily, and so few drivers were willing to return the questionnaires. There are probably many reasons for that happening.

On the issue of the driver's perspective, I note that Dr Soames Job made some comment about the evidence of drivers. It is an issue about which people have different opinions. We have to remember that in coronial reports we also have the evidence of independent witnesses—which may be of more value than the driver's perspective." (Minutes of Evidence 19 June 1995, p. 46)

3.20 STAYSAFE then asked whether, from a legal point of view, the best stance for anyone who struck a child while driving would be to say that they did not see the child:

Mr GIBSON (CHAIRMAN): "From your records, in the majority of cases has the child or the driver been blamed for the accident?"

Ms BLACK: "This is a difficult issue. The police are the people who go to investigate the accident. Part of their responsibility is to decide whether the driver should be charged in some way or whether some offence has been committed by the driver. That is the focus of the police. I again refer to the Federal Office of Road Safety study and other studies. In the majority of cases the pedestrian has been held responsible. This is particularly so with child pedestrian accidents. Having said that, that does not mean that there were not things that the driver could possibly have done to avoid the accident. For example, the police cannot charge someone for speeding if they were within the speed limit. However, we might know that if the driver had been travelling more slowly—which might have been appropriate in the circumstances—the accident may have been avoided."

Mr GIBSON (CHAIRMAN): "The reason I asked that question is that there was a case not too long ago in which a nine-year-old boy was killed. He was hit by a driver who was on the wrong side of the road. His total defence was that he did not see the child. No charges were laid against this person. I wonder whether there is any evidence which says that nine times out of 10 the child cops the blame."

Ms BLACK:. In the study of the Federal Office of Road Safety the pedestrian was deemed to be solely responsible in 69% of pedestrian accidents. You should keep in mind these are fatalities only. You get different results sometimes when you look at serious injuries. It was higher than 70% for young children." (Minutes of Evidence 19 June 1995, p. 46)

3.21 A case of particular interest to STAYSAFE 26 (1994) was Government Insurance Office (NSW) -v- Johnson (1991) 13 MVR 209. This case, which was an appeal to the Supreme Court of New South Wales, involved a 17 year old school girl who had alighted from the centre-rear door of a bus which had stopped double parked in the roadway. After walking to the rear of the bus and looking left and right for passing vehicles but seeing none, the school girl began crossing the roadway and was struck by a vehicle travelling in the opposite direction to the bus. The school girl sued the driver for damages resulting from the injuries she received in the crash. The driver of the vehicle admitted to travelling at 60 km/h prior to the collision. He admitted that while he had seen that the bus had stopped and that the school girl had emerged onto the roadway, he had not reduced his speed. In evidence, the school girl explained that she had not seen the approaching vehicle because of a dip in the road and the presence of a viaduct which obscured her view. The trial judge found the driver of the vehicle negligent in failing to anticipate that there might be people getting off the bus and crossing the road. The driver appealed on the ground that there was contributory negligence by the school girl. The Court of Appeal, however, upheld the trial judge's decision. Mahoney JA commented:

> "In the circumstances, if the vehicle was approaching at the speed found, namely some 60 km per hour, the time in question was very short. The fact that the plaintiff, having looked both ways as she said, then commenced to cross and had proceeded only a matter of two to three steps to a distance one to 2 m over the imaginary centre line, shows that there was very little time involved. If this was so, the fact that during that very short time she had looked across to the other side of the road where she was going rather than again to the left does not, in my opinion, betoken contributory negligence." (at 212)

3.22 This case emphasises the extreme rapidity with which school child pedestrian crashes around buses can occur. It is also important because it deals with a situation where there is no claim that the school child pedestrian 'darted out' or ran across the road without first attempting to keep a proper look out for passing vehicles.

3.23 Another important case examined by STAYSAFE that has attracted a great deal of interest and publicity is Scrase -v- Jarvis & Others (1998) Australian Torts Reporter 81-471. On Friday 3 April 1998, Justice Ambrose of the Queensland Supreme Court awarded more than $570,000 in damages to the parents of Kerryn Scrase, a 10 year old school girl killed on 17 November 1993. Kerryn was struck and killed by a passing car as she was attempting to cross a busy street after leaving a Surfside Buslines school bus. At the time of the crash Kerryn was on an errand to fetch her younger sister (age 8 years at the time). The younger sister had earlier been denied access to the school bus because she had forgotten her school bus pass, and had returned home to obtain the bus pass. Both sisters were known to the bus driver by name and had travelled on the same bus for over a year. The bus driver was also aware that both children possessed current school bus passes. Despite this knowledge, the bus driver acted in accordance with the 'company policy' of the bus operator to refuse to permit school children who did not produce a current school bus pass to board the bus. In awarding damages against the bus operator Mr Justice Ambrose described the bus company's bus pass policy 'on its face ... was a grossly unreasonable one which put school children of tender years at unnecessary risk'. The implementation of such a policy was, of itself, negligent.

3.24 Scrase -v- Jarvis & Others is the first time that an Australian court has held a school bus operator vicariously liable for the design and implementation of an administrative policy which placed children at risk unnecessarily. Because vicarious liability had been established, Mr Justice Ambrose did not consider the question as to whether the bus operator was in any event responsible for that negligence on the basis discussed in The Commonwealth -v- Introvigne (1982) 150 CLR 258 at 271.

3.25 In the same action damages were also awarded against each of the school bus driver (Henry Jarvis) and the driver of the car that struck and killed Kerryn (Kevin Lynch). The court found that the school bus driver was negligent for having failed to warn Kerryn of the risks of passing traffic. The court determined that the bus driver knew school children regularly ran across from in front of school buses; knew that this propensity exposed them to serious risks of death or injury; knew that Kerryn was likely to be in a hurry to fetch her sister; and ought to have known that Lynch's vehicle (which would have been clearly visible in Jarvis' rear view mirror) was rapidly approaching the stationary school bus from behind. The car driver was held to be negligent for passing a stationary school bus at between 60-65 km/h, which was exacerbated by his failure to give any warning of his approach by sounding the vehicle's horn. The court found this conduct to have been a serious breach of the driver's duty of care, given that a stationary school bus should act as a warning beacon to road users and that the driver had seen the bus for at least 11-12 seconds during his approach prior to colliding with Kerryn.

3.26 The case raises at least two important points. First, Scrase -v- Jarvis & Others underscores the important role played by the common law in exposing and condemning conduct that exposes the public to avoidable risks of death and injury. Second, operators and regulators are not immune from successful litigation. While Scrase -v- Jarvis & Others demonstrates that the courts will require rigorous safety standards, even in the absence of specific government legislation, STAYSAFE notes that it is the decision of a single Supreme Court judge, and also notes that an appeal against the judgement may still be lodged.

RECOMMENDATION 2: The Roads and Traffic Authority monitor the appeal process in the case of Scrase -v- Jarvis & Others (1998) Australian Torts Reporter 81-471, and assess the effect of the judgement in Scrase on legal liabilities associated with child pedestrian behaviour, particularly in terms of safe travel to and from school.

3.27 Following examination of these cases, STAYSAFE concluded that a motorist travelling in areas of high densities of children, particularly around schools, parks and school buses, must reasonably expect that school child pedestrians will be in the vicinity and that they might emerge onto the roadway and into the vehicle path suddenly, with or without notice.

3.28 When asked to assess the contributory negligence of the parties involved in a pedestrian-vehicle conflict and collision, the courts seem, with consideration of the differing individual facts of each case, to be likely to find that the driver of the vehicle involved has not acted in accord with the reasonable standards or expectations of a duty of care to the pedestrian. These reasonable expectations comprise the duty of care placed on motorists to not act negligently, and to avoid actions that endanger other members of the community. In general, the negligence of the driver appears to be increased where child pedestrians are concerned. STAYSAFE believes that it is appropriate for the Roads and Traffic Authority to develop a program of public education and awareness to ensure that motorists are aware of their responsibilities to pedestrians, particularly child pedestrians.

RECOMMENDATION 3: The Roads and Traffic Authority to develop a program of public education and awareness to ensure that motorists are aware of their legal responsibilities to pedestrians, particularly child pedestrians.

Contributory negligence by children

3.29 There have been Australian cases that have examined the question of contributory negligence by children. The test for negligence by a child was variously laid down by the High Court of Australia in McHale -v- Watson [1966] 115 CLR 199, concerning a young boy who threw a sharpened piece of welding rod at a post expecting it to stick into the post. The sharpened piece of welding rod hit a young girl standing nearby and severely injured her. At trial, it was found that the boy had not intended to hit the girl with the missile or to frighten her, and that on consideration of the age of the boy he could not be found negligent against the standard of his peers. The decision was subject to an appeal to the High Court. There were differing opinions between the Justices of the High Court as to the nature of the test of negligence, but it was agreed by a majority decision that the test is that a child is expected to conform to a standard appropriate for children of the same age, intelligence and experience. If a child is not able to understand the nature and likely consequences of his or her actions, then the child cannot be held negligent, but given that there is a perception of the risks involved in performing the action the child must display the judgement and behaviour appropriate for all children of similar attributes. On this basis, the decision of the trial judge to take the age of the boy into consideration as regards his possible negligence was correct, and the trial judge's findings that the boy had not behaved negligently was upheld. The minority dissenting opinion was that the duty of care owed by the boy to the girl was to take such care as an ordinary man (i.e., an adult) would have taken in the circumstances.

3.30 The applicability of the test for contributory negligence for children as defined in the majority decision in McHale -v- Watson was subject to comment in Wiech -v- Amato 6 SASR 1973, which dealt with a situation of a child pedestrian riding a toy vehicle who was involved in a collision while crossing the road. The circumstances of the case were that a 5 year old boy rode a tricycle across a road and was struck by a motor vehicle. The driver of the motor vehicle was found to have not kept a proper look out. The driver, who had been found negligent, was assigned 90 per cent of the responsibility for the damage caused, but the child was held to have been guilty of want of care for his own safety, and was assessed as having contributed 10 per cent.

3.31 Wiech -v- Amato (1973) 6 SASR 442 is of particular interest for two reasons: first, it identified the nature of the inquiry to be made of a child pedestrian as regards his or her actions; and second, it examined the relationship between the law and scientific knowledge.

3.32 As held in Wiech -v- Amato, the proper inquiry to be made of the actions of a child pedestrian is to ask: If the child knows or has been taught that he or she must not go out onto the road at a time when it is likely that a collision might occur with a passing vehicle, and the child proceeds to do so, has the child then failed to take care of his or her own safety? In the particular circumstances of this case, the trial judge determined that even a 5 year old boy could have, and should have, appreciated the dangers involved in his actions in crossing the road on his tricycle. The difficulty, of course, lies with the question of the child's perception of the risks as assessed by the child's knowledge of road safety.

3.33 Zelling J., in the determination of Wiech -v- Amato, suggested that there is a more fundamental question that should be asked:

> "...there is a threshold question which has to be asked ... and it is this: Given that the child has the formal knowledge of the risks of the road which child of his age would possess, and I find that this child did possess that, was his ability to assess spatio-temporal movement sufficient to bring into effect in his mind the warning which he had been given with regard to taking care on the road? In other words, if a child is not old enough to be able to correlate spatio-temporal movement, he will not appreciate that he is in danger when in fact he is, and therefore he will see no reason to apply his knowledge of and instruction on road safety, but which on the present test he is to be judged. It is obvious that, if one were dealing with an older child or with an adult, when he saw the car coming from his right, and parenthetically I think ...[he] did see the car prior to the accident, she should have correlated the time he had to cross, the space the car was away from him, and the speed at which the car was travelling, and should have decided that it was cutting things too fine to cross at all. This is an ability

which a five year old does not possess." (at 445-446).

The answer to this additional question lies in the domain of science, and deals with issues relating to the development of affective, cognitive, and motor processes in children.

3.34 STAYSAFE also examined an English case, Gough -v- Thorne [1966] 3 All ER 398, where a 13 year old girl had waited to cross the road with her brothers aged 17 and 10 years of age. A truck stopped, and the truck driver beckoned them to cross while he held his right hand out to warn other traffic to stop. A following vehicle approached the stopped truck at an excessive speed and overtook it, striking the girl just as she emerged from in front of the truck as she crossed the road. The trial judge found the motorist in the vehicle which struck the girl to be negligent in that the motorists was going too fast in the circumstances and should have been keeping a proper look out and seen the truck driver's signal. However, the trial judge held the girl to have been one-third to blame because she had not paused as she moved past the front of the truck to check the roadway for following traffic. On appeal it was held that the girl had not contributed in any way to the collision occurring. Age was an important material fact to be considered. A very young child cannot be guilty of contributory negligence, but an older child may be guilty of contributory negligence, depending on the circumstances. The essential question was whether an ordinary child of 13 years of age could be reasonably expected to have done more than she had: she had waited at the roadside until the truck had stopped and she had been waved across by the truck driver. While it might have been reasonable to assume that an adult pedestrian might have sought to confirm that the truck driver was giving the proper signal to stop following traffic and that there was, in fact, no following vehicle that might overtake the stopped truck, such thought processes should not be expected of a 13 year old child.

3.35 When asked to assess the contributory negligence of the parties involved in a pedestrian-vehicle conflict and collision, the courts seem, with consideration of the differing individual facts of each case, to be likely to find that the driver of the vehicle involved has not acted in accord with the reasonable standards or expectations of a duty of care to the pedestrian. These reasonable expectations comprise the duty of care placed on motorists to not act negligently, and to avoid actions that endanger other members of the community. In general, the negligence of the driver appears to be increased where child pedestrians are concerned. The approaching motorist is expected to slow down, position the motor vehicle away from the child, keep a proper lookout for unexpected behaviour by the child, and sound cautionary warnings if necessary. Such actions would be regarded as reasonable in both the narrower legal sense and in general examination. In contrast, the behaviour of the school child is to be judged in relation to the typical behaviour of school children of similar age and abilities. This standard of behaviour required by a child can be markedly different from those actions adjudged reasonable in an adult; this said, it seems, however, that even the youngest child of school age is capable of appreciating, in some form, the risks involved in crossing the road, and therefore has a responsibility to some degree to ensure his or her own safety.

3.36 STAYSAFE was then quite surprised to find research evidence that indicates that motorists do not act in accordance with the relatively stringent duty of care that is placed upon them in situations involving child pedestrians. For example, Howarth and Lightburn (1980) studied the behaviour of child pedestrians and drivers in what they termed distant encounters (where a child pedestrian arrives at the edge of the roadway when an approaching vehicle is more than 20 yards away but not more than 100 yards away) and close encounters (where a child pedestrian arrives at the edge of the roadway when an approaching vehicle is less than 20 yards away). When faced with a distant encounter with an approaching vehicle the child pedestrian may either wait and let the vehicle pass before crossing, or pass in front of the vehicle with or without the active assistance of the driver. In most cases, the child pedestrian waited for the vehicle to pass, showing what Howarth and Lightburn termed long-range anticipation. In contrast, few drivers showed long-range anticipation by either varying speed or moving the position of the vehicle towards the centre of the roadway away from the child pedestrian. Close encounters with an approaching vehicle, or what are often called pedestrian-vehicle conflicts, were resolved by both child pedestrians and drivers taking action to avoid a potential collision. However, it seemed that the actions taken by child pedestrians were more vigorous, and in the long run more effective, in minimising the risk of a collision. Although it was rather difficult to assess fully, when faced with a close encounter or conflict with an approaching vehicle children seemed to be particularly aware of the presence of the vehicle and took an active role in avoiding any potential collision.

3.37 In reviewing these findings some years later, Howarth and Gunn (1982) commented:

> "These observations provided no evidence that drivers anticipate potential accidents with child pedestrians, whereas children clearly do. Of the 99.99 per cent of the potential accidents which are avoided most seem to be avoided because of the action of the children. If anyone is 'heedless' it is more likely to be the drivers rather than the children. There can be little doubt that the children who have accidents are more than averagely heedless on the occasion on which the accident occurs. It is also possible that some of these accidents occur to the very small number of drivers who do vary their behaviour in the presence of child pedestrians, but the probability of this occurring is exceedingly small. This evidence suggests that most child pedestrian accidents occur between a child who is uncharacteristically and exceptionally heedless, and a driver who is routinely so." (pp.273-274).

3.38 A similar view was expressed by Dr Michael Henderson, an independent consultant in road safety, based on later research by Howarth:

> "The behaviour of pedestrians cannot be considered in isolation, without taking into account the associated behaviour of vehicle drivers and riders with whom they may collide. A study in England (Howarth, 1985) showed that drivers tend to leave most of the responsibility for avoiding accidents to the pedestrian, even when the pedestrian is a child in a residential area or near a school, where most pedestrian accidents occur. Observations of driver and pedestrian behaviour showed that drivers never took avoiding behaviour until the pedestrian was within the stopping distance of the car, which is too late. Even child pedestrians showed more anticipation of danger than the drivers. Radar speed measurements outside schools showed no reduction in the speed of vehicles even when children were waiting to cross the road, and there was no increase in the distance of the vehicles from the kerb even when a child was standing on the edge." (Dr Henderson, Submission PED 192, p. 9)

3.39 Howarth et al. (1985) argue that overwhelmingly, child pedestrian crashes are attributed to the irresponsibility or thoughtlessness of the children by crash investigators and by the courts. The available evidence suggests that this view is biased and misleading and that pedestrian safety could be most effectively increased by measures aimed at increasing the responsibility of drivers for avoiding a risky incident or a crash.

3.40 STAYSAFE notes Dr Henderson's belief that it is arguable that the mind set of most drivers is that a pedestrian, of any age, will not step off the kerb into the roadway:

> "It is well known that general recognition and acceptance of community risks are commonly at great variance from the actual degree of hazard. Parents may be fearful of tiny risks to their children, and take extraordinary measures to minimise hazards such as that of lead poisoning by petrol fumes. Yet behind the wheel, the same parents will behave as if children are always sensible, observant human beings, and by driving so as to assign hazard avoidance to children they dismiss the possibility that children will behave like children. After passing hundreds of children who have *not* jumped out in front of their cars, their experience indicates that these incidents will never happen. Yet accident statistics show that they happen often. Most drivers do not properly assess the harm they may cause to others, even when driving within legal limits and at their normal level of risk acceptance. Fewer than 2% of drivers in a study in Birmingham, despite many having been drinking or travelling well over the speed limit, accepted that their driving had had anything [to] do with their colliding with a child pedestrian. (Dr Henderson, Submission PED 192, pp. 9-10)

3.41 Dr Henderson went on to say in evidence to STAYSAFE:

> **DR HENDERSON** "I think that childlike behaviour and childhood behaviour in many cases cannot be changed, because it is normal and you are trying to impose things that cannot be imposed. I do not think that that is necessarily a pessimistic view because if you look again at the historical trends, they are favourable in terms of pedestrians and they have become more and more favourable over a very large number of years. I think it is impossible to point out single factors for that; it is a whole bunch of things that are coming together. So, whatever is happening is not making things worse; it is generally making things better. I think this sort of research gives us an understanding to say to the driver 'Every now and again your assumption that the child will not move will be wrong and at that time you may hit that child and that will result in the rest of your life being ruined.'" (Minutes of Evidence 17 July 1995, p. 12)

Concluding comments

3.42 In summary, the judgements arising in the legal cases cited earlier in this chapter indicate that the relationship of duties of care between school child pedestrians and motorists nearing their location favours, in great part, the child. The approaching motorist is expected to slow down, position the motor vehicle away from the child, keep a proper lookout for unexpected behaviour by the child, and sound cautionary warnings if necessary. Such behaviours would be regarded as reasonable actions in both the narrow legal sense and in general examination.

3.43 In contrast, the behaviour of the school child is to be judged in relation to the typical behaviour of school children of similar age and abilities. The standard of behaviour required by a child can be markedly different from those actions adjudged reasonable in an adult. Nevertheless, it seems that even the youngest child of school age should be capable of appreciating the risks involved in crossing the road, and has a responsibility to some degree to ensure his or her own safety.

3.44 Research evidence indicates that, rather than exercising the stringent duty of care that is expected of them, motorists transfer their responsibility to child pedestrians. Unfortunately, children, as demonstrated in Chapter 2 of this report, are easily distracted and as a consequence, do not always act in accordance with expected behaviour.

3.45 STAYSAFE believes that it would be reasonable therefore for a greater onus to be placed on a motorist to keep a proper lookout for unexpected child pedestrian behaviour and to reduce speed in areas where children might be present on a road. Indications should also be provided to motorists by the road environment as to what constitutes appropriate behaviour in the circumstances.

4

ROAD SAFETY EDUCATION PROGRAMS

4.1 In preceding Chapters, STAYSAFE has examined the nature of child pedestrian behaviour and, in contrast, the nature of the behaviour of drivers around pedestrians. In this chapter, STAYSAFE will review the road safety education programs that address child pedestrian safety, both directly and as part of a more general educative process about road safety.

The Roads and Traffic Authority education programs and resources

4.2 The Roads and Traffic Authority summarised the resources and strategies available for road safety education for children. The Roads and Traffic Authority's road safety education program is a long term road safety education strategy identified within the Road Safety 2000 strategic plan. The program is delivered through formal education structures. All key education sectors are program partners: the Department of School Education, the Catholic Education Commission, the Association of Independent Schools, and the Macquarie University. Much of the program's success is attributable to its intersectoral nature.

4.3 The road safety education program has preschool and primary elements: the early childhood road safety education program and the 'Street Sense' primary school program. These programs are principally targeted at children's services staff and classroom teachers, together with preschool directors and the school executive. The issue of child pedestrian safety is extensively addressed at these program levels. Professional development, consultancy support and resources are provided through the schools to address pedestrian safety within the context of an ongoing, curriculum-based road safety education program.

4.4 The early childhood road safety education program and the 'Street Sense' primary school program also recognise the importance of families (parents/carers) as principal educators and role models for children under 12 years. To support families these levels of the program provide a range of resources which address child pedestrian safety. These are distributed through children's services, school and community groups and agencies.

4.5 The early childhood road safety education program has also developed a professional development package 'Working with Parents'. The service is delivered to staff and directors of children's services to assist them to work effectively with families. It addresses issues such as ensuring consistency of messages and behaviours.

4.6 Overall, the resources developed for the New South Wales road safety education program have received strong approval from education and road safety professionals, both within New South Wales and throughout Australia. For example, a survey of road safety education early childhood sector and primary schools conducted in 1994, revealed a high level of endorsement for program resources. A national review of preschool resources, conducted for the Federal Office of Road Safety by the Kindergarten Union in 1994, led to the Federal Office of Road Safety requesting permission from the Roads and Traffic Authority to enable the national distribution of the 'Kids and Traffic' resources as the best available road safety teaching materials in Australia for preschool children.

4.7 The New South Wales road safety education program has been in place since the mid-1980s. During this period there has been a 68% decrease in the number of child (0-14 years) pedestrian fatalities. This compares to a 37% decrease for the 15 years and older age group for the same period. Serious pedestrian casualties among children 0-12 years have decreased by one third since 1990.

4.8 The Roads and Traffic Authority noted that their child pedestrian safety resources included a number of key messages for families, emphasising that children under 8 years of age are dependent road users. Children under 8 years of age should be accompanied in traffic environments and should have their hand held by an adult in traffic environments. Children under 10 years of age should be accompanied in traffic environments. Adults should always drop off or pick up their primary school aged children on the same side of the road as the school or bus stop. Parents should teach their children to wait for them to arrive if they are not at the school gate or bus stop when the child arrives. Children should enter or exit a motor vehicle through the rear kerbside "safety" door. Families should use marked pedestrian crossings wherever possible, and parents should model and discuss safe pedestrian behaviour.

4.9 At the same time, the Roads and Traffic Authority has developed key messages for children, including the "safe crossing procedur". This is a procedure, which the Roads and Traffic Authority recommends should not to be taught verbatim to students as a "golden rule". Teachers present the procedure for the safe crossing of a road, using language appropriate to the students to ensure that students comprehend concepts such as "edge/kerb", "clear vision", and "safe place". The local environment of the school, such as outer suburban, rural/semi rural, or remote, requires the message to be adapted by teachers to ensure it is meaningful to all students. The procedure is to:

> Stop one step back from the edge of the kerb. If exiting a school bus, wait until the bus to move on.
>
> Watch for traffic, turning your head both ways to look and listen for traffic. Wait until there is no traffic or the traffic has stopped.
>
> Walk quickly across the road, continuing to turn your head both ways, looking, listening and thinking about traffic.

4.10 The Roads and Traffic Authority suggests some additional key pedestrian safety messages for children which can be developed by the school or within the family, including: Hold an adult's hand in traffic. Never run onto the road. Crossing from between parked vehicles is dangerous. Always choose a safe place to cross (clear vision).

4.11 The Roads and Traffic Authority indicated that child pedestrian safety resources included pedestrian safety resources for families currently provided through primary schools and preschools:

> "Street Sense" Kindergarten Parent Calendar. The 1997 calendar for parents of Kindergarten children has been ordered by government schools (99.7%); Catholic schools (79%) and independent schools (55.5%).
>
> The Safest Way (advice for parents/carers). This video has been developed for use with parents and parent bodies. It has been extensively promoted to primary schools throughout New South Wales. The video highlights the vulnerability of children under 10 years in traffic environments and provides parent discussion and advice on teaching road safety to children and ensuring adequate supervision.
>
> Transport and Safety: A Handbook for Parents. This handbook, produced by the New South Wales Federation of Parents and Citizens Associations, in conjunction with the Roads and Traffic Authority, has been provided to all affiliated parent bodies in New South Wales and is available, on order, to all New South Wales parent bodies.
>
> Our Children, Our Responsibility. Two booklets, one for coordinators of playgroups and one for parents of children attending playgroups. The booklets contain information and "teaching" advice for families on passenger and pedestrian safety and safe play. Particular emphasis is placed on the vulnerability of young children in traffic environments, the need for adult supervision and the need for adults to model and teach safe crossing procedures to children.
>
> Local Government Road Safety Officers Parent Parking Kit. Developed in conjunction with education sectors, the kit contains information on working with schools, road safety tips for families which can be included in school newsletters and flyers for parents who are parked illegally. It will be available following the launch of the 1997 Back to School campaign.
>
> School Bus Safety For Parents pamphlet (English and 15 community languages).
>
> Safe School Travel pamphlet for parents of Kindergarten students.
>
> Child/Family Pedestrian Worksheets. These have been developed for children

under 8 years and over 8 years, and include messages for families about child pedestrian safety and school bus safety (pedestrian phase).

"Kids and Traffic" Gazette. A road safety education magazine produced to support children's services (preschools, long day care centres, kindergarten, family day care, occasional day care, mobile preschools, playgroups, early intervention services and DSE preschools). In 1996 two issues were distributed to over 3 500 services. Each gazette deals with a specific road safety issue and includes a road safety poster. Services display the poster on family notice boards.

4.12 The ongoing advertising of pedestrian safety resources to community groups occurs through the mechanism of a Community Outreach Road Safety Education Catalogue. Catalogue information brochures were mailed, in August, to a variety of youth and community clubs and agencies and RSOs have continued to promote the Community Catalogue.

4.13 The Roads and Traffic Authority confirmed that ongoing activities included strategies to facilitate parent education via schools and children's services—including the development of a contract with the New Children's Hospital Westmead to sell road safety resources through the hospital shop; development of parent child pedestrian safety (including school bus safety) information to support the development of new Kindergarten-Year 6 pedestrian safety classroom programs; development of parent education video (which includes pedestrian safety) for children's services staff to use with families of children under 5 years; and publication of issues of the "Kids and Traffic" Gazette.

4.14 The Roads and Traffic Authority's Back to School campaign includes education and publicity elements. It targets parents, motorists, schools, students and local government road safety officers. Each target group will be provided with appropriate road safety messages designed to achieve positive behaviours.

- Parents are targeted through radio campaigns such as the 'Hold Me Close' campaign which urges parents to hold their child's hand in traffic, as well as School Bus Safety brochures and other school bus/pedestrian safety information through their child's school. The aim is to increase parents awareness that children under ten years of age need to be accompanied while crossing the road, with an emphasis on holding hands as the key element of effective supervision for children under 8. The campaign aims to increase parents/carers knowledge of:-
  - parking regulations around schools
  - waiting on the same side of the road as the bus stop
  - never calling a child across the road .
- Motorists are targeted through the ABC and No Rhyme No Reason drive time radio campaign (during school travel times) alerting motorists to child pedestrians.
- Schools will receive information on the campaign, an order form for parent and school resources and contact information for road safety education consultants. Principals will be requested to ensure that road safety is delivered by teachers early in the term. Students

will also be targeted through the Wait, Watch, Walk TVC screened in cinemas during the end of the school holidays.

- Local Government Road Safety Officers will receive information on the campaign and a Parent Parking Kit which provides resources for parent education about safe parking, pick up and drop off procedures.

4.15 STAYSAFE strongly endorses these approaches, and recommends that the Roads and Traffic Authority continue campaigns to make parents and children aware of child pedestrian safety issues by a process of "revision and reiteration" through all means available, including education campaigns in schools and via the media.

4.16 STAYSAFE has, during previous inquiries and reports, expressed concern about the effectiveness of the road safety education program in New South Wales school sectors. As was discussed earlier, recent research indicates that although children are taught safe pedestrian practices under these programs, that knowledge may not necessarily be applied in a real world situation. Dr Bussey, of Macquarie University, summed this up when she said:

> **DR BUSSEY:** "A lot of accidents involving young children occur when those children are focusing on other factors. Young children in particular have great difficulty in diverting attention to other factors. They are preoccupied with "Oh, my ball has raced on to the street" or whatever. There will always be situations in which children will not be able adequately to regulate their behaviour. So whenever cars are travelling fast and this happens, there will be an accident. Consequently, again, a policy issue in reducing those kinds of accidents is that there is no way to teach self-regulatory skills to children in school training programs to enable them to avoid those situations unless drivers drive more defensively and take pedestrians into account and drive more slowly. Signs may be needed, such as: "This is a pedestrian friendly neighbourhood". The simple reality is that driver's reaction times are such that if they are speeding there is no way they can stop in time when these things happen and consequently injuries or fatalities will occur in those situations. (Minutes of Evidence 17 July 1995, p. 6)

4.17 STAYSAFE notes that there are evaluations underway of the road safety education program (see STAYSAFE 47, 1998, for a detailed discussion). This remainder of this chapter will examine current road safety education programs at both the school and community level to assess their effectiveness in changing road use behaviour.

Road safety education in schools

4.18 Australian jurisdictions, as in many overseas countries, have invested substantial funds in road safety education in the belief that it is possible to improve the behaviour of road users through systematic education efforts. One of the reasons for regarding the education system as being, potentially, the most effective provider of information, is the unique position of the school as the single institution attended by practically all children within a jurisdiction. In New South Wales, children attend either schools under the State system, systemic Catholic schools, or private schools that are usually affiliated with a particular religious denomination.

4.19 The genesis of the New South Wales road safety education program for schools lies with the activities in the early 1980s of the Traffic Authority, which was amalgamated into the new Roads and Traffic Authority structure in 1988. In the decades preceding the 1980s there had been educational activities undertaken in schools to promote road safety, but it was increasingly recognised that there was a need to develop appropriate structure to support a coherent road safety education program in New South Wales schools.

4.20 In 1983, an advisory committee was formed to co-ordinate this road safety education program in New South Wales. This advisory body was the Advisory Committee on Road Safety Education. The Advisory Committee on Road Safety Education advised the Minister for Transport and the Minister for Education, through the Director of the Traffic Authority and the Director-General of the Department of Education, respectively, on matters relating to road safety education.

4.21 Below this advisory level, there were bureaucratic structures put in place to support the program. An Education Section within the Traffic Authority worked in close co-operation with the Health Studies area in the Directorate of Studies of the Department of Education.

4.22 In 1988, a structured approach towards a sustained road safety education program was developed. This approach was developed as a co-operative endeavour between the Roads and Traffic Authority and the Association of Independent Schools, the Catholic Education Commission, Macquarie University Institute of Early Childhood, the New South Wales Department of School Education and the New South Wales Police Service.

4.23 The approach, known as the Road Safety Education Program, was based on the premise that:

> "The most effective way of providing road safety education for children and adolescents is through the delivery of developmentally appropriate, curriculum-based learning experiences which are structured by professional teachers and supported by parents and community groups." (Roads and Traffic Authority, February 1995, p. 18).

4.24 The major elements of the program are:

- statewide policy and syllabus development
- curriculum materials development for early childhood staff and classroom teachers Kindergarten to Year 12, and
- the employment of road safety education consultants and advisers within the education sectors to assist staff in early childhood centres and classroom teachers in implementing road safety education

4.25 The program has a statewide reach and is targeted at over one million children and adolescents in 4,500 schools and early childhood centres. For children 0 - 5 years, delivery is focussed in early childhood centres and playgroups and for children in Kindergarten to Year 12, the program is a component of the New South Wales Board of Studies Personal Development, Health and Physical Education syllabus. In total, the program involves more than 65,000 teachers and over 900,000 students in more than 3,000 schools. As well, almost 2,300 early childhood centres with more than 100,000 playgroup members and more than 63,000 early childhood students are also involved.

4.26 Resources and materials to support road safety education have been developed by the Roads and Traffic Authority, in consultation with education agencies, and involve active student participation in learning activities. Following is a brief description of the resources available for specific age groups:

> *The Early Childhood Road Safety Education Program (Kids and Traffic)*
> The program addresses key road safety issues for children 0-5 years and their families: safe passenger behaviour, safe pedestrian behaviour and safe play. These issues are explored within the context of children under 5 being dependent road users.
>
> *Primary School Program (Street Sense)*
> The Street Sense program has two levels (Level one targeted at children from Kindergarten to Year 2 and Level 2 targeted at children from Years 3 to 6) and addresses passenger, pedestrian, cycling and school bus safety within the context of students becoming increasingly independent road users. The program is targeted at primary school teachers and school principals with the idea that a teacher and principal will deliver the road safety information and knowledge to the children.

4.27 In 1989, Ball et al. (1996a) undertook a survey of 581 primary school teachers and found that only 15 % claimed that their school had a specific road safety program. Of these teachers, 73% of these teachers said that road safety was taught as part of the school's Health Education program. Of the teachers who responded to the survey, 65% had taught some road safety in 1989, leaving 35% who had not taught any.

4.28 Another further survey of Year 6 students was undertaken in 1990 by Ball et al. (1996b) students to assess changes in students' knowledge, attitudes and reported behaviour following exposure to the 'Street Sense' program. Ball and his colleagues recommended that a second survey be conducted after the program had had time to be used extensively in the school system..

4.29 Both of the above surveys were eventually issued as Roads and Traffic Authority research notes in 1996 after STAYSAFE identified their existence, although they carry publication information dated in 1994.

4.30 STAYSAFE found it strange that the surveys were not made published until 1996 and given that a period of six years had elapsed since they were undertaken, had not been augmented by a more recent survey as recommended by Ball and his colleagues. However, STAYSAFE notes the following comment from Ms Rosemary Rouse, then the Manager, Education Programs, Roads and Traffic Authority, which indicates that an another evaluation was undertaken in 1994:

> **Ms ROUSE:** The "Street Sense" program is targeted at primary school teachers and school principals with the idea that a teacher and principal will deliver the road safety information and knowledge to the children. We measure whether the children are getting road safety information by the number of teachers who are teaching road safety in the primary schools. When we first did a survey of road safety education in schools, 35% of primary school teachers reported that they had not taught any road safety education. But the 1994 evaluations results are very encouraging. That year, only 4% of the 36,000 primary teacher in New South Wales said they had not taught any road safety during that year. Over 81% of New South Wales primary teachers had specifically addressed the issue of safe road crossing, and 77% addressed pedestrian safety issues generally, so those issues are a little wider and include safe play issues, correct use of the footpath and being visible on the roads (Minutes of Evidence, 19 June 1995 p. 56).

4.31 In response to further questions from STAYSAFE regarding the level of education provided through the Street Sense program and the status of this and similar programs, the Roads and Traffic Authority offered the following:

> "Answers to hypothetical questions must be considered within the current context of primary education. In New South Wales schools, road safety education programs are principally delivered within the 'Safe Living Strand' of the Personal Development Health and Physical Education (PDHPE) Key Learning Area. The Board of Studies mandates no set time for delivery of this, or any other key learning area in primary schools. For government schools the current priorities are the delivery of literacy and numeracy programs.
>
> In 1994, a survey of road safety education delivery in New South Wales primary schools was conducted. It revealed that the 'Street Sense' primary school resources receive strong endorsement from teachers and principals, with 48% of teachers using the 'Street Sense' kit and 78% of teachers using the 'Street Sense' calendar. With respect to delivery, only 4% of primary teachers had not taught road safety during 1994. Pedestrian safety had been taught by 77% of primary teachers with 81% of teachers specifically teaching safe crossing behaviour.
>
> The current 'Street Sense' resources provide teachers Kindergarten-Year 6 with a variety of resources (teacher resources, video/audio, story book, picture pack, etc) which support the ongoing delivery, throughout primary school, of passenger, pedestrian, school bus and bicycle safety to students. The 'Street Sense' Level 1 Kit for Kindergarten-Year 2 contains six pedestrian units. The 'Street Sense' Level 2 Kit for Years 3-6 contains three pedestrian units.

It is recognised by the Roads and Traffic Authority and all education sectors that, given its age (the kits were produced in 1988) the 'Street Sense' kits are no longer current in terms of curriculum or road safety. However, initial evaluation of the kits has revealed strong endorsement for the current range of resources. Development of new primary program kits has commenced on the basis that they are for the use of professional educators who utilise and adapt resources to meet the individual needs of their students. The majority of teachers do not present resources or programs without adaptation.

It must also be emphasised that the nature of road safety education delivered to students will vary from school to school depending on the learning needs of the students and the school environment. It is in this context that classroom teachers, in schools with large numbers of NESB students, will adapt resources to ensure that learning outcomes are achieved by all students. Achievement of learning outcomes, rather than time allocation for road safety is, therefore, the real educational issue for road safety education.

4.32 There are also resources and materials to support road safety education in the high school years:

High School Program (Young Driver and RoadWhys)
There are two programs that are aimed at older children and teenagers in high school—the Young Driver Program, which is part of the series outlined above and the RoadWhys Program, which is a police-delivered program.

4.33 According to the Roads and Traffic Authority, the key road safety issues for high school students are the pre and novice driver issues related to speed, drink and drug driving, peer pressure, risk taking in cars, fatigue and non-use of occupant restraints in cars, both as passengers and drivers. Ms Rosemary Rouse, then the Manager, Education Programs, Roads and Traffic Authority, stated:

Ms ROUSE: "Within the Young Driver Program pedestrian safety is addressed in the year 7 to 10 level, focussing on the issues of risk taking as a pedestrian, peer influence in risk taking as a pedestrian—that is, skylarking about in groups after school or in the evening—and alcohol and drugs. We concentrate on that. We also address pedestrian issues from the point of view of the future driver. Pedestrians are viewed as a group of vulnerable road users and quite a bit is done in assessing the vulnerable nature of pedestrians from the point of view of future motorists." (Minutes of Evidence 19 June 1995, p. 75)

4.34 To coordinate road safety education throughout New South Wales education sectors, a number of initiatives have been implemented, including:

(a) Road Safety Education Program Agreements, or service level agreements, between the Roads and Traffic Authority and the Department of Education and Training, the Catholic Education Commission, New South Wales (CEC); the Association of Independent

Schools, and the Macquarie University. Each Agreement documents the expectations for the delivery of the New South Wales Road Safety Education Program and provides a framework for the ongoing program monitoring, reporting and evaluation. STAYSAFE notes that the Roads and Traffic Authority was the first transport agency in Australia to have achieved such agreements with education sectors.

(b) School (K-12) Road Safety Education Program Action Plans, which describe the activities and priorities of the program and identifies program accountabilities. The plan ensures a coordinated and strategic statewide approach.

(c) Development of a new primary road safety education program. The Board of Studies has been contracted to coordinate development of new road safety education resources for primary schools in New South Wales. A project steering committee which included representatives from the Board of Studies, Roads and Traffic Authority, Department of Education and Training, Association of Independent Schools, Catholic Education Commission, and Macquarie University has been established. Development commenced in late 1996 with pedestrian safety to be the first issue addressed.

4.35 The range of resources currently available to support the delivery of pedestrian safety education are described and illustrated on pages 16-21 of the Primary Schools Road Safety Education Program Catalogue. Additionally, pedestrian safety units are included in the 'Street Sense' Kits and the two 'Street Sense' Teacher Resource Booklets. All resources are provided, free of charge, to all New South Wales schools. Kindergarten teachers are also encouraged to order and utilise 'Kids and Traffic' resources listed on pages 33-36 of this Catalogue.

4.36 STAYSAFE noted the development of the Western Australian Road Safety in Schools Project, where the Centre for Health Promotion Research at Curtin University of Technology was co-ordinating a three year project with the goal of minimising the harm associated with all forms of road usage by encouraging students to think in the traffic environment and to be aware of the consequences of their actions. The evaluation component of the project was designed to answer the following questions:

- What types of road safety education materials are currently used and/or preferred by Years K through 12 teachers?
- What factors predict teacher implementation of the Road Safety education materials?
- To what extent can the Road Safety materials and teacher training impact on Years 2 through 5 students, their parents and their teachers road safety-related knowledge, attitude and behaviours? (Cross et al., June 1995)

4.37 The Western Australian Road Safety in School Project is Western Australia's first significant venture into the development of curriculum-based road safety education resources for schools. STAYSAFE notes that project workers have sought extensive expert advice from the Roads and Traffic Authority Education section, and will be largely based on the Roads and Traffic Authority 'Street Sense' primary school road safety program. The project, which is still in progress, aims to produce curriculum-based materials for students in Years K- 10. It aims to provide 15 lessons per year level, which are linked to the health syllabus. To date only resources for Kindergarten classes have been completed. These are the New South Wales 'Kids and Traffic' program with some additional revised 'Street Sense' resources. Following independent evaluation of all Australian preschool programs, the Federal Office of Road Safety identified the New South Wales program as exemplifying best practice and reprinted the program for use in all Australian states. The remainder of the materials are due for completion in 1997.

4.38 As part of the Western Australian Road Safety in School Project an evaluation is being undertaken. The evaluation has not yet been completed. In 1996, the evaluation coordinator made a presentation to Roads and Traffic Authority road safety personnel on a formative evaluation conducted by Curtin University. The evaluation included a literature review to identify existing interventions, interviews with classroom teachers, and a review of current road safety educational materials. Roads and Traffic Authority resources featured extensively in the latter review. The Roads and Traffic Authority has received a copy of the Formative Evaluation report and has requested further evaluation results as they become available. These will be reviewed and considered by the Roads and Traffic Authority in due course and the results will be monitored by STAYSAFE.

4.39 STAYSAFE also examined the issue of road safety training for teachers. Ball et al. (1996) noted:

> "Currently, teacher training institutions do not address traffic safety education issues specifically in the programs conducted for teachers in training. Very few teachers have had in service or pre-service training to assist them in including traffic safety as a relevant part of mainstream teaching (Traffic Safety Education Working Party Report, 1985). Training programs for teachers to instruct them in how to use road safety education materials has mainly consisted of in-service courses. However, the National Roads and Motorists' Association (1988) indicates that in one College of Advanced Education, a course has recently been introduced into the teacher training curriculum which focuses on training teachers how to present road safety education, and aims to have such trained teachers acting as co-ordinators of road safety education in their schools." (Ball et al., 1996, p. 3)

4.40 The Roads and Traffic Authority also commented on teacher training in road safety, indicating that teachers learn about the road safety education program through Roads and Traffic Authority publicity and publications and through sector based publicity strategies. These program publicity strategies included mailouts to schools/educators, publications which promote the program and its resources, presentations on the program targeted communications for campaigns such as Back to School and Bicycle Week and targeted communication to teachers and principals through letters, mailouts, calendars, information brochures, presentations at national and state transport and education conferences and workshops, advertising of in-service programs, training programs such as workshops, etc..

4.41 STAYSAFE notes that a key principle of the Road Safety Education Program is outsourced program implementation through the education sectors. The Roads and Traffic

Authority funds each sector to employ program consultants to manage implementation to children's services and to schools and students Kindergarten-Year 12 within each sector. To support the delivery of road safety education to children and adolescents, the Roads and Traffic Authority develops high quality curriculum-based resources and provides them, free of charge, to all schools and children's services.

4.42 The consultancy model adopted by all sectors is the 'train the trainer' model. Schools and teachers are provided with professional development and curriculum consultancy support by road safety education consultants working from within each sector. For example, to support consultants to provide quality information about road safety issues, the Roads and Traffic Authority has provided a set of Road Safety Education Program overhead transparencies to each consultant. Consultants assist teachers to deliver quality road safety education through PDHPE classroom teaching and learning programs. Consultants also work with school executive and, if appropriate, parent bodies to develop school policies/management plans which address road safety issues.

4.43 In all sectors, in-servicing is structured to occur through staff or faculty meetings, particularly on 'pupil free' days and with whole day/sessional workshops held within the school or at an external venue. The level of consultant activity is illustrated by initial activity feedback from the Association of Independent Schools, where in 1996, 442 participants from 326 independent schools/campuses, attended road safety inservices conducted by the Association of Independent Schools at external venues. In addition 101 schools were provided with an service at their school, with a total of 335 school personnel attending.

4.44 A tertiary training strategy has been developed by the Roads and Traffic Authority to provide road safety education to students in appropriate undergraduate and postgraduate programs. A key issue in the provision of road safety information to tertiary students in universities is the culture of academic autonomy in program development. There is no 'curriculum' in university programs, and the provision of road safety education input must be negotiated with academics on an individual basis. The key groups identified for training in 1996 were students in early childhood undergraduate programs and child studies courses in TAFE colleges. This is because of the high level of staff turnover in early childhood education (58% over a 2 year period in 1988-90), the rapid expansion of centres and the lack of structure within the sector which makes in-servicing of child care workers difficult in comparison to school teachers. The strategy was initiated through a workshop which provided information on the New South Wales Road Safety Education Program to early childhood university and TAFE teachers. Following the success of this workshop, a Tertiary Student Resource Kit for university and TAFE students was developed with input from academics and TAFE teachers throughout New South Wales. The kit was provided to students as part of the road safety service. All libraries in targeted universities and TAFE Colleges were provided with a complimentary set of 'Kids and Traffic' and 'Street Sense' resources.

4.45 STAYSAFE also examined the funding of road safety education. There is significant funding for road safety educational activities. Currently, funding is provided on an annual basis to the Department of Education and Training for the delivery of the School (K-12) Road Safety Education Program to government primary and high schools. Key elements of the program for which core funding is provided include: program management, professional development, consultancy support, provision of expert advice, program monitoring and evaluation and input into the development of inter-sectoral strategies and resources for the program. STAYSAFE notes that in 1995-96, $0.696M in funding was provided to the Department of Education and Training (then the Department of School Education), $0.414M in funding was provided to the Catholic Education Commission, $0.229M in funding was provided to the Association of Independent Schools, and $0.553M in funding was provided to the Institute of Early Childhood, Macquarie University. In 1996-97, a $1M core program funding was allocated to the Department of Education and Training (then the Department of School Education), with additional funding for the appointment of a program evaluator position ($65,000) and for specific evaluation projects such as the 'Street Sense' evaluation ($25,000) and the 'Road Whys' evaluation ($52,000). A $0.415M core program funding was allocated to the Catholic Education Commission, $0.220M core program funding has been allocated to the Association of Independent Schools, and $0.600M core program funding was allocated to the Institute of Early Childhood, Macquarie University. STAYSAFE notes that the specific project-based funding is identified and discussed in recent annual review of road safety reports (see, e.g., STAYSAFE 47, 1998).

4.46 STAYSAFE notes that the restructuring of the then Department of School Education in 1995, significantly impacted upon the government schools area of the road safety education project. In fact, from December 1995 until June 1996, there was no provision of field consultancy support to schools through the road safety education project.

4.47 STAYSAFE was particularly concerned to examine parent education for road safety. Rivara and colleagues noted that:

> "While road safety education in schools raises the level of young children's road safety behaviour, the participation of parents is also both necessary and extremely important. Isolated school-based programs are likely to be ineffective without parental reinforcement of the educational message." (Rivara et al., 1989, cited by Antill, 1994b, pp. 8-9)

This quote was also cited by the Centre for Health Promotion Research, Curtin University, which undertook a literature search as part of a formative evaluation for the Western Australian Road Safety in Schools Project. Teachers of Years 1 and 2 that were interviewed as part of the project agreed that there is a need for some form of linking road safety education taught in school to the home, as road safety is not just a school subject.. It was noted, however, that it is very hard to get parents involved. (Centre for Health Promotion Research, January 1995, p.20 & 22).

4.48 The Organisation for Economic Co-operation and Development (1983) agreed that parents play an important part in their child's road safety:

> "... to be effective, road safety education for children should involve parents, and should incorporate practical training. If parents are to educate their children about road safety, train their children in actual traffic and create the appropriate behaviour, then the traffic education of children first of all involves the education of parents and other adults." (cited by Antill,

1994b, p. 9)

4.49 As mentioned earlier, the late Associate Professor John Antill, of the School of Behavioural Sciences, Macquarie University, undertook a survey of the road safety attitudes, knowledge and behaviours of parents of children aged 5 to 7 years and 8 to 12 years. The results were published in two research notes by the Roads and Traffic Authority (Antill, 1994a, 1994b). The purpose of the study involving 5-7 year olds was to obtain information on the role of parents in teaching their children about road safety. Road safety was seen to be the greatest threat to their children's physical safety by parents of children aged 5 to 7 years. Crossing the road when walking to and from school was of particular concern, followed by children running onto the road and playing on or near the road.

4.50 The parents of this age group believed it was their responsibility to teach their children about road safety, with the school having an important but lesser role. The main ways in which road safety lessons were taught were through practical experience: practising the correct behaviour with the child or playing games, telling the child, or setting a good example, although some parents admitted to setting bad examples, particularly when driving a motor vehicle. It was also clear from the survey that a number of parents did not use pedestrian crossings when they were not with their children. About half the parents said that they had sufficient materials/resources for teaching their children while about one-third said they had received information. Most of this information came from the school, but Antill noted that it was probably produced by the Roads and Traffic Authority or Police. The majority said that they would like more information, but expressed reservations on suitability and time constraints.

4.51 Antill also surveyed parents of 8 to 12 year olds (Antill, 1994b). The aim of this survey was to assess the feasibility of introducing a road safety education program aimed at parents of children in this age group. The results of the study gave information on parents' concerns about road safety, the safety of the local environment, children's and parents' road safety attitudes and behaviours, what parents taught their children about road safety and the effects of this teaching on the children, parents' knowledge and understanding of young children's limitations in the traffic environment, and parents' willingness to participate in school-based and home-based road safety programs. Antill found that there was good deal of concern about road safety, and enthusiasm for road safety education programs that provided material for parents to use with their young children. He also noted that children showed they were very aware of their parent's road safety behaviour.

4.52 Based on the findings of his surveys, Dr Antill suggested that a road safety education program—one that involves parents teaching their children at home—should be introduced on a trial basis for parents of children aged 5 to 7 and 8 to 12 years. STAYSAFE welcomed the reports by Dr Antill because, as he stated, there was virtually no information available on the role of parents in teaching their children about road safety.

RECOMMENDATION 4: The Roads and Traffic Authority ensure that there are appropriate educational materials to assist parents in teaching their children about road safety, and in particular, materials that address child pedestrian safety issues in situations commonly experienced by children (travel to and from school, pedestrian movements associated with buses and other public transport, pedestrian safety in local streets, and pedestrian safety in shopping precincts).

4.53 It is also not clear whether the recommendations made by Dr Antill were accepted by the Roads and Traffic Authority or rejected. However, the following summaries were provided by the Roads and Traffic Authority concerning the now published research studies identified by STAYSAFE in their unpublished form.

Research Note RN6/94: Parents and Road Safety
Antill notes that the

> "The results of this study cannot be seen as representing the view of all parents of 5-7 year olds. Most important, the sample comprised volunteers, who were doubtless more enthusiastic than the general population about safety issues in general and possibly about road safety in particular.
>
> In addition to this enthusiasm, another factor was the issue of social desirability: here respondents to surveys provide those answers to questions which they think the researchers wanted to hear. Thus...the parents in the sample may have given answers...that represented them as being far more enthusiastic about safety programs than was in fact the case."

This report included a number of suggestions for the development and implementation of a trial parent delivered road safety education program for children aged 5-7 years. The report recommended that the program emphasise pedestrian and passenger safety and safe play and highlight the importance of parents setting a good example.

The Road Safety Education Program recognises the significant role played by parents in the road safety education of children. The most effective way of teaching road safety to children is through schools and parents working in unison to deliver consistent messages and develop consistent behaviours. The 1994 Road Safety In Primary Schools survey confirmed that principals and teachers consider parent involvement as an essential element of a successful road safety education program.

In July 1995, focus group surveys were conducted of metropolitan and regional parents to evaluate the 1994 'Street Sense' Kindergarten calendar. The sample in this survey was more representative than the Antill sample and arguably less affected by the 'desirability factor' since the focus of discussion was the usefulness and quality of a parent resource, rather than their preparedness to teach a road safety program.

Key finding of the 1995 'Street Sense' Calendar Evaluation Report were: Road safety is a primary concern among parents of Kindergarten children. Parents generally felt that they have little time available to teach road safety to children via resources. Resources should be developed so that the need for assistance by parents is minimal and parents have minimal text to read. A calendar was considered to be an effective teaching tool as it provides a year-round prompt. Schools are seen by parents to play a critical role in the development and understanding of children's road safety skills.

In keeping with these findings, the Roads and Traffic Authority, together with the education sectors, has developed a number of strategies to promote the delivery of consistent road safety messages by families and schools. These centre on promoting adult supervision and provision of practical experiences in real traffic environments. Parents are urged to supervise/accompany children under 10 years in traffic environments. They are also urged to practise within their local traffic environment, the safety procedures their children are taught in classrooms. Parents are generally most concerned with road safety when their children are young and specifically when they enter Kindergarten. The program has, therefore, concentrated on this group in an attempt to establish a dialogue between parents and schools which will commence an ongoing partnership in road safety education.

The 1996 and 1997 calendars, therefore, are child rather than parent centred with text restricted to key information and behaviours for parents and children. In 1997, over 99% of parents with children entering Kindergarten in a government school will receive a road safety Parent calendar.

Other resources available to assist parents and community groups to provide road safety education are videos, worksheets/parent notes, fun packs etc. These are illustrated in the Road Safety Education Program Community Catalogue.

Research Note RN 9/94: Pre Driver Attitudes, Knowledge and Behaviours
In his conclusions Antill notes that:

> "Boys said they would drive dangerously more often than did girls"
>
> "Education was seen as an important avenue for influencing people to become safer drivers: critical issues to be studied should, it was felt, include the consequences of drink driving, speeding, showing off, risk taking and submitting to peer pressure".
>
> "Knowledgable victims were seen as the most appropriate people to present such programs... Other people in positions appropriate. .. such as Police and Roads and Traffic Authority workers, were seen as suitable presenters".

The 'Young Driver' and Road Whys programs have addressed a number of these conclusions. All address the key issues for young drivers and all highlight risk taking and peer pressure as issues for young drivers, particularly males. There are four presentations within the Road Whys program. These are:

- 'Speeding Gets You Nowhere Fast' (Speeding)
- 'A Time to Choose' (Drink Driving)

- 'Regret Is Such a Short Distance' (Occupant Restraint)
- 'Running On Empty' (Driver Fatigue)

The use of police as presenters of the Road Whys program is based on the added value they bring to the presentations because of the student perception that police are road safety experts.

The 'Young Driver' program also addresses the key road safety issues for pre and novice drivers: speeding, drink and drug driving, driver fatigue and use of occupant restraints. Again, issues are explored within the context of driver inexperience and peer pressure, showing off and risk taking.

The program is delivered to students in Years 7-12. Resources which support the program have been progressively developed over the last three years. They include:

three teacher resource books 'Driving With Attitude' (Years 7-10 and 11-12);
three video teaching kits 'Handle With Care', 'Go Back, You Are Going The Wrong Way' and 'The Driving Experience' which was produced in July 1996;
'The Driving Experience' highlights the issue of male involvement in road crashes and challenges the behaviours of young male drivers;
'Handle With Care' is a drama which incorporates an accident scenario and features real victims of head injury within the video.

The 'Young Driver' program has been developed within the context of PDHPE for delivery by classroom teachers. This ensures that road safety is viewed by students and teachers as 'real learning' and not as a peripheral, unimportant issue, relegated to non-teachers or restricted to special days/excursions. Road safety learning outcomes are identified by the PDHPE syllabus and within the resources.

The use of accident victims to present on road safety to students raises a number of issues. The limited availability of effective speakers results in limited access and means that a statewide program could not be provided. This is of particular concern to education systems which demand equity of access for all students.

Other issues relate to learning outcomes. The 'Young Driver' and Road Whys programs have been developed in conjunction with the education sectors to ensure consistency and high quality of road safety education. The content of the presentations reflect current road safety messages and are aligned with current educational syllabuses and policies. The delivery structure, classroom teachers and police, ensures that all students throughout New South Wales can receive a high quality road safety education.

There is also the potential for students to rationalise the victim's experience as unique ('I'd never do that/be in that situation') and therefore not applicable to them and their lives or for students to undervalue the consequences of the experience ('they don't look or seem too badly off'). Learning outcomes, may relate more to developing understanding and tolerance of people with disabilities, than to the development of road safety knowledge and safe attitudes and behaviours.

Three programs currently provide accident victim speakers for high schools. These are the Spinesafe program, Headway and the Paralympian program. Each program provides injury prevention messages in the context of raising awareness of the needs of people with disabilities. Information on the Paralympian program is contained in the High School Road Safety Education Program Catalogue.

Research Note RN 2/94: 'Drinking and Driving: the attitudes knowledge and intended behaviour of adolescents'.
The conclusions of this report are that:

> "A follow up evaluation of the Are You In Control? resource to be conducted. Comment This resource has been replaced by the 'Young Driver' and 'Road Whys' programs. An evaluation of each of these programs will be conducted over the next two years. Strategies to counteract drinking and driving behaviour which specifically target young males should be developed. This recommendation has been taken on board by the Roads and Traffic Authority and is reflected in both the 'Young Driver' and the 'Road Whys' resources. Both programs are male focused and address drink driving.

Programs which extend student's knowledge about the penalties for drink driving; reduce myths associated with 'sobering up' and ability to control a vehicle while under the influence of alcohol; promote RBT and enhance student's ability to develop strategies to avoid drink driving should be developed.

The 'Young Driver' and 'Road Whys' programs contain resources which address these issues. Two video resources 'The Driving Experience' and 'A Time To Choose ' in particular, focus on the legal limit and the legal, social and moral consequences of drink driving and highlight the need for both drivers and passengers to plan ahead to reduce the harm associated with drinking.

Research Note RN 3/94: Adolescents and road safety: seat belts and bicycle and skateboard safety helmets
The conclusions of this report are: "Seat belt education and promotion strategies should focus on extending knowledge and pro-safety attitudes and behaviours to include specific situations such as back seats and travelling at low speeds and the likelihood of detection.

The 'Young Driver' and 'Road Whys' program resources address many findings of the Antill report regarding adolescent seat belt and helmet use. Resources focus on knowledge, safe attitude and behaviour development through student centred presentations, activities and worksheets. The issues are explored in the context of peer pressure and driver inexperience. A key point is that the materials foster the development of 'coping mechanisms' and harm minimisation strategies.

The 'Driving With Attitude' (Years 9-10 and Years 11-12), 'The Driving Experience' and 'Go Back You are Going the Wrong Way' resources, along with the Road Whys occupant restraint presentation 'Regret is Such a Short Distance' deal specifically with seat belts. Particular issues such as not wearing seat belts in the back seat, when travelling short distances and vehicle overcrowding are addressed. Consequences of non-use of restraints, such as injury severity, loss of life/quality of life are explored, as are the legal and moral responsibilities of drivers and other passengers. The likelihood of 'detection and punishment' by police is presently small and therefore not highlighted as a major reason for compliance.

4.54 The Roads and Traffic Authority produces special road safety education products which are designed to help parents and carers educate children in safe road use. Material available through this program includes kits, videos books, car fun packs, stickers, posters and worksheets, together with general road safety information for motorists, including driver fatigue, drink driving, and the results of crash tests on cars. Road safety education resources are also made available to community groups such as vacation care centres, brownies and cubs, church groups and before and after school care centres through a Community Outreach Program.

4.55 Early childhood centres are also encouraged by the Roads and Traffic Authority to talk to parents and carers about safe road user practice, emphasising the following points:

- children must always be accompanied by an adult who should always walk with their child on a safe route to school
- parents should locate where children may safely be dropped off and picked up from school. Parents must never call their child across the road to meet them but pick them up and drop them off on the school side of the road
- safe travel in the car, particularly the use of seat belts and safety door. (*The Kids and Traffic Gazette*, Issue 3, 1995 and Fact Sheet: *Be safe over the break*).

Motorist education by the Roads and Traffic Authority

4.56 STAYSAFE wondered about the education materials for motorists that had been developed by the Roads and Traffic Authority. Education of drivers about pedestrian safety occurs in several ways. Generally at least one media campaign regarding pedestrian safety is run each year, two are planned for 1997/8. In addition to campaigns, driver education occurs through the Road User Handbook, which learner drivers study in order to pass the knowledge test. There are 22 items on the Driver Knowledge Test which cover pedestrian issues.

Local council safety campaigns

4.57 The Roads and Traffic Authority advised STAYSAFE that much of the local community activity is undertaken in the context of the local government Road Safety Officers program, where resources and seed funding are provided by the Roads and Traffic Authority. The objectives of the Local Council Safety Campaigns are to:

- continue to develop community ownership and participation in road safety
- extend the development of an integrated framework in local government areas for road

safety planning and action
- meet local road safety targets
- establish and/or expand the budget within each local government area for road safety
- encourage further development of local road safety strategic plans
- increase the number of local Councils participating in the project (Roads and Traffic Authority, December 1995, p. 2).

4.58 The lynchpin of the program is a road safety officer who is appointed to develop and deliver campaign activities. In order to link engineering and education programs, the position is based in the Technical Services Section of each Council. A steering committee consisting of key road safety stakeholders also operates within each Council and works closely with the road safety officer to develop campaign action plans with a focus on local safety issues. The Roads and Traffic Authority also provides two full time Local Programs Officers to liaise and provide assistance to each council in the program. These officers attend steering committee meetings, provide accurate road safety advice and technical assistance and contribute to the planning processes within each campaign.

4.59 The program commenced in 1992 in the Fairfield and Canterbury-Bankstown areas with the aim of developing a focus on local road safety programs in areas with high annual crash and injury tolls and with large population bases. Following a summary of the programs in operation at these Councils.

Fairfield 'Streets Ahead' program

4.60 Fairfield was selected for the initial local council safety campaign trial because it had one of the worst road crash and fatality records in New South Wales and was ranked in the top three metropolitan areas for road trauma. Furthermore, over half (51.6 per cent) of the population of Fairfield were born overseas and represent 133 countries including Vietnam, the former Yugoslavia, Italy, Cambodia, China, England, Chile, the Philippines, Uruguay and Iraq. More than 60 languages are spoken in the area, while a third of overseas born residents speak little or no English (Fairfield City Road Safety Action Team, 1994, p.2 and p.5).

4.61 The Fairfield council has produced a strategic road safety plan to the year 2000 based on the 'Four E's' of road safety: engineering, enforcement, environmental and education. Following are some of their strategies for improving pedestrian road safety:

> *"Vulnerable road users*
> Conduct pedestrian/cyclist publicity and education programmes, specifically targeted at vulnerable road users, such as the elderly and young;
> Initiate and support 'safe routes to schools' programmes; and
> Encourage greater parent and carer responsibility for children and teenage road users, particularly pedestrian behaviour, helmet and seat belt usage.
>
> *School education*

Consult with local schools every two years, to identify priorities and gain feedback on road safety issues, which affect them;
Support placement, promotion and implementation of educational resources as well as training of teachers and police, in the use of road safety kits and programmes;
Establish a road safety reference library for use by local schools; and
Encourage and support school based road safety activities." (Fairfield City Road Safety Action Team, 1994, p.18).

4.62 Using the community theme of 'Streets Ahead', the Fairfield program utilised local agencies, media and community groups (both English and non English speaking background) to develop a calendar of activities to enhance road safety and boost police enforcement. The program was jointly funded by the Roads and Traffic Authority and the Federal Office of Road Safety for its first year of operation and is now fully funded by the Council. The success of the program is evidenced by statistics which indicate that the toll for the Fairfield area has reduced from around 20 in the early nineties to 6 in 1992, 6 in 1993 and 5 in 1994, with similar injury reductions (Roads and Traffic Authority, December 1994, p. 3).

4.63 Community achievements for the Fairfield program in 1995 included:

- a pedestrian campaign which targeted the Assyrian community
- participation in the Roads and Traffic Authority's media campaign targeting child restraint use among the NESB community
- construction commenced in the middle of 1995 of a Community and Road Education Scheme (CARES) facility.
- participation in a Safe Routes to School trial.
- a pedestrian safety week campaign which included the distribution of "Look Out Pedestrian About" stickers and flyers from multi-storey car park toll booths.

4.64 Funding for Fairfield program in 1995 was achieved through grants, fundraising and free media advertising and editorials (see Table 8).

Canterbury-Bankstown Street-Safe Campaign

4.65 The Canterbury-Bankstown Street Safe Campaign was established in September 1992 and was the first joint Council road safety project. The main aim of this program has been to reduce the accidents involving the young and elderly pedestrians by identifying the dangers affecting them and developing solutions to minimise their risk. Strategies included the integration of education, advocacy and local area traffic engineering improvements. The special needs of residents from non English speaking backgrounds was an important element.

TABLE 8: Funding For The Fairfield Streets Ahead Program, 1995

Free print advertising and editorial, (estimate)	6,865
Grants received from:	
Safe Routes to School (Roads and Traffic Authority)	9,500
CARES (in conjunction with Bankstown and Canterbury Councils)	
Roads and Traffic Authority	120,000
Motor Accidents Authority	60,000
McDonalds	5,000
Bankstown Pacing Club	5,000
Schools	1,200
Pedestrians Safety Week	3,000
Sponsored goods and services	12,000

Source: (Roads and Traffic Authority, December 1995, Appendix 4, Fairfield)

4.66 In 1995 the projects were largely focussed on pedestrian safety and occupant restrains issues, with special consideration being given to Asian and Arabic residents. By linking education, advocacy and where appropriate, local area traffic engineering improvements, with on-going support from key stakeholders, the Council believes that the project has been effective in drawing their communities together to address local road safety concerns. (Roads and Traffic Authority, December 1995, Appendix 4, Canterbury/Bankstown).

4.67 Joint projects under the Street Safe Road Safety Campaign include:
- Street Safe Pre-School Road Safety Kit and launch
- Watch Out For Us Video and launch
- Community and Road Safety Education Scheme (CARES) in conjunction with Fairfield Council
- Think Before You Cross Pedestrian Safety Campaign
- Asian and Arabic Appreciation Night
- Operation Marathon ((Roads and Traffic Authority, December 1995, Appendix 4, Canterbury/Bankstown).

4.68 Both the Canterbury and Bankstown Councils also conducted individual road safety programs and have developed action plans. In 1994 Bankstown City Council accepted the Street Safe Road Safety Campaign as a permanent part of the Council's structure and fully funds the position of road safety officer. In terms of the success of the program, pedestrian fatalities in the Canterbury-Bankstown area dropped from around 32 each year, to 8 in 1994 (Roads and Traffic Authority, December 1994, p. 3).

The local council road safety officer program

4.69 STAYSAFE has concluded that the involvement of road safety officers within local councils has been successful initiative in dealing with pedestrian trauma. Now, not only is the program operating within metropolitan Sydney councils, but the program has also been extended throughout New South Wales.

4.70 The success of the program was evident from the beginning. STAYSAFE has noted the comments of the [then] Chief Executive of the Roads and Traffic Authority, Mr Max Moore-Wilton in 1994:

> "As this program enters its second year, it is becoming clear the local government is a major contributor in reducing Sydney's road toll. The local programs....clearly demonstrate the value of linking engineering and education programs at a local level and the focal role played by Road Safety Officers." (Roads and Traffic Authority, December 1994, p. 1).

4.71 These sentiments were echoed by the current Chief Executive of the Roads and Traffic Authority, Mr Ron Christie, when he said:

> "This year has seen the third year of a program that continues to drive Sydney's road toll to lower levels. The placement of road safety officers within local government ensures that

programs are delivered to improve road safety for Sydney's communities." (Roads and Traffic Authority, December 1995, p. 1)

4.72 An assessment of the Road Safety Officer program by the Monash University Accident Research Centre found that the following outcomes had been achieved:

- Road Safety Officers were influencing traffic engineers to consider the reactions and behaviours of road users
- Road Safety Officers were providing a contact point for members of the community with road safety concerns
- Road Safety Officers were reactive to Council and the community and so allow road safety activities to become tailored to the particular needs of the community
- The very existence of a road safety officer gives road safety credibility to the community
- Road Safety Officers have been able to draw together and work with other organisation and individuals with a role to play in road safety
- The current project has succeeded in raising the interest and enthusiasm of other Councils to join the project
- The project is attracting more road safety funding to Councils
- The combination of a Road Safety Officers with behavioural knowledge and engineers who could supply the technical background is a productive arrangement

The evaluation noted that there were some areas where improvements could be effected, including the need to increase clerical assistance, improvements in the communications structure of some Councils, and increased involvement of Roads and Traffic Authority staff and Senior Council officers in project planning (Roads and Traffic Authority, December 1994, p. 7).

4.73 The Roads and Traffic Authority produced the following comparison of fatalities in local government areas that have and do not have a road safety officer (see Table 9).

TABLE 9: Fatalities 1994 : Roads and Traffic Authority Sydney Region 1 January - 31 December 1994 inclusive

	Total fatalities			Pedestrian fatalities		
	1993	**1994**	**% Change**	**1993**	**1994**	**% Change**
Councils with Road Safety Officers as at December 1994	134	130	-3%	43	35	-19%
Councils without Road Safety Officers	65	103	+58%	32	40	+25%

Source: Roads and Traffic Authority, December 1994, p. 8

4.74 During 1995, two thirds of Councils with an Road Safety Officer experienced a downturn in fatalities, with most of the remaining Councils experiencing only a marginal increase (Roads and Traffic Authority, December 1995, p. 11).

4.75 STAYSAFE notes that the Roads and Traffic Authority is conducting an extensive evaluation of the program which will explore the success of the total local government road safety program across the state. The evaluation will include both the local council road safety officer project and a project co-ordinated by the Institute of Municipal Engineers (I.M.E.A.).

Continued funding for the position of road safety officer

4.76 An issue identified by STAYSAFE was the manner by which local council officer road safety officer positions will continue to be funded in the future. In evidence before STAYSAFE, the Roads and Traffic Authority has questioned whether local councils will be ready to take on the funding role independently after the expiration of the initial funding period. The Roads and Traffic Authority believes that by taking over the funding of the positions, local councils will demonstrate the level of local community ownership that is called for in the Roads and Traffic Authority's *Road Safety 2000* strategic plan.

4.77 Several road safety officers who appeared before STAYSAFE expressed concern as to whether local councils could meet the required level of funding that would enable the road safety officer program to continue, citing, for example, one local council which terminated the position after 12 months when forward funding could not be guaranteed. Mr Harvey, former Road Safety Officer with the Campbelltown City Council commented that:

> **Mr HARVEY:** "It seems strange, looking at the [Roads and Traffic Authority] strategic plan for the year 2000, that a project such as this is not funded for the full strategic plan, given that the first area of concern is community involvement in road safety". (Minutes of Evidence 25 June 1995, p.625)

Ms Barlow, Road Safety Officer for Rockdale Council noted that:

> **Ms BARLOW:** "Councils have competing needs and road safety is not an area which Councils have had to undertake in the past. They may be committed to road safety, but when it comes to funding it is not an issue." (Minutes of Evidence 25 June 1995, p.625).

4.78 The Roads and Traffic Authority provided the following information on road safety officers:

> The Roads and Traffic Authority funds the Road Safety Officer (RSO) positions 100% in Year 1. The Roads and Traffic Authority provides 50% funding of the RSO position in Year 2 (other 50% council funding). During 1996, the Roads and Traffic Authority announced

that it would continue the 50% funding of the RSO positions to the year 2000. If an RSO is fully funded by council, or the position has been made permanent (8 councils in Sydney Region), the Roads and Traffic Authority then provides grants of approximately $30,000 to support the 12 month action plan of road safety activities undertaken by the Road Safety Officer.

A survey of all Road Safety Officers was undertaken during September - October 1996. At the time of the survey, 73 Councils in NSW had an RSO (this represents 41% of councils in NSW). There are approximately 54 RSO positions - some positions (particularly in Roads and Traffic Authority's Northern Region) are part time and shared between 2-3 councils.

The Local Government Road Safety Program is comprised of three key components:

The Local Government and Shires Association (LGSA) / Road Safety Project

The Institute of Municipal Engineering Australia (NSW Division) (IMEA) / Road Safety Project

The Local Council Road Safety Officer Program

The Roads and Traffic Authority provides support for councils who do not have a road safety officer through the LGSA / Road Safety Project and the IMEA / Road Safety Project. A brief overview of these two components of the program is provided below.

The IMEA / Road Safety Project

This project targets council personnel and encourages councils to undertake activities in road safety and develop road safety plans. It provides; seeding funding (from the Motor Accidents Authority) for local council road safety activities, training, coordination of demonstration projects in road safety planning, and contributes to the development of best practice in the area.

The objectives of this program are to:

increase the priority of road safety in Local Government activities and management plans

increase the expertise (knowledge, understanding, skills) of road safety practice at the Local Government level

encourage Local Government to develop and implement road safety plans as part of their 3-5 year management plans and reporting plans

assist with the coordination of the project at a local/state/ national level and facilitate the development of a formal and informal network of personnel in Local Government road safety

monitor and report on the IMEA/ Roads and Traffic Authority project and assist in the evaluation of the effectiveness of the overall Road Safety 2000 Local Government Road Safety Program in achieving its goals.

The IMEA/Local Government Road Safety project achievements include:

development of a road safety strategy applicable to local government

a statewide survey of local government road safety activity and planning

seven statewide workshops on how to develop a road safety plan

sponsorship from the Motor Accidents Authority (MAA) to provide seeding grants to councils for the development of road safety projects and plans
MAA road safety grant offer, selection of projects and administration of grants
development of a 3 year strategic plan for the project
production of a local government road safety newsletter
widespread publicity of the project statewide and nationally
development and implementation of a Local Government Excellence in Road Safety Awards Scheme
development of a training strategy in road safety practice for engineering staff
development of a document on criteria and guidelines for developing demonstration projects in road safety planning
setting up and management of demonstration projects in road safety planning
assistance with planning for a Local Government Road Safety Conference held in November 1996.

The LGSA / Roads and Traffic Authority Road Safety Project
This project seeks to enhance the Local Government Road Safety Program through greater involvement and leadership by elected councillors in the development of policy and strategies.

The objectives of this program are to:
increase awareness, understanding and priority of road safety by Local Government
increase the priority of road safety in Local Government activities and management plans leading to identification of road safety plans as core council business
develop road safety strategies and policies
increase councillor understanding of road safety to enable it to be acknowledged as a key policy area
develop council capacity to assist in the development of community understanding, ownership and participation in road safety
increase the expertise of road safety practice at a local Government level

4.79 STAYSAFE asked the Roads and traffic Authority about the evaluation of the road safety officer program that has demonstrated a clear advantage to the program in terms of reduced road trauma, particularly pedestrian trauma. The Roads and Traffic Authority replied:

> "An evaluation strategy and action plan has been developed and is being implemented to monitor and evaluate, to the year 2000, all components of the local government road safety program, (including the RSO Program). The evaluation action plan includes the collection of information on local road safety activity and projects, including pedestrian safety projects.
>
> The Local Government Road Safety Program is part of the longer term strategy designed to ensure community commitment to improved road safety and ownership of the relevant issues. In this regard the appropriate objective to be evaluated concerns the level, intensity and quality of community action. These elements do form part of the evaluation strategy, but the major program is still largely in its infancy and only preliminary data on the issues are currently available. For this type of longer term educational initiative it is extremely difficult to isolate direct links back to road trauma outcomes. However, performance of pedestrian safety and other trauma is being monitored."

Community and Road Education Scheme

4.80 The Community and Road Education Scheme (CARES) was conceived by Senior Constable (now Sergeant) Ray Robinson and jointly developed by the Police Service and the Roads and Traffic Authority. CARES is a purpose built scale road system that provided practical hand on road user training for children in a realistic environment, but without the presence of life threatening traffic. The system includes traffic lights, stop and yield signs, a roundabout, a pedestrian crossing and a skills testing area. The CARES Program specifically targets 9 to 13 year olds and is presented over four stages:

Stage 1 - Police pre-visit to schools
Stage 2 - CARES kit
Stage 3 - School visit to CARES site and
Stage 4 - Police post visit to schools

4.81 The program is presented by experienced police officers who work in close cooperation with school teachers. There are currently facilities at Prospect, St Ives, St Marys, and Bass Hill, and more are planned in Sydney, Botany, Hornsby and country areas. CARES facilities are typically operated on a full-time basis by members of the New South Wales Police Service and consist of mini roadway network (including various types of intersections), traffic hazards, lights and roundabouts. CARES Prospect, which was the first complex to open, caters for 60 children each day and approximately 11,000 per year. The complex is supported by the Education Department as part of the Personal Development/Physical Education PDPE curriculum. A separate pedestrian safety area, with 'walk/don't walk' pedestrian/traffic light and pelican crossing option has been installed which can be used by elderly as well as young road users.

4.82 STAYSAFE notes with approval that the attendance of school children at the CARES facilities is usually associated with bus excursion travel, and bus operators and schools use the opportunity to discuss bus safety and pedestrian safety around buses.

4.83 STAYSAFE 26 (1994) recommended that:

> "RECOMMENDATION 33: The Roads and Traffic Authority, in consultation with the New South Wales Police Service and others, ensure that the development of a Pedestrian Awareness Program within the Community and Education Scheme (CARES) incorporates information relevant to enhancing the safety of school children as pedestrians as pedestrians around buses."

In its formal response to STAYSAFE 26, the Roads and Traffic Authority replied that CARES facilities focus on bicycle safety but pedestrian safety information can be incorporated. The New South Wales Police Service replied that existing CARES complexes at Prospect, St. Marys and St Ives have incorporated a pedestrian awareness program into their curriculum which includes a bus safety component.

Tomorrow's Drivers Exhibition

4.84 STAYSAFE also noted the NRMA's Tomorrow's Drivers initiative. The Tomorrow's Drivers Exhibition is a joint venture between the NRMA and Questacon which involves hands-on interactive learning. The exhibition is targeted at the 9 - 14 year olds and includes the following exhibits:

Child's Eyes which explores the phenomenon of limited peripheral vision and the difficulties it poses for young road users

Now You See me which is designed to illustrate the danger of wearing dark clothing when walking at night

Road Crossing which shows how difficult it is to cross a busy road

Walking Into Danger which highlights typical hazards that a child might encounter as a pedestrian and

Distracted Pedestrian which uses a talking dog to reinforce the need for children to avoid distractions when walking near a road (NRMA, Submission PED 130, Appendix 1).

4.85 It is the NRMA's view that:

"Teaching safe pedestrian and safe cycling behaviour to young people lays the foundation for safe road user behaviour later in life when they take control of a vehicle. We also believe that breaking the cycle of intolerance of lack of understanding is a crucial factor in improving the attitude and ultimately behaviour of all road users. By pursuing our philosophy of road user education through Tomorrow's Drivers, as opposed to discrete programs for each road user class, we aim to intal a positive road safety attitude at an early age and create greater respect for the needs of all road user classes." (NRMA Submission PED 130, p. 4).

4.86 STAYSAFE notes, however, the NRMA's admission that its success had been limited in getting the road safety message across because children are inherently problematic regarding their actions and changing their behaviour through education is difficult.

Child in Hospital Injury Prevention Program

4.87 The Child In Hospital Injury Prevention Program (CHIPP) is a safety activity-based program run by the Child Safety Centre of the Royal Alexander Hospital for Children (Camperdown, NSW). The program is designed to be used by play therapists, nurse/health educators and is targeted at children in hospital (either with an injury or other illness) and their families. Road safety comprises one third of the program, which utilises a safety koala (CHIPP) mascot, craft and worksheets as well as parent information. The program aims to create awareness about safety and was developed in conjunction with the Roads and Traffic Authority, Kidsafe and other organisations.

4.88 STAYSAFE 26 (1994) concluded that:

> "...there needs to be more co-ordination between the Department of School Education and the Roads and Traffic Authority as to school road safety education. There has been concern that road safety materials may end up in a corner of the library, accessed infrequently by teachers within the schools. Currently, the school sectors employ road safety consultants at an area or Regional level, but usually only the Principal has responsibility within each school for the implementation of road safety educational programs.
>
> STAYSAFE believes that it is necessary that there be much greater focus on the issue, extending to even requiring one teacher, in addition to the Principal, in every school in the State to be responsible for co-ordinating the road safety education curriculum within the school and making sure that other staff are appropriately in-services, in the same way that is done for other aspects of the Personal Development, Health and Physical Education key learning area. (STAYSAFE 26, p. 144)

4.89 STAYSAFE 26 (1994, Recommendation 30) called on the Department of Education and Training (previously the Department of School Education) to develop and implement a policy requiring each school within the school sectors to have a designated teacher as a road safety officer to receive in service training on road safety and school bus safety issues, and to be responsible for the training of other teachers and overseeing the implementation of the road safety syllabus within each school according to need. STAYSAFE has been advised that the Department of School Education is currently examining this recommendation (see STAYSAFE 33).

The use of the media in road safety education

4.90 The Roads and Traffic Authority targets its media promotion concerning child pedestrian safety issues in the 1997 Back to School campaign in the following ways:-

- Bus safety messages to children are targeted at children by showing cinema advertisements during the school holidays and showing television commercials during targeted television programs.
- Radio advertisements are scheduled to coincide with the school journey (8.45 a.m. - 9:00 a.m. and 3.15 p.m. - 3.45 p.m.) to remind parents and drivers in the vicinity of schools to take care.
- A campaign launch is held at the commencement of the campaign to encourage media coverage of the campaign issues. Media kits are distributed to all media outlets in New South Wales to try and receive editorial coverage.
- Community based activities are encouraged and planned for campaign to encourage local media coverage of the campaign issues. Dubs are made available of the radio advertisements so community road safety officers and regional Roads and Traffic

Authority can negotiate free community service spots to extend the media converge of the campaign.

- Information directly to school children is done via the School Education Section.

A summary of views considered

4.91 STAYSAFE attempted to summarise the views about the effectiveness of road safety education in addressing child pedestrian trauma. Ball et al notes that:

> "Very little research has been undertaken on the effectiveness of education as a strategy to reduce the numbers involved in road accidents. Certainly there is a strong belief that education can and does have a considerable impact on reducing the road accident rate. But there is still a great need for research to establish the types of road safety educational programs that are most effective with certain target groups..." (Ball et al, 1990, p.2)

4.92 Pettit concurs with this opinion, recommending that in order to discover what is required in educational programs aimed at lessening children's impulsivity in traffic, there is a need to build on research findings from the type of study outlined in her report to the Roads and Traffic Authority. She suggests that it may also be worth exploring techniques devised by some psychologists for helping children to develop self-control, and applying them to real or simulated traffic situations. While stressing the importance of children learning to control their impulsivity, Pettit also believes that guidance from trusted adults who can serve as a model also seems to have a significant part to play. She recommends that this would be an important area for further research in relation to traffic education.

4.93 Associate Professor Taplin provided the following framework for the prevention of child pedestrian crashes through education:

> "*Road safety education programs for children represent the conventional method employed in the attempt to reduce their involvement in traffic accidents.*
> ...Educational campaigns directed at children from preschool age up can significantly contribute to their knowledge about safe behaviour on the roads. To be effective, however, this increased understanding of road-safe conduct must be translated into improved behaviour on the footpaths and roads. For this to happen, children need to acquire the skills involved in the identification of where and when it is safe for them to cross a road. This will be best achieved by supervised behavioural training methods. In general, the evidence suggests that children have the cognitive ability to master these skills by about 9 years of age, although some task components may be learned earlier."

4.94 However, Associate Professor Taplin does not seem to be as convinced about the role of impulsivity in crashes classified as mid-block dart out, recommending a multifaceted approach to road safety education:

> "[Mid-block dart out] might be attributed to impulsiveness, in which case training programs targeted at children should be designed to teach them self-control skills using something like a stop-think-act approach. It might also be attributed to a lack of awareness of risk factors on the road, in which case training programs should be focussed on the recognition of these

indications of potential danger, including those that may be difficult to see. Or it might be attributed to the limited ability of young children to attend to many different things at once...If an attentional deficit is the problem for young children, then training programs should seek to automatise appropriate responding through frequent rehearsals of safe routines."

4.95 Dr Bussey also recommends a multifaceted approach:

Dr BUSSEY: "In terms of a theoretical perspective I would be looking at, what the child knows is important. We need to understand what children know at various ages. We need to instruct them in those concepts and then teach them to apply those concepts in their behaviour in specific situations. Children have some developmental limitations. No matter what kinds of training procedures are put in place, you will not do anything about that unless all of a sudden you can make a four year old act like a 30 year old, which will be very difficult. So there are some limitations one must be aware of and handle to an extent. Although training programs can be put into operation for children to increase their awareness and various skills, other changes are still necessary to be implemented if those training programs are to be effective.

Many of the theories, however, in particular the Piagetian approach, do not take into account is that knowing rules does not mean you will behave in accord with them. The reality is that you do not. Motivational factors are incredibly important. A lot of accidents involving young children occur when those children are focusing on other factors. Young children in particular have great difficulty in diverting attention to other factors. They are preoccupied with "Oh, my ball has raced on to the street" or whatever. There will always be situations in which children will not be able adequately to regulate their behaviour. So whenever cars are travelling fast and this happens, there will be an accident. Consequently, again, a policy issue in reducing those kinds of accidents is that there is no way to teach self-regulatory skills to children in school training programs to enable them to avoid those situations unless drivers drive more defensively and take pedestrians into account and drive more slowly. Signs may be needed, such as: "This is a pedestrian friendly neighbourhood". The simple reality is that driver's reaction times are such that if they are speeding there is no way they can stop in time when these things happen and consequently injuries or fatalities will occur in those situations.

You cannot rely on or put it all on the child. There is a lot you can do. You can teach children the rules and how to apply them, but they need backup in parenting practices and how they are taught and regulated in the home about the rules. They need good models and to see adults obeying some of the rules. Every time you see transgressive behaviour and nothing happens to the adult, you think you too can do it. That is an important factor. The media has an awfully important role

> to play in this area. For instance, in afternoon cartoons the media could start to value crossing the road at certain places and looking to the left and right as behaviour that the peer group regards as important. We know that a lot of motivational factors come from the peer group. Children want to do things to please other kids. If it is not cool to do something, they do not want to do it. Consequently, the way in which these venues are established and the way children take these things on board are not totally dependent upon themselves, because that is also dependent on the culture in which they live in which these things are being promoted all the time. The more ways in which this approach is promoted environmentally through speed limits and actively enforcing and valuing these ideas and putting up signs about being more child friendly and putting pedestrian safety at a higher cost than traffic flow, the more will all of these kinds of things work interactively when there is a good training program to reduce the incidence of some of these injuries. It is a multifaceted issue. Doing one thing without doing the others will not have much impact. (Minutes of Evidence 17 July 1995, p. 6)

4.96 These comments reflect a more general issue. STAYSAFE has noted the comments of Dr Michael Henderson, an eminent road safety expert:

> "Public education and law enforcement activities in relation to pedestrian safety should concentrate on the vehicle operator where behavioural change is sought. The most vulnerable pedestrians are the very young, the very old, and the very drunk. It is an exercise in futility to expect such groups to change their behaviour in response to public education or the law. Essentially, they are in no position to do so." (Dr Henderson, Submission PED 192, p.10)

4.97 STAYSAFE 26 (1994) recommended that education campaigns be directed toward emphasising safe behaviour by motorists around school buses, to which the Roads and Traffic Authority replied that this was in progress. It would seem, however, that a much broader approach is required to improve the behaviour of motorists in areas with a high density of children and parents in the vicinity of schools. STAYSAFE recommends therefore that the Roads and Traffic Authority undertake an education program which will warn motorists of the possibility that children may suddenly dart-out into the road in the vicinity of schools.

4.98 STAYSAFE notes that changing the beliefs of motorists may require more than persuasive communications: for example, while increasing the perceived likelihood of being stopped and fined for speeding will probably require measures that actually do increase the likelihood of being stopped and fined, other beliefs are more susceptible to being changed without a corresponding change in reality. An example of the latter would be beliefs about the relationship between speeding and accident-involvement, especially accidents causing fatal injuries to pedestrians. It may well be possible to increase the perceived likelihood of being involved in such an accident as a result of speeding by means of well-designed propaganda. The impact of speed on child pedestrian crashes is discussed later in this report.

4.99 Impulsiveness and distractibility, together with cognitive and perceptual limitations, are inherent characteristics of young children, due to their developmental stage. These limitations are recognised in the pedestrian component of the education program through a changing emphasis in message as children mature. For example, in the younger age groups the emphasis in the pedestrian area is on children taking hold of an adult's hand. For older children instruction and modelling of safe crossing behaviours become a focus, as cognitive skills and extent of pedestrian activity increase. The information on children's limitations in the traffic environment is also used to explain to parents and carers the need to supervise children up to the age of 10 years and to hold the hand of children up to 8 years. Radio advertisements directed to drivers also emphasise the inherent characteristics of children which make them unpredictable in the road environment.

4.100 In this chapter, STAYSAFE has documented the extensive range of approaches and resources that are available under the road safety education program and other related road safety programs to address child pedestrian safety issues. STAYSAFE believes that it would be appropriate for the Roads and Traffic Authority attempt to draw together the various educational initiatives to address child pedestrian trauma as part of the development of a road safety strategy for the 2001-2010 period, perhaps through a major workshop focussed exclusively on child pedestrian safety.

RECOMMENDATION 5: The Roads and Traffic Authority, in consultation with other agencies and jurisdictions as appropriate, undertake a major workshop focussed exclusively on child pedestrian safety, and, as part of this workshop, examine the various educational initiatives to address child pedestrian trauma as part of the development of a road safety strategy for the 2001-2010 period.

5

THE ROAD ENVIRONMENT

5.1 There is limited potential for general public education, and widespread enforcement of pedestrian behaviour is unlikely in the near future. This being the case, modifications to the physical environment, particularly to achieve reductions in vehicle speed, are of paramount importance. (Roads and Traffic Authority, June 1995, p.21)

5.2 This chapter will examine the manner in which the various aspects of the road environment impact upon child pedestrian safety. Particular emphasis will be given the pedestrian crossings, safe routes to school, signage and visibility.

Pedestrian crossings and other pedestrian facilities

5.3 Among road users, prime responsibility for pedestrian safety rests with the vehicle users. It is far more likely that such responsibility will be properly exercised if the degree of risk is perfectly clear to the driver or rider that pedestrians—including the young, old, disabled or drunk—in any given area or street are numerous, free-moving, and may at any time unexpectedly appear right in front of the vehicle.

5.4 In other words, it is location of potential conflict between drivers and pedestrians that requires as much detailed attention by researchers and planners as the behaviour of pedestrians. If high-risk locations are clearly identifiable to drivers and pedestrians alike, the former have the best opportunity to adjust their behaviour accordingly, and the latter can be helped to avoid those locations that are at highest risk. (Dr Henderson, Submission PED 192, p. 14)

5.5 Some of the major types of pedestrian facilities in common use in New South Wales include:

> A <u>zebra</u> crossing is a marked foot crossing with striped marks parallel to the kerb.
>
> A <u>wombat</u> crossing is predominantly used at schools and consists of a raised threshold flat top speed hump with marked foot crossing at the top.
>
> <u>Children's crossings</u> are provided near schools. Drivers must stop if they see children waiting and they must remain stationary until the crossing is completely clear before

proceeding. Special rules can apply when children are journeying to or from school. At these times, special flags are displayed and a "lollipop" person may be on duty. Some children's crossing operate as zebra crossings outside of school hours.

Pedestrian bridges and underpasses take the form of a narrow bridge crossing above a road or tunnel below a road. Pedestrians usually approach and leave the bridge or underpass by means of stairs or ramps. In some instances the bridge is joined directly to buildings.

Pedestrian refuges enable pedestrians to cross a busy or wide road in two stages, but is not a marked pedestrian crossing. Pedestrians must give way to cars and wait between the yellow cylinders on the island until it is safe to continue across the road.

Almost all signalised intersections feature pedestrian crossing facilities, delineated by roadway markings and red "DON'T WALK" and green "WALK" signals. Most signalised pedestrian crossing feature and auditory signalling system for the visually impaired. A limited number of signalised intersections in high volume pedestrian and motorised traffic areas have been modified as 'scramble crossings' and allow pedestrian movement in any direction across the roadway as all vehicular traffic is stopped for the pedestrian sequence.

A pelican crossing is a signalised mid-block pedestrian crossing. For the pedestrian, the operation of the signals is the same as at any other signalised crossing. However, for the driver the signals differ in that when the driver may proceed through the crossing with care when the amber light is flashing.

A magpie crossing has features to enhance the safety of older pedestrians, including ramps with flat slopes, centre refuge with railing, road narrowing (where appropriate) and raised reflectorised pavements markings.

A centipede crossing is a number of refuge islands linked together with painted refuges. This type of crossing is used mainly on wide roads where pedestrian movements are scattered.

A Blinky Bill, or cockatoo, crossing is a recent innovation based on the Belisha beacon crossings of the early part of the century, where a pedestrian is able to activate flashing amber lights on demand in order to assist in crossing a road safely.

5.6 STAYSAFE was interested to learn of several new type of crossing that have recently been developed by the Roads and Traffic Authority—wombat, centipede and Blinky Bill—and joint ventures between the Roads and Traffic Authority and the private sector to build pedestrian bridges.

5.7 Wombat crossings are an invention of the Sydney Region Traffic Management and Road Safety staff of the Roads and Traffic Authority. Mr Gary Stapleton, Suburban Amenity Manager, Roads and Traffic Authority provided the following description of the process by which this type of crossing was developed:

> **Mr STAPLETON:** "The wombat crossings evolved through the work of one of my staff members. It was noticed that people crossed on raised platforms...and through observation and questioning we discovered that people believed that vehicles travelled slowest at the raised platform part of the facility. Therefore, it was thought to be the appropriate place to site a crossing. Research has been conducted on 30-odd sites, and this indicated that speed reductions were achieved in the order of 50%. One location which was surveyed indicated reductions from speeds of 69 to 70 km/h to, following the installation of the wombat crossing, 34 to 37 km/h. This was a dramatic reduction. (Minutes of Evidence, 19 June 1996, p.90).
>
> The standard height and width of a wombat crossing is 75 millimetres by 4 metres and traffic is carried two ways. On wider carriageways, the crossing incorporates a pedestrian refuge to provide protection for pedestrians when confronted by a car travelling at high speed.
>
> The wombat crossing can also incorporate a pedestrian crossing on the platform and is generally provided outside of schools. The Roads and Traffic Authority noted that this type of crossing had received a good response from the public. Kerb blisters prevent cars parking near a wombat crossing. As a result pedestrians are afforded greater protection because they can be seen by motorists and can see approaching vehicles (Minutes of Evidence, 19 June 1996, p.90).

5.8 A centipede crossing is an extension of a pedestrian refuge and was developed by the Roads and Traffic Authority for use at a location with a park with wide access on one side of the road, and on the other a fairly heavy residential area. Children were crossing randomly along to road, which was a low speed and low volume carriageway. In this case a central refuge point was considered to be more appropriate than a long pedestrian crossing. The Roads and Traffic Authority believes that this type of facility has been successful where there is a combination of land use, namely a park with no definable entry point and a residential area:

> **Mr STAPLETON:** "An example of this can be found in Beamish Street in Campsie. People wanted to cross the road at many different points, and we provided something very similar to the facility on this slide. A different colour marking is used for the centre of the road. This was a unique situation. The device has been successful as people can park prams or shopping carts in the refuge while crossing the road." (Minutes of Evidence, 19 June 1996, p.90)

5.9 STAYSAFE also examined the 'Blinky Bill' or cockatoo crossing. This crossing type was developed for use in locations that do not warrant traffic lights but require enhanced motorist visibility. A button activates intense solar powered strobe lights which highlight the pedestrian crossing the road for 30 seconds. The concept was based on a older pedestrian facility known as a 'Belisha Beacon' because, as the Roads and Traffic Authority put it:

> **Mr STAPLETON**: "It was just that we had a use for these solar powered lights that were developed for the school zones, so we decided to use them with some other devices.... It is highly visible...[and]...very low-cost as well."

5.10 STAYSAFE notes that the Roads and Traffic Authority has reviewed the appropriateness of the trial Solar PALS (Solar-powered Pedestrian Activated Light System) supplement to marked foot crossings. The review identified concerns with the further use of these facilities, based on the following factors:

- There is no obligation on the part of pedestrians to activate the flashing warning lights prior to using the marked foot crossing.
- There is potential for motorists to become conditioned to only comply with their statutory obligations at the marked foot crossing when the warning lights are flashing, thus increasing the probability of conflict when a pedestrian has not activated the flashing warning lights prior to using the marked foot crossing.
- The facilities could give pedestrians a false sense of security, particularly children, visually disabled and elderly pedestrians, who may feel they have similar rights and level of protection afforded by traffic control signals. This situation is due to the similarities in the equipment used, push buttons and lights.

Unfortunately, this review has not, to STAYSAFE's knowledge, been published.

5.11 The Roads and Traffic Authority indicated that it would move towards removing the existing Solar PALS facilities following negotiation of appropriate replacement measures with the respective local councils. However, some facilities are still in place, for example, in Bourke Street, Redfern.

5.12 STAYSAFE believes that further exploration of the use of 'Blinky Bill' or cockatoo-type pedestrian facilities using pedestrian-activated flashing lights is merited, particularly in the vicinity of schools and in situations where a school operates with split sites..

RECOMMENDATION 6: The Roads and Traffic review its policy regarding the use of 'Blinky Bill' or cockatoo-type pedestrian facilities using pedestrian-activated flashing amber lights, particularly in the vicinity of schools and in situations where a school operates with split sites.

5.13 STAYSAFE also examined the school pedestrian bridge program in some detail. The program involves joint private/public sector arrangements under which a private developer finances and builds the bridge in return for advertising signage rights. Examples of these bridges can be seen on the Princes Highway at Gymea, on Pennant Hills Road at Thornleigh, at King Georges Road at Beverly Hills and on Warringah Road in Forestville. Obviously, the risk of a crash involving a pedestrian on a bridge is zero, therefore this facility provides a safe means of crossing a busy road. However, the design of the bridge itself would seem to be an important factor in encouraging pedestrian use, in that if the bridges were too high off the ground, then people might not want to walk up the side ramp to reach the main span. To some pedestrians, particularly children, there is a perception that it may be faster to cross at ground level than climb the bridge—the fact that it is safer to use the bridge would not be taken into consideration. To address this potential problem, guard rails which inhibit ground level crossing have been installed at bridge sites.

5.14 The siting and use of the bridges for advertising has come under criticism, particularly from local councils. *The Daily Telegraph* reported that:

> "Pedestrian bridges being built across Sydney have come under attack from local councils for being nothing more than unsightly advertising spaces. The bridges are going up around schools...but the advertising company building them, Boyd Outdoor, is choosing sites where they are unnecessary and rarely used....Ryde Mayor Jim Hull said some of the schools where Boyd Outdoor had planned bridges in his area were near shopping centres with significant pedestrian safety initiatives.
>
> Canterbury Council last year approved a pedestrian bridge at Beverly Hills North Public School, on busy King George's Rd, Beverly Hills, after demand from the public school. City development committee chairman John Hatzistergos said the council was "not happy" about the advertising, which he described as "pretty ugly". But he said the council was put in an awkward position, because it did not want to appear to be opposing safety concerns.
>
> Similarly, Sutherland councillor Paul Smith said the council was reluctant to change its planning rules to approve a similar structure outside Gymea High School on the Princes Highway." (Daily Telegraph, 19 August 1996, p.15)

5.15 *The Daily Telegraph* also reported a response by Boyd Outdoors, a major outdoor advertising vendor and a supporter of the installation of pedestrian bridges. Mr Boyd was reported as saying that the sites are selected from an Education Department "blackspot" list which identified schools which could be helped by a bridge. Bridges constructed under the school pedestrian bridge program enable the provision of safer pedestrian access adjacent to schools where sources of (normal road) funding are not immediately available, and that the Department of Education and Training has been working with the Roads and Traffic Authority to ensure progress with the program for some years.

5.16 Issues of the amenity and safety impacts of advertising have been common with the school pedestrian bridge program. Some local communities and local councils have not accepted advertising as a means of funding these bridges. As an example, STAYSAFE noted that parents at Warrawee Public School, in Sydney northern suburbs, successfully resisted the development of a pedestrian bridge (featuring advertising) to be placed over the Pacific Highway despite the obvious safety benefits, purely on the basis of the amenity of the structure. The local council, Kuring-gai Council, also has a policy banning outdoor advertising.

5.17 STAYSAFE believes that the pedestrian bridge program is an innovative way of improving pedestrian safety and amenity, and improving traffic movement along roads, without significant cost to Government. It is clear, however, that greater consultation is needed between the Roads and Traffic Authority, the Department of Education, local Councils and the private sector when determining the locations for these pedestrian bridges, and that care should also be taken to ensure that the advertising does not become overwhelming, thereby contributing to traffic and environmental problems.

RECOMMENDATION 7: The Roads and Traffic Authority:

(a) review the school pedestrian bridge program to ensure that appropriate locations for these pedestrian bridges are identified;

(b) and ensure that advertising on the pedestrian bridges does not become overwhelming, thereby contributing to traffic and environmental problems.

Use of pedestrian crossings by children

5.18 As mentioned earlier in this report, the most common type of crash involving a child pedestrian results from a mid-block 'dart out' by the child, that is, the motorist runs down a child attempting to cross the road away from a corner or intersection. Road trauma statistics indicate that 85% of pedestrian crashes happen away from pedestrian crossing facilities.

5.19 As discussed in earlier chapters, the research evidence regarding pedestrian trauma indicates that children can be easily distracted and are not necessarily aware of approaching traffic when they move to cross a road. However, this cannot be said of crashes where a child has made a conscious decision to dart across a road because a pedestrian crossing was not situated on the direct route that the child was following. The most likely cause in this scenario is that the child has emerged from a driveway, side street or public pathway and intends travelling directly forwards, irrespective of whether or not a crossing is located at that point.

5.20 The Roads and Traffic Authority believes that:

> "It is important that traffic control facilities are 'pedestrian friendly' and attractive, to encourage pedestrians to use them...Pedestrian crossing demands are diverse so pedestrian facilities can only every serve the more intensive desire lines. Hence the use of specific criteria or 'warrants', to guide their provision. The criteria are expressed in terms of number of pedestrians per hour, number of vehicles per hour, situational, environmental and land use factors. This warrant also seeks to ensure that rarely-used facilities don't breed complacency and disregard by drivers, with the possibility of disastrous consequences when they are used.
>
> However, there is often public demand for facilities where the warrants are not met and the cost of installing and maintaining, for example pedestrian signals ($60,000 to $80,000 for

> installation and around $6,000 per annum to maintain) also becomes an issue. "Unwarranted" facilities - ie those whose "benefits" do not exceed their "costs" constitute an opportunity cost. Those funds are not then available to save lives or reduce injuries elsewhere (Roads and Traffic Authority, Submission PED 67, p.20)

5.21 STAYSAFE accepts that it is not feasible to install crossings at all locations requested by the public, however, given the growing number of different types of crossings, not all of which require traffic signals, careful consideration should be given to installing an appropriate type at locations frequented by children and the elderly. Care should also be taken when planning bicycle and public pathways to ensure that these intersect busy roads at sites where crossings are located.

RECOMMENDATION 8: The Roads and Traffic Authority review its criteria for the installation of pedestrian facilities to:
- **(a) include the identification and description of new types of pedestrian facilities;**
- **(b) identify the types of facilities appropriate for different road users (i.e., children, the elderly, etc.).**

Community knowledge of pedestrian crossings

5.22 STAYSAFE expressed concern that the type and function of pedestrian crossings may be poorly understood by the community. In response, Mr Paul Yannoulatos, Chief Engineer of Botany Council, replied:

> **Mr YANNOULATOS:** "Interestingly enough, when we got together as a group to discuss our submission this was raised between us as engineers. We all had our slightly different interpretations of what the different crossings all meant. It brought to our attention that there is a need. If the professionals cannot all agree, imagine how the poor public out there are totally confused. One of the things that the Roads and Traffic Authority has done is given the crossings animals names. As you are probably aware, the zebra crossing has been around for some time. There is a pelican crossing, a wombat crossing and a magpie crossing. The idea behind that is so that people can associate with these types of names, I think particularly children...
>
> The Roads and Traffic Authority and local government do know about it, but the general public I think would be confused. What is needed, of course, is an educational program. That is where, I guess, the road safety officers come into line with that." (Minutes of Evidence, 22 August 1994, p.19)

5.23 STAYSAFE also voiced this concern to Roads and Traffic Authority witnesses:

> **Mr GIBSON (CHAIRMAN):** "There are so many of these magpies crossings,

and speed-calming devices, and what have you, do you think we are confusing the motorist."
Mr FORD: "Yes."

Mr GIBSON (CHAIRMAN): "The point is, how do we educate the public? In my area there are a number of speed-calming devices, humps in the road and what have you. People actually get on those and think that they are a legitimate crossings when they are not. People are going to get killed out there because of it. There have been many accidents because the public are confused."

Mr FORD: "The answer to your question is yes, as I said from the beginning. Let me explain: within the Roads and Traffic Authority approximately two years ago—it might have been a little longer than that, 1991 or 1992—we were becoming increasingly concerned about the lack of consistency in local area traffic-management schemes, traffic-calming schemes and schemes in school zones or even through shopping centres. Local area traffic management had got to a point, really, where there was no clear use of what we call best practice. The standards were generally poor and a lot of it was experimental. We put together, in concert with the Federal Office of Road Safety and the Western Sydney Regional Organisation of Councils a set of best practice guidelines called 'Towards Traffic Calming'.

Those guidelines have now been promulgated right around the State and they are absolutely consistent in what they are proposing. What you see in Dubbo you will see in Marrickville, Wollongong, etc.. Behind those guidelines we have been actively encouraging Councils to participate with the Roads and Traffic Authority in putting in traffic-calming schemes or upgrading the nature of the schemes they have. Around Sydney we have a variety of schemes which are very, very good. At the same time we probably have a large number which are terrible or could be improved. What we are trying to work towards within, say, a three-to-five-year period is some consistency for exactly the reasons you mentioned: so that a driver, irrespective of where he is in the State, does not encounter any situations which are totally alien. It is a very high priority area." (Minutes of Evidence, 19 June 1995, p.70)

STAYSAFE recommends that the Roads and Traffic Authority ensure that the different types of pedestrian crossing facilities and their uses should be included as part of road safety educational programs and in publicity associated with safe driving and safe road use.

RECOMMENDATION 9: The Roads and Traffic Authority ensure that the different types of pedestrian crossing facilities and their uses are included as part of road safety educational programs and in publicity associated with safe driving and safe road use.

Knowledge of pedestrian crossing facilities

5.24 Pedestrians in Australia frequently violate pedestrian signals and STAYSAFE agrees that this is a contributing factor in child pedestrian crashes. Of concern, however, is the pedestrian crash which results from a motorist being unable to stop when suddenly confronted by a child on a pedestrian crossing. In these cases the most likely cause of the crash is:

- failure to give way to the pedestrian or exercise sufficient care
- the speed that the car is travelling:
- the motorist is not aware of the crossing either because of poor visibility or lack of signage

The Motor Traffic Regulations 1935 provide for children's crossings. STAYSAFE is concerned that there does not seem to have been any evaluation of drivers' knowledge of the requirement for stopping at such a crossing.

RECOMMENDATION 10: The Roads and Traffic Authority undertake research to determine the understanding of New South Wales motorists of the requirements of pedestrian crossings, particularly children's crossings.

5.25 STAYSAFE also notes the comments of Mr Stapleton, a Roads and Traffic Authority witnesses:

> **Mr G. STAPLETON**: "I am not aware of any current research, but I was involved some time ago in research on checking the effectiveness of the advance warning road markings associated with these crossings. We have diamond and zig-zag lines which feature as advance warnings. In some cases 'Ped X' is marked on the road. The research indicated that the zig-zag markings were the most effective of the three techniques. They gave advance warnings of crossing which were badly sited. That is the only research of which I am aware."

STAYSAFE regards it as critical that appropriate research should be undertaken to better understand the effect of signage and road markings in both providing advance warning of pedestrian facilities and in delineating the facilities.

RECOMMENDATION 11: The Roads and Traffic Authority:

(a) review existing research knowledge concerning the effect of signage and road markings in both providing advance warning of pedestrian facilities and in delineating the facilities; and

(b) undertake such research as is required to better understand the effect of signage and road markings in both providing advance warning of pedestrian facilities and in delineating the facilities.

5.26 The Roads and Traffic Authority provided the following summary of teaching methods employed in both children and adults with respect to crossings:

"Teaching of Children

The key pedestrian message for preschool children is to hold an adult's hand (bag, clothing, pram) in traffic environments.

School children are taught key pedestrian safety behaviours, principally via the safe crossing procedure. This is a procedure, not to be taught to students as a 'golden rule'. Teachers present the procedure using language appropriate to the students to ensure that students comprehend concepts such as 'edge/kerb', 'clear vision', 'safe place' and checking the meaning that children take from the safety procedures. The emphasis is on ensuring learning outcomes. The advertisement 'wait', 'watch', 'walk' provides a trigger for each phase of the safe crossing procedure. Teachers adapt this message to the understanding of their students:

Stop one step back from the edge of the kerb.
Choose a safe place to cross.
Watch for traffic, turning your head both ways to look and listen for traffic.
Wait until there is no traffic or the traffic has stopped.
Walk quickly across the road, continuing to turn your head both ways, looking, listening and thinking about traffic.

Additional key pedestrian safety points for children (school/family):

Use a marked crossing wherever possible
Wait until the green pedestrian light is operating
Never run onto the road
Crossing from between parked vehicles is dangerous
Always choose a safe place to cross (clear vision)

In regard to pedestrian safety around school buses, the above safe crossing procedure still applies. However, students are also taught to wait until the bus has driven away and they have clear vision of the road.

The concepts of 'clear vision' and 'a safe place' involve judgements which can be extremely complex. To ensure students achieve learning outcomes, teachers check student understanding of these concepts and development of their judgement skills.

The Police may support schools to deliver pedestrian safety education. The Police Picture Pack resource which has been developed in consultation with the Police Service provides police with appropriate materials to assist them to deliver pedestrian safety education.

Teaching of adults

Driving adults are taught through the driver licensing process of the different types of pedestrian crossing facilities. A pamphlet called Pedestrian Crossings was developed in 1991 and revised in 1996. It has been distributed through the regions and Road Safety Officers.

> The Traffic Management Branch has recently undertaken some community scanning to identify the facilities most in need of pedestrian education. The main priorities will be targeted through education and awareness campaigns in 1997-98. In addition attention will be paid to ensuring any new pedestrian products are developed in accordance with best practice guidelines."

5.27 The Roads and Traffic Authority has produced a brochure which describes some of the pedestrian crossings currently in use in New South Wales. STAYSAFE believes, however, that a wider campaign, utilising the media, should be undertaken to increase community awareness of these facilities and the laws pertaining to their use. The campaign should also include a message to alert drivers that pedestrians have right of way at crossings showing a green 'walk' signal, particularly where the motorist is making a left hand turn through the pedestrian crossing. Conversely, pedestrians should be warned to watch out for cars turning left onto the crossing.

Siting of pedestrian crossing facilities

5.28 In response to a question as to what factors should be considered in determining the location of pedestrian crossings, the Roads and Traffic Authority commented:

> **Mr FORD:** "Probably the most important criterion is to locate the crossing in such a way that drivers have quite clear and unencumbered sight distance to the crossing. This generally requires that the crossing be located in such a way that it is removed from a conflicting device, such as another signalled intersection, so that there is absolutely no confusion between the two; that the kerbside is clear; that the sight line on to the crossing is unrestricted—and that involves no stopping and no standing restrictions. Further criteria would be that it is generally on the desire line of the pedestrians, that is where most of the pedestrians wish to go—you can get to a situation where a facility is provided but is not used because it is generally off the line where most people wish to go; that it must be well lit at night—that is, that it must have good night-time visibility including floodlighting if required; and, wherever possible, be in a low speed zone. We are talking about particularly where we have marked foot crossings and not signalled crossings."
>
> **Mr GIBSON (CHAIRMAN):** "What about the view of the pedestrian? You did not mention that; you mentioned the view so far as the driver was concerned."
>
> **Mr FORD:** "The principal concern is pedestrian safety and the loose cannon, if you like, of the driver. You must locate the crossing in such a way that you give the driver every opportunity to sight the pedestrian. Secondly, you locate the crossing in such a way as to ensure that it is on what we call the desire line for most pedestrian movements. If you put it down here and people are crossing the road up there, you are wasting your time."

> **Mr SMITH:** "It is also a contra situation. If the driver has got good vision, obviously the pedestrian must have good vision."
>
> **Mr FORD:** "Yes."
>
> **Mr GIBSON (CHAIRMAN):** "Surely you are not suggesting that a crossing should be placed in a popular position rather than in a safe position?"
>
> **Mr FORD**: "Quite the contrary. The location must be safe but there are a variety of safe locations. We would put it in the safest location which is the location most acceptable to the majority of pedestrians. The pedestrian pattern of crossing the road is extremely complex. If we could pick up, say, 50 per cent in one corridor we would be doing extremely well. We put it in the safest place which is acceptable to the majority of pedestrians." (Minutes of Evidence, 19 June 1996, p.65)

Timing of signalised pedestrian crossing facilities

5.29 An issue of concern that was raised in several submissions to this inquiry was the timed phasing of signals at pedestrian crossings. It would also seem to STAYSAFE that the timing of pedestrian signals could also be a major influence on the acceptability of use of a pedestrian crossing facility (cf., Mr Ford's comments in the preceding section). Roads and Traffic Authority witnesses commented:

> **Mr HARRISON (STAYSAFE):** "With regard to pedestrian crossing on signalised pedestrian crossing and mid-block pedestrian crossings, what work has been done to review and modify the time phasing of traffic lights to provide sufficient duration for at-risk people crossing roads?"
>
> **Mr FORD:** "In the Sydney environment we have a number of locations where there are significant numbers of pedestrians who are potentially at risk: the elderly and the young particularly are two groups for whom road crossing is increasingly arduous, particularly on high speed roads and busy arterial roads like Military Road. At a number of locations the duration of the green 'WALK' signal is increased around about school starting and finishing times, or in the off-peak of business hours when most of the elderly are shopping and moving between community facilities. For example, these facilities are on Military Road, Spit Junction, Spit Road-Ourimbah Road and Whiteman Road. At SCEGGS we rewind the walk duration time just prior to the peak times and we have the buses organised in such a way that we can get that extra road crossing time for the children. With the difficulties loaded into the peak times, we are looking at putting in a pedestrian bridge to solve the problem. In and around the city we

recently introduced crisscross crossing. You may be aware of a signal crossing at which all legs of the intersection run simultaneously. We have now formalised diagonal crossings, and we have signals facing the diagonal movement. Five or six of these are now in place. In a number of cases at retirement villages a transponder device or something as simple as a key may be used. By inserting the key in a transponder device with a controller, extra time will be provided to cross the road. Experiments are about to start on measuring the rate at which people cross a road automatically. Mr Stapleton is more competent to talk about that point later. We can detect the speed at which people actually cross a road and we can slow down or speed up the time of the green advance code. We can have detectors in the pavement to sense walking frames and wheelchairs and provide additional time for road crossing, if required. You are aware of a push-button system for blind pedestrians known as audio-tactile. That is a scatter gun view across a variety of technology running at the moment. (Minutes of Evidence 19 June 1995, pp.55-6)

5.30 A common response from the Roads and Traffic Authority to STAYSAFE in the area of road safety has been that 'interim guidelines are being developed', and questions on the siting of pedestrian facilities evoked a similar response.

Mr SMITH: "In the late 1980s the Traffic Authority released some interim guidelines for pedestrian facilities. They remain interim. What is the reasoning for that? It is probably what we have all been talking about here, updating."

Mr FORD: "It is a very good question but, nevertheless, the answer is the one you have given us. There has been a significant change in the number and style of control devices for pedestrians. I have mentioned wombats but I have not mentioned pelicans, and there is another one, centre-pedes. We have a menagerie but, nevertheless, we have in place this evaluation I mentioned earlier and we are moving towards putting in place, if you like, a more comprehensive set of pedestrian safety guidelines. They are currently being developed.

The devices we are using each have a specific application. We may be targeting the elderly with a magpie style of crossing or the young with a wombat style of crossing in a school zone. To that extent, based on the evaluation I mentioned earlier, we are working now towards a comprehensive set of guidelines, not an interim set of guidelines, for school safety." (Minutes of Evidence, 19 June 1995, p.70)

5.31 The review of the documents "Interim Guidelines for the Planning and Design of School Traffic and Pedestrian Facilities" and "Interim Guidelines for the Planning and Design of School Bus Routes and Bus Stops" is planned to be pursued as part of the development of the School Facilities component of the Roads and Traffic Authority Traffic Engineering Manual.

Fundamental to this process was the need to review and update Roads and Traffic Authority policies and guidelines for School Zones and the School Crossing Supervisor Scheme, as well as the development of the Safe Routes to Schools guidelines. As these initiatives near completion, STAYSAFE understands that the Roads and Traffic Authority will then be in a position to progress development of the School Facilities component of the Traffic Engineering Manual.

Summary and conclusions

5.32 The Roads and Traffic Authority has prepared Road Safety Environment Guidelines which identify the road safety principles and techniques that need to be applied to achieve a safe road environment. The guidelines address child pedestrian issues in three sections: (i) traffic management; (ii) traffic control devices; and (iii) transport and traffic planning. STAYSAFE has found, however, that child pedestrian issues were not addressed in the sections on signposting or delineation.

5.33 STAYSAFE welcomes the initiatives that the Roads and Traffic Authority has shown in developing pedestrian crossings that are specific to user requirements. However, STAYSAFE believes that road modifications for pedestrians, such as magpie crossings, wombat crossings, 40 km/h speed restrictions outside schools during school hours and the installation of flashing beacons—a modern version of the Belisha beacon of the 1930s—and traffic signals at pedestrians crossings might not be enough to improve child pedestrian casualties.

5.34 Further development of the Roads and Traffic Authority's pedestrian bridge program might be the appropriate measure needed to solve the problems of pedestrians crossing major roads in the Sydney metropolitan area.

6

THE CHILD PEDESTRIAN IN THE SCHOOL ENVIRONMENT

6.1 STAYSAFE was particularly concerned with examining the pedestrian safety issues associated with children and schools, as it would seem that this situation is likely to be the primary unaccompanied pedestrian experience of children away from their immediate home environment and away from parents and carers. The general issues to be addressed were well stated by Roads and Traffic Authority witnesses:

> **Mr STAPLETON:** "With school zones essentially you cannot just rely on engineering devices to provide you with the ultimate result. It must be a combination of three things...it is an interactive process actually between engineering devices and enforcement, and I think community education. I guess how to improve it is to bring those three elements together and make them far more interactive and promote the requirement of having to have a safe environment in and about a school." (Minutes of Evidence, 19 June 1996, p.98)

6.2 This chapter examines the policies and initiatives to address pedestrian safety in and about schools. While many schools in New South Wales are located on a single site away from major roads and highways and have a range of playing field and other sports-related resources, there is a sizeable proportion of primary schools which have one or more of these characteristics. If the demands of schooling require travel to and from school along a major road, or if during school children as required to cross roads to access classrooms and other educational and sporting facilities, then pedestrian safety in and about schools is a major issue in road safety.

Safer routes to school

6.3 STAYSAFE was interested in work that had been done in designing and implementing road and traffic engineering programs to enhance the safety of children as pedestrians travelling to and from school. This concept has a long history. For example, in 1966, Traffic Commission Victoria published a document titled "An Action Programme to Increase the Safety of Children Going to and from School". This report outlined a program to remove or reduce a number of factors present in school child accidents, and proposed the development of safe routes to school.

6.4 In 1990, VicRoads completed an investigation into the causes of pedestrian accidents with a view to reducing their incidence and severity. Pedestrian Accident Report No. 6 recommended:

> "To safeguard children in traffic, a combination of behavioural and engineering programs would be most effective. Given that physical separation is the only guarantee of safety, the environment needs to be adapted to the child where possible. The effectiveness of these physical treatments will be increased by consistent and systematic education of children and those responsible for them." (cited by VicRoads, 1994, p. 9)

6.5 VicRoads approached the municipalities of Brunswick, Coburg, Dandenong and Springvale to participate in the development of Safe Routes To School pilot programs during 1990-1992. The aim and objectives of this project are shown below:

Safe Routes to Schools: Aim and Objectives

The aim of SRTS is to reduce the incidence and severity of injuries to primary school-age children as pedestrians, bicyclists and passengers.

The objectives of the program are to:

- involve municipalities and primary school communities in identifying child road safety problems
- involve municipalities and primary school communities in developing and providing behavioural, educational and engineering road safety interventions for the local community
- identify and improve the major routes where children walk or ride
- school staff to develop and implement a comprehensive and on-going traffic safety education program which includes issues confronting children travelling in their local area (eg when walking to the local park)
- encourage children and parents walking or cycling in their local area to use safe routes and recommended crossing points
- provide educational awareness and "hand-on" activities for parents and carers to assist the development of children's traffic safety skills as pedestrians, cyclists and passengers
- where appropriate encourage more children and parents to walk or cycle to school using the safe routes
- raise awareness of child road safety issues in the local community

6.6 VicRoads also examined child characteristics which put them at risk, finding that children are not little adults, but we often expect them to act as adults do. VicRoads found that the characteristics displayed by children when crossing roads were similar to those outlined in earlier chapters of this report.

6.7 VicRoads concluded that children less than 9 years of age are considered to be too young to be unsupervised near traffic. Interestingly, observations made during the Safe Routes to

School pilot programs mentioned above indicated that, although young children were accompanied by adults or older siblings, they were not supervised by them. VicRoads also found that adults were poor role models in their crossing behaviour, a factor which does not encourage safe crossings procedures by children (VicRoads, 1994).

6.8 VicRoads released a report, entitled *Working Together to Achieve Safety and Amenity in Local Streets* in 1992 which found that drivers can fail to anticipate the presence of children because many tend to focus on the road:

> "....the drivers stated that often when they are turning off the main road into the residential street network, it is not easy for them to recognise that they have entered a local street and therefore, they may not adjust their driving by slowing down.
>
> Many stated that when they are diving in areas with which they are unfamiliar, they drive slowly and take more care. In areas with which they are quite familiar, they travel at a higher speed. Complacency and "taking things for granted" when in familiar surroundings were mentioned, in contrast to being in an unfamiliar street, where drivers said that they concentrate more on what is going on around them (VicRoads, 1994, p.11)

6.9 In 1996, STAYSAFE visited Albury, where it had the opportunity to discuss the Safe Routes to School program that was being implemented by the Albury City Council, Albury school communities and the Albury Road Safety Group. The first twelve months of the project involved community consultation within the target area to identify and investigate traffic safety issues confronting children in the local area. This was followed by the development of an Engineering and Education Action Plan for each of the participating schools for Council and school endorsement. The ultimate aim was to establish a strategy for the installation of local engineering improvements and focussed traffic safety education programs, both in schools and with parents/carers.

6.10 STAYSAFE also examined the Designated Safe Routes to School program conducted by the City of Melville in Western Australia. This program was the winner of the National Innovation Award 1993 for Urban Planning, Development and Infrastructure, and established a network of designated safe routes to all schools in the area. Children were shown the safest route to school by following painted footprints on paths. Pedestrian crossings were provided with raised platforms, hand rails and footpath stop signs to help educate children about road safety. The result, the City of Melville believes, is a greater understanding of road safety among children and the reduction of traffic accidents near schools.

6.11 STAYSAFE 26 (1994) noted that a "Safe Ways to School" program was being developed by the Sydney Region of the Roads and Traffic Authority. The development of such a program was supported by Ms Bruton, a Department of School Education witness. She commented:

> **MS BRUTON:** "Most of our work in road safety education at the moment focuses heavily on curriculum and training teachers in effective teaching and

> learning activities. The concept of safety at schools or on designated routes is one in which the Bureau of Road Safety or the Roads and Traffic Authority are interested in exploring with the department. We have not commenced on that project but there have been significant studies similar to that in Victoria and I think there is a similar concept in Canada. They have our support in exploring that concept and ensuring that we provide avenues for students to exercise safe pedestrian behaviour within a safer traffic environment." (Minutes of Evidence, 21 February 1994, p.17)

6.12 When asked to explain the development of the New South Wales safe routes to school program, Roads and Traffic Authority witnesses replied:

> **Mr MEHTA**: "As far as safe routes to school is concerned, at the moment we have a pilot program to investigate and test the guidelines which were produced by Vic Roads in Victoria. At the moment we have three local government areas which are working on preparing feasibility studies for safety in schools. Another seven local government areas are working on similar schemes, two of which will start work in the next financial year. The intention here is to use the work which was done by Victoria—instead of producing our own—to test it, to see how it works in our local conditions, to gain some experience and to then produce our own guidelines. Local government will be able to use it and develop safer routes to schools. The next step is to implement them. That is where the funding allocation has to be looked at very closely." (Minutes of Evidence, 19 June 1996, p.49)

6.13 STAYSAFE has noted that the Roads and Traffic Authority is now, in the late 1990s, heavily involved in the implementation of a Safer Routes to School Program across New South Wales. Draft Safer Routes to School guidelines were completed in April 1996 and reviewed by the users (Roads and Traffic Authority, road safety officers, local councils, police, Parents and Citizens Associations, Department of School Education, Catholic Education Commission representatives, Association of Independent Schools representatives, and the Department of Transport). The feedback from these user groups indicated a need for an overview paper to outline issues and problems relating to safety of children travelling to and from school, strategies in place to address these and an outline of the guidelines. It was also suggested that a brochure was needed. These were completed and a review of the final drafts was made by 20 users in December 1996. The guidelines were targeted for completion in early 1997. In September 1997, the Minister for Roads, the Hon. Carl Scully MP, answered a Question Without Notice in the Legislative Assembly about the Safer Routes to School program:

> **Mr STEWART MP:** "My question without notice is directed to the Minister for Roads. What is the Government doing to protect children travelling to and from schools in New South Wales?"

Hon. Carl SCULLY, Minister for Roads: "As a community we have a special road safety responsibility towards children. This is particularly the case for younger children who simply cannot be taught to act like adults in traffic and who can be particularly vulnerable. Much work has been done over recent years to improve road safety for young children. Accident, injury and death rates have all fallen significantly. In 1986, 48 pedestrians aged under 16 were killed; by last year the figure had fallen to 18. But one death is still one too many. The State Government is committed to achieving further safety improvements for young children on our roads. Travel to and from school is one area we are targeting for stronger action....

Each day 600,000 children travel to and from primary schools in New South Wales; the overwhelming majority do so safely. However, the Government wants to make school travel even safer. I am pleased to announce that this week all the 2,560 primary schools in New South Wales are receiving kits inviting them to join the Government's new safer routes to school program....

The safer routes to school program is a unique community-based initiative, drawing together a wide range of groups in a co-operative effort to identify safer ways for primary school children to travel between home and school. It involves the Roads and Traffic Authority, the Department of School Education, police, the Local Government and Shires Associations of New South Wales, the Federation of School Community Organisations, the Federation of Parents and Citizens Associations of New South Wales, the Catholic Education Commission, the Council of Catholic School Parents, the New South Wales Parents Council and the Institute of Municipal Engineering Australia.

The centrepiece of the program is an investigation, or audit, of the individual travel routes of every child at participating schools. A school route survey, including a questionnaire and a route map, will be mailed to the homes of all children. The questionnaires are being printed in English and in 13 other community languages. Parents or carers will be asked to provide information about the way their children get to and from school. Each child's route will then be assessed for safety and personalised route safety plans will be prepared. The plans will highlight specific safety features and may identify safer travel routes for students. Traditional road safety measures generally deal with target groups. The unique potential of the safer routes to school program lies in its assessment of the particular safety needs of individual children.

With the support of schools, parents and others, safer routes to school will further reduce the risk of injury to school children. The initiative reinforces this State's leading role in road safety in Australia, and it will be a significant step towards

> increasing community confidence in the security of our children. Safer routes to school is being complemented by the Government's school bus safety trial, which will begin in the Newcastle and Lake Macquarie areas on the first day of the next school term, Monday, 13 October. The trial, which picks up a recommendation of the STAYSAFE Committee, will require traffic behind buses to slow to 40 kilometres an hour when children are getting on or off a bus. Prominent flashing signs saying '40km/hr' and 'School Children' will be fitted to the backs of school buses operating on routes servicing 40 schools....
>
> The Government will conduct a survey to see how the school bus safety trial works, and I will see the results of that. The Minister for Transport and I will visit Newcastle soon to initiate the trial. Few things, if any, are more important than the safety and the security of our children. This issue should unite all members of the community, ...
>
> Human nature being what it is, it is unlikely that we will ever totally eliminate road accidents involving children. But for the Government, parents and the wider community, that should be our aim." (Proceedings of the Legislative Assembly, 25 September 1997, pp.609-610)

STAYSAFE notes that the Safer Routes to School program has not been without its critics, both in terms of basic concept of the program and in terms of the resource demands of the program during its commencement phases. STAYSAFE suggests that the management of the Safer Routes to School program implementation should include an evaluation timetable that will allow for some of the critical challenges to program to be examined in a timely manner.

RECOMMENDATION 12: The Roads and Traffic Authority ensure that the management of the implementation of the Safer Routes to School program should include an evaluation timetable that will allow for some of the critical issues associated with the program to be examined in a timely manner.

6.14 STAYSAFE notes that the review of the documents "Interim Guidelines for the Planning and Design of School Traffic and Pedestrian Facilities" and "Interim Guidelines for the Planning and Design of School Bus Routes and Bus Stops" is planned to be pursued as part of the development of the school facilities component of the Roads and Traffic Authority's Traffic Engineering Manual, and that fundamental to this process was the need to review and update the policies and guidelines for School Zones and the School Crossing Supervisor Scheme, as well as the development of the Safe Routes to Schools program guidelines. As these initiatives are now nearing completion, the Roads and Traffic Authority will be in a position to progress development of the school facilities component of the Traffic Engineering Manual. STAYSAFE will monitor the progress of this development.

RECOMMENDATION 13: The Roads and Traffic Authority ensure that the development of the school facilities component of the Traffic Engineering Manual includes a review of the policies and guidelines for School Zones and the School Crossing Supervisor Scheme, as well as the development of the Safer Routes to Schools program guidelines.

6.15 STAYSAFE 26 (1994, see Recommendation 4) recommended that the Roads and Traffic Authority should establish a School Travel Safety Task Force with a brief to ensure that there is an integration of effort in the areas of road safety education in schools; pedestrian safety issues involving school children (including school bus safety and safe routes to school); other issues affecting school children (e.g., bicycle safety); and bus safety and other public transport issues. The Roads and Traffic Authority replied that issues of school children's pedestrian safety are covered through a range of existing task forces and consultative systems including the Pedestrian and Bicycle Safety Task Force, the Safe Routes to School Steering Committee, the Road Safety Education Implementation Committee and the Bus and Coach Advisory Committee. Further consultation was not deemed to be required (see STAYSAFE 33, 1995).

6.16 STAYSAFE 26 (1994, see Recommendation 24) also recommended that the Roads and Traffic Authority, in consultation with the Department of School Education, the Department of Planning, the Shires and Local Government Association, Institute of Municipal Engineering Australia, and other interested organisations, should ensure that procedures for the conduct of a pedestrian safety audit are developed for use where a new school, or a major rehabilitation of an existing school, is being planned, and such pedestrian audits should include an examination of the provision of bus loading zones, drop off zones for parents, and potential points of pedestrian and vehicle-bus conflicts. The Roads and Traffic Authority and AUSTROADS Road Safety Audit procedures are available for use by the Department of School Education and the Department of Public Works in construction of new schools or major rehabilitation of existing schools. These safety audits [take into account] pedestrian and bus considerations. Training in safety audits procedures for Roads and Traffic Authority staff also has the potential to extend to local council staff.

RECOMMENDATION 14: The Roads and Traffic Authority, in consultation with the Local Government and Shires Associations and the Institute of Municipal Engineering Australia, develop and promote a training program for roads, education and local council staff in the conduct of road safety audits, including pedestrian safety audits.

The School Crossing Supervisors Scheme

6.17 Considerable concern was expressed to STAYSAFE during the course of this inquiry about the provision of funding for the School Crossing Supervisors Scheme. STAYSAFE asked the Roads and Traffic Authority to provide STAYSAFE with an update on this program:

Mr THOMPSON (STAYSAFE): "Have there been many developments in the civilian school crossing monitors program since the Committee received evidence on this program last year? For example, our late colleague John Newman noted the functional authority of these supervisors to ensure that the traffic stops. Has there been any extension of their authority in terms of lodging of information for the prosecution of the drivers of offending vehicles?"

Mr FORD (ROADS AND TRAFFIC AUTHORITY): "The Roads and Traffic Authority assumed administrative funding responsibility for the civilian crossings supervisor scheme in 1991 from the Police Service. Since that time it has produced comprehensive guidelines to assess and plan crossing supervisor schemes. It has introduced a regional administrative training program for crossing supervisors—similar to the programs that we currently use for our traffic controllers. Currently it is proposed to increase the number of crossing supervisors from 272 to 512 in New South Wales. The crossing supervisors will have an integral role in our safe routes to school program." (Minutes of Evidence 19 June 1996, p. 49).

Parking near schools

6.18 Another area of concern expressed in submissions to STAYSAFE was the provision of parking for parents in the vicinity of schools. The Federation of Parents and Citizens Association in New South Wales believes that the problem lies not only with parental behaviour but also with the environment around the school. The publicity officer with the Federation of Parents and Citizens Association commented:

Ms BAKER: "I cannot think of anything more heartbreaking for a parent. What on earth could one do to them after they had sat in a car on the wrong side of the road and called their child across into the path of an oncoming vehicle? There is no punishment one could hand out to such a person that would be worse than what that person had just witnessed. The difficulty is, in many instances, with our laws. There are 'No Standing' zones around schools.

We have a society in which parents are terrified to allow their children to walk home, so they park. They cannot get out of their cars and walk across, because the guy with the book is there. It is not a small fine; we are talking major money when you cop a $70 fine for standing for five minutes. There goes the food bill for the week. We need to look at the whole issue. It is a dangerous practice, but why are parents doing it? Why do they nurture their children to eight, nine or 10 years of age, and all of that cost goes for five minutes inattention when they call them to their death. We need to look at the whole range. We need to ascertain what is happening, what is needed to make school zones safe.

Parking bays for parents are absolutely vital; places for people to pull in, set down and pick up so that kids can get to and from their parents' cars safely. Parents do not want to kill their children; they do not want to see their children killed. That is the reason most of them drive to the school, to pick up their children. They are terrified of the stranger danger. We need to seriously look at those issues rather than at punitive measures, or more punitive measures, with the computerised checklist: here is a parent who has 500 warnings, let us book them. Probably the parent has 500 warnings because the parent wants the child to be safe. We need to look a little more broadly at those issues and find solutions, rather than simply punishment."

6.19 Other witnesses representing the Federation of Parents and Citizens Association agreed with Ms Baker's comments:

> **Ms BARKER:** "I think we have to find a balance. There might be cases where parents do park across the road because they have not thought of the consequences, and hopefully that issue might be addressed in the general public education campaign. It is something that affects all of us. It is very hard for some people to be aware of everything. There is a point about the parking. If there were more parking available or a place where parents could be directed to near the school, and they knew that when they came in one gate it would be safer for the children and less likely that they themselves would be fined, perhaps there could be a compromise." (Minutes of Evidence 20 December 1993, pp. 9–42)

6.20 The NRMA agreed that the actions of some parents around schools is a serious problem that needs to be addressed by education, both for parents and children:

> "Parking associated with setting down and picking up children at schools can increase the risk of children being involved in an accident and lead to increased traffic congestion. NRMA therefore believes that drivers should adhere to parking restrictions in lanes around schools. Continued education, for parents and children, is a vital component in improving the parking chaos that currently exists around some schools.
>
> Notwithstanding this point, NRMA is aware of the pressures of time and inconvenience often placed on parents and guardians picking up and setting down children at schools. To suggest that parents are acting purely out of selfishness, or discourtesy, is over simplistic. Constraints on time, particularly with working parents, can lead to a trade off between safety and convenience. Lack of adequate parking facilities makes it extremely difficult for parents to comply with what they may know to be safe parking practice around schools. (NRMA, Submission PED 130, p. 21)

6.21 STAYSAFE 26 (1994) examined the Roads and Traffic Authority's interim guidelines for the planning and design of school traffic and pedestrian crossings. The interim guidelines were developed to assist in the planning and design of school sites, or in the redevelopment of existing school sites and are organised into three sections:

(i) general requirements: including site selection considerations, and the traffic facilities required for safe school operation

(ii) On-site planning and safety: including staff and visitor parking, student parking, service and emergency vehicle access, and criteria for the design of driveways and roadways within the school site

(iii) On-street planning and safety: including school bus zones, zones for parents to drop off or pick up children, bicycle routes, and certain traffic management and safety devices such as children's crossings, underpasses and overpasses, and kerbside pedestrian barriers.

6.22 STAYSAFE 26 (1994) noted that the guidelines provide that two basic safety principles apply to all school sites. First, that there is a provision of adequate on-site parking and unloading space designed for all modes of transport. Second, the physical routes provided for access to the school by the different modes of transport should be separated as much as possible.

6.23 These interim guidelines for school child pedestrian safety were also included within the Roads and Traffic Authority's Road Environment Safety Guidelines (1992).

6.24 STAYSAFE 26 (1994) concluded after examination of the various guidelines affecting school child pedestrian safety that the relevant road engineering guidelines are in need of revision to reflect new forms of pedestrian behaviour, new signs and markings, and to revise and extend the existing recommendations for best practice. The guidelines should also be modified to include existing developments such as the 40km/h speed zones outside schools. STAYSAFE will continue to monitor the implementation of its recommendations made on this issue.

40 km/h school speed zones

6.25 On the matter of the review of the 40 km/h school speed zoning, the Roads and Traffic Authority indicated that a review of the policies and guidelines for School Zones was undertaken during 1996 culminating in the release of a revised school zones document in November 1996. The revised policies and guidelines allow for wider application of school zones throughout New South Wales, consistency of site selection and times of operation, improved signposting and the provision of supplementary pavement markings at the entry to the zone.

6.26 Importantly, traffic regulations under the Traffic Act 1909 have also been amended to prescribe a school zone sign as a speed limit sign. A further amendment will allow a school zone sign to apply to a network of two (2) or more public streets.

6.27 The operation times of the school zone reduced speed limit is restricted to the morning (8:00 am to 9:30 am) and afternoon (2:30pm to 4:00pm) periods to coincide with those times when there is activity along the school frontage and students will be on or near the road.

6.28 The Roads and Traffic Authority advised that the introduction of school zone reduced speed limits outside these morning and afternoon peak periods, where the reason to reduce speed would not be obvious to motorists due to the lack of associated school pedestrian and vehicular activity, would have little credibility with motorists and is unlikely to result in an operational reduction in travel speeds throughout the school day. It was thought that such an approach could compromise the overall intent and effectiveness of the school zone scheme.

6.29 STAYSAFE was concerned that the moves toward increased flexibility in school hours and school attendance might see school children entering and leaving school grounds at times outside the standard hours featured on the signs. Moreover, in some schools with split sites, there is a need for children to move across roads from site to site during the day. The Roads and Traffic Authority did not address the general issue of changes in hours and attendance patterns, but indicated that in unusual circumstances, such at split site schools with buildings on both sides of the road, alternative measures such as enhanced pedestrian crossing facilities are recommended to maintain an acceptable level of crossing safety throughout the school day.

6.30 The revised policies and guidelines for school zones generally only precludes the provision of school zones on six (6) lane roads and four (4) lane roads with peak period 'Clearway', 'No Stopping' and 'No Standing' restrictions. Such restrictions are provided on arterial roads due to the traffic capacity needs of the route. Under circumstances where the provision of a school zone would generally be precluded, the Roads and Traffic Authority recommends that every effort be made to relocate pedestrian access and activity to another frontage if one exists. If this is not possible, enhancement of traffic and pedestrian management should be considered including off-road shared pedestrian and bicycle facilities. A localised reduction in the prevailing speed limit on multi-lane arterial roads in the vicinity of schools, as suggested, would have little credibility with motorists and is unlikely to result in an operational reduction in travel speeds due to the lack of correlation between the recognised traffic function of the route and the speed limit.

6.31 STAYSAFE concurs with this argument, but nonetheless urges the Roads and Traffic Authority to continue to examine how the issue of excessive speeding in school zones might be better addressed, in particular via more vigorous awareness campaigns.

RECOMMENDATION 15: The Roads and Traffic Authority to continue to examine how the issue of speeding in school zones might be better addressed, including:

(i) speeds during school hours but outside the standard school children travel hours;

(ii) increased public education and awareness campaigns of the 40 km/h speed limits.

Visibility of child pedestrians

6.32 A common excuse given by motorists involved in a pedestrian crash is that they did not see the child in time to avoid a collision. Roads and traffic Authority witnesses commented:

> **Ms BLACK:** "I think that often happens when the pedestrian runs out onto the road. One category of accidents that characterises child pedestrian accidents as compared to adult pedestrian accidents relates to children emerging between vehicles, either stationary or in traffic. Something like 25 per cent of accidents involving children under nine years are of that type. Because of their small size they are obscured by the vehicle. That would be one situation in which the driver often would not see the child...." (Minutes of Evidence 19 June 1996, p.44)

and later:

> **Mr MEHTA:** "I would like to add a couple of things to what Ms Black has said. One of the studies that has been done has indicated that the cone of vision for a driver is much narrower at higher speeds, but when the speeds are lower the cone of vision for the driver is bigger. Bicycles, pedestrians and other vehicles are much more likely to be seen by a driver who is driving slowly than one who is going fast, because of the difference in the cone of vision." (Minutes of Evidence 19 June 1996, p.46)

6.33 3M Australia Pty Ltd told STAYSAFE that most people have not really addressed the problem of a motorist not being able to see pedestrians, particularly at night where the background ambience is quite dark and people traditionally wear dark clothing.

6.34 Whilst this is not necessarily the case for child pedestrians, it highlights the need for children to make themselves more visible by wearing bright clothes, particularly when the light is poor or in wet weather. STAYSAFE examined the use of retro flective technologies that can be incorporated into garments worn by school children, as well as accessories such as school bags (eg Australia Pty Ltd, Submission PED 173; Elves (Safety) Sales, Submission PED 261). STAYSAFE was impressed with developments in this area, and viewed a number of product samples, including rain coats, school bags and hats that incorporated retro reflective patches or retro reflective thread. It was indicated that the cost of these garments and accessories would be competitive with similar apparel that does not include retro reflective materials.

6.35 STAYSAFE believes that the use of retro reflective materials in school apparel has the potential of increasing the visibility of school child pedestrians during their travel to or from school. The development of garments and accessories for the use of school children that incorporate retro reflective materials should be strongly encouraged. STAYSAFE 26 (1994, Recommendation 26) recommended that:

"RECOMMENDATION 26: The Roads and Traffic Authority, in conjunction with the Department of School Education and the school sectors, investigate the feasibility of requiring schools to incorporate reflective thread or other materials into the design of the clothing and accessories of school children."

6.36 STAYSAFE was therefore surprised by the Roads and Traffic Authority's response, namely:

"... that the [Bus Safety Advisory] Committee has advised that this is impractical. Reflective material is of limited benefit in daylight. However the Department of School Education will encourage schools to consider the benefits of light, bright colours for school uniforms and accessories." (see STAYSAFE 33, 1996)

6.37 STAYSAFE believes that much more must be done to make children more visible to motorists and the use of brighter school clothing and reflective materials on bags warrant further attention.

RECOMMENDATION 16: The Roads and Traffic Authority, in conjunction with the Department of School Education and the school sectors, review the previous response to the feasibility of requiring schools to incorporate reflective thread or other materials into the design of the clothing and accessories of school children.

7

THE IMPACT OF VEHICLE SPEED AND VEHICLE ENGINEERING ON CHILD PEDESTRIAN SAFETY

7.1 In this chapter, the effect of vehicle factors on child pedestrian trauma are briefing discussed, including the role of vehicle speed in the likelihood and severity of a child pedestrian being run down by a driver.

Child pedestrians and speed

7.2 STAYSAFE has noted the remark of Stapleton (1987):

> "The basic needs of a child pedestrian environment are slower traffic speed and visibility giving time to avert potential collisions between children and vehicles" (p.3)

The speed at which a motorist travels through an area where children are likely to be present on the road has an important bearing both on the motorists ability to avoid a crash, and where a crash occurs, on the extent of trauma.

7.3 The fundamental issue for STAYSAFE is the simple physics involved in bringing a motor vehicle to a stop when a child suddenly dart's out onto the roadway. The facts are simple, a car travelling at 60 km/h will need around 30 metres to come to a complete halt. A car travelling at 70 km/h will need almost 40 metres. A car travelling at 80 km/h needs almost 50 metres. In contrast, a car travelling at 50 km/h needs less than 25 metres to stop. A child who suddenly steps in front of a car travelling at 60 km/h and 25 metres away is likely to be struck at a speed of about 44 km/h; if the same car was travelling at 50 km/h, the driver should have just enough time to stop the vehicle and avoid the child altogether, partly due to the shorter distance travelled in the time required for the driver to react and commence braking, and partly due to a reduced braking distance. In situations when a driver is faced with an emergency stop, even a difference of 10 km/h in initial speed can mean either crash involvement or the avoidance of impact with a child pedestrian.

7.4 STAYSAFE recently examined a proposal to introduce a 50 km/h urban speed limit in New South Wales and recommended this 50 km/h be adopted as the general urban speed limit, applicable to all roads in urban areas that are not otherwise signposted with a different speed limit

(STAYSAFE 34, 1996).

Vehicle engineering

7.5 STAYSAFE was curious as to the impact of vehicle engineering on the survivability of children involved in a pedestrian crash. STAYSAFE questioned Roads and Traffic Authority witnesses on this point:

> **Mr SMITH (STAYSAFE):** "You have written that generally if a pedestrian is struck by a motor vehicle travelling at less than 55 kilometres per hour, he or she is likely to survive. If the road speed of a vehicle is 55 kilometres per hour, what is the likely impact speed for a typical pedestrian crash? Is this relationship also relevant to child pedestrians, and should the travel speeds be lower still, as has been found for elderly pedestrians?"
>
> **Mr RIGBY:** "There are a number of issues to run through. The reference speed you talk about there came from a paper I presented at the pedestrian safety conference last November. The reference to that speed differential came from a paper by S. J. Ashton, a 1982 paper entitled 'Vehicle Design and Pedestrian Accidents', which was published in a book titled *Pedestrian Accidents*, editors A. J. Chapman, S. M. Wade and H. C. Foote, John Wilding 1982. That particular paper, of which I have an extract here, which is about the impact of vehicle design on pedestrian injury, refers back to previous papers and works of Ashton and his various colleagues. ...The essential thing to remember is that every pedestrian accident has actually three impacts. The first is when the vehicle impacts part of the pedestrian. Typically, for an adult, for example, it is below the knee. The pedestrian then slips over and his head often hits part of the front of the vehicle—typically, the bonnet or the windscreen—at a certain speed. Then he usually gets carried forward to the speed of the vehicle, which is usually decelerating, and he gets thrown off. The third impact is when his head or part of his body hits the ground, so there are three parameters where injury can occur. One is the initial force of the impact—typically broken shins or knee cartilage damage. Head or chest damage is associated with the secondary impact, particularly if the person hits the pillar of the car. Sometimes, if the car is fast enough, he will rotate totally and land behind the car. That is the tertiary impact. The third impact can be the most severe.
>
> Looking at the situation with children, children are typically impacted at a higher level of their body than adults; the first impact can occur between the thigh and the hips. If it is a very small child, below about five, it can occur in the shoulder and the head. A tremendous amount of damage can occur from that primary impact,

and even very low speeds can cause critical injury in that situation. The very small child tends to get run over—the car goes over the top—whereas a bigger child or adult can go over the car so that they are run under, rather than over. There is a critical distinction there. If the child gets caught under the car and is dragged along—and I have been to a few of those—the impacts are often fatal, so a very low speed can be very severe.

There is another dimension to that as well, and that is the type of vehicle. It is interesting to note that the newer generation of cars—when I say newer, I mean the last 20 years—has a much more aerodynamic pedestrian friendly design, and have tended to slip underneath pedestrians. Older vehicles had higher moments of acceleration and their height tended to cause more injuries...The vehicle design and the way it hits the pedestrian is quite significant as well." (Minutes of Evidence, 19 June 1996, p.)

7.6 The NRMA noted in its submission that a major factor in road safety is how well drivers can see other road users, including pedestrians. Significant factors include the location of windows and pillars relative to the driver and the degree of tinting on windows and the windscreen (NRMA, Submission PED 130, p.36)

7.7 When asked what research it had undertaken into the impact of vehicle engineering on child pedestrian crashes, the Roads and Traffic Authority replied:

The Hon. J. S. TINGLE (STAYSAFE): "... on page 44 of your submission to the Standing Committee on Road Safety you have a graph showing the impact of vehicles travelling at given speeds on pedestrians who are hit. What research has the Roads and Traffic Authority undertaken on the nature and extent of child pedestrian injury as influenced by vehicle design or after market fittings such as bullbars rather than just speed? Have you undertaken any research in that area?"

Mr TAYLOR: "A number of initiatives are currently in train and I would like to give you some information about them. We are nearing completion of a child pedestrian study involving child pedestrians in accidents. The study will also record the presence or absence of a bullbar as part of one of the criteria of one of the study. So from that study we should get an identification of whether there are links with bullbars as a factor in pedestrian injury from the frontal aggression of a motor vehicle. In addition, we have just commenced a 12 to 18 month long study of about 3,000 vehicles in crashes, a crashworthiness study. Vehicles will be inspected from a whole range of crashes to determine the degree or otherwise of vehicle defects as a factor in the crash among other things. In that study we would expect that we would get over 400 pedestrian crashes on average and a proportion will be of children and a proportion will be on the front of the vehicle."

(Minutes of Evidence, 19 June 1995, p.73)

STAYSAFE notes that the study of vehicle crashworthiness by examining real crashes is still continuing (see STAYSAFE 47, 1998).

7.8 STAYSAFE believes that it would be appropriate for the Roads and Traffic Authority to conduct a specific research review into the impact of vehicle engineering on child pedestrian crashes, particularly with regard to the size of vehicle and the use of bull bars. STAYSAFE also notes the pedestrian trauma and bull bar issues discussed in the seminar on 'Developing Safer Motor Vehicles for Australia' held at Parliament House, Sydney in April 1998 (see STAYSAFE 44, 1998)

RECOMMENDATION 17: The Roads and Traffic Authority to conduct a specific research review into the impact of vehicle engineering on child pedestrian crashes, particularly with regard to the size of vehicle and the use of bull bars.

8

DISCUSSION

8.1 Two major strands have emerged from the investigations undertaken for this report. The first is that the safety message about pedestrian trauma and its avoidance must be constantly reiterated to children and adults to remain effective. The second is that the statistical analysis of child pedestrian injuries and fatalities remains uncoordinated across the relevant agencies.

Education and public awareness

8.2 The Roads and Traffic Authority's road safety education program is a long term road safety education strategy identified within the Road Safety 2000 strategic plan. Much of the program's success is attributable to its inter-sectoral nature.

8.3 The road safety education program has preschool and primary elements: the early childhood road safety education program and the 'Street Sense' primary school program. The issue of child pedestrian safety is extensively addressed at these program levels. The early childhood road safety education program and the 'Street Sense' primary school program also recognise the importance of families (parents/carers) as principal educators and role models for children under 12 years.

8.4 The Roads and Traffic Authority's child pedestrian safety resources included a number of key messages for families, emphasising that children under 8 years of age are dependent road users. Children under 8 years of age should be accompanied in traffic environments and should have their hand held by an adult in traffic environments. Children under 10 years of age should be accompanied in traffic environments. Adults should always drop off or pick up their primary school aged children on the same side of the road as the school or bus stop. Parents should teach their children to wait for them to arrive if they are not at the school gate or bus stop when the child arrives. Children should enter or exit a motor vehicle through the rear kerbside 'safety' door. Families should use marked pedestrian crossings wherever possible, and parents should model and discuss safe pedestrian behaviour.

8.5 At the same time, the Roads and Traffic Authority has developed key messages for children, including the 'safe crossing procedure'. This is a procedure, which the Roads and Traffic Authority recommends should not to be taught verbatim to students as a 'golden rule'. Teachers present the procedure for the safe crossing of a road, using language appropriate to the students to ensure that students comprehend concepts such as 'edge/kerb', 'clear vision', and 'safe place'. The local environment of the school, such as outer suburban, rural/semi rural, or remote, requires the message to be adapted by teachers to ensure it is meaningful to all students.

8.6 The Roads and Traffic Authority suggests some additional key pedestrian safety messages for children which can be developed by the school or within the family, including: Hold an adult's hand in traffic. Never run onto the road. Crossing from between parked vehicles is dangerous. Always choose a safe place to cross (clear vision).

8.7 STAYSAFE strongly endorses these approaches, and recommends that the Roads and Traffic Authority continue campaigns to make parents and children aware of child pedestrian safety issues by a process of "revision and reiteration" through all means available, including education campaigns in schools and via the media.

Improvements to data collection and analysis

8.8 A recurring theme in STAYSAFE reports has been the failure of agencies involved in road safety to cross reference data. The following exchange took place between STAYSAFE and representatives from the Motor Accidents Authority and Westmead Hospital:

> **The Hon. J. H. JOBLING (STAYSAFE):** "My question relates to a question I asked ... in a similar inquiry in 1988. Do you cross reference your data in relation to child deaths with the coronial inquiry, police and hospitals? If you do, who holds this total database? If you do not, can you offer me a reason why it has not been undertaken?"
>
> **Ms HAYES:** "We do not cross reference that data and I do not think that I can offer you a reason why it has not been done. I do not know that it has been looked at. If it is something that is an issue, the Authority would be pleased to have a look at it. Our database only contains information on all the claims lodged under the motor accident scheme, so it does not cover all children that are injured in an accident. It is only where fault can be claimed that a claim is actually lodged, so naturally we do not cover all those systems. The information that is contained in that is the details of the accident, the vehicles and the people involved; it does not include cause of accident. There perhaps needs to be linking between the Roads and Traffic Authority databases and our databases. There have been some discussions about that, but I do not know the outcome."
>
> **The Hon. J. H. JOBLING (STAYSAFE):** Ms Maxwell, do you have anything to add, from the children's hospital point of view?

Ms MAXWELL: "The only thing I am aware of is that there has been some link with Westmead Hospital—some researchers there—and the Coroner's Court in terms of providing information and access to that information, following the deaths of children related to injury. That was established some time ago, possibly about 1989. It related particularly to drowning and expanded from there. However, I could not offer any more comment than that, except to say that I am aware that in Victoria they have greater links with the Coroner's Court and injury prevention workers and researchers. I believe they produce some very fruitful and important results from that."

The Hon. J. S. TINGLE (STAYSAFE): "I would like to clarify that. Do I take it that the databases on insurance claims that the Motor Accidents Authority holds do not necessarily have compilations of statistical data that would allow this Committee to really get a better view of the incidence of child pedestrian injury, even the economic cost to the community associated with accidents involving children and motor vehicles? Is there nothing we can put our fingers on, as it were, which would tell us that?"

8.9 STAYSAFE notes the recent decision by the Motor Accidents Authority, the Roads and traffic Authority and the Department of Health to establish a Centre for Risk Management Research at the University of New South Wales

8.10 Drummond and Ozanne-Smith (1991) noted that:

"The generally accepted source of injury data for pedestrian and bicyclist traffic related injury data is police accident reports. While these may considerably mis-report the presence and severity of injury, particularly for less severe injuries (Agron & Dunkle, 1985; Statts et al, 1990) they are the source which best identified the geographic location of the injury event by road type, and even whether the injury occurred within the road system (some bicyclist injuries identified in hospital data may occur off-road).

On the other hand, health system data better describes the presence, nature and severity of injuries. For these and other reasons, investigations into improved reporting systems and linkages of police, insurance and health care data are under investigation in Australia and elsewhere (p.12).

8.11 Dr Henderson expressed a similar view:

Dr HENDERSON: "Yes, I think that is making a lot of this particular piece of work but what I thought was fascinating about the work, which has been supported by later work by the same group and others, is that it is gives us a new understanding of the interaction between the driver, the car, the environment and the pedestrian, because it shows the fallacy of using usually police reported statistics which are historically only ever put in originally to support the legal system and to attribute blame; not to find out facts. Now we are finding out facts, we find out that the drivers make the assumption that the children are going to do the right thing. Fortunately, and I think in a very impressive manner, they do, which shows that a lot of the early childhood training must be having a good effect, and perhaps the supervision as well. I think what it does is help us to understand better ways for education rather than for changing the legal system." (Minutes of Evidence, 17 July 1995, p.12)

8.12 STAYSAFE believes that one of the first projects to be undertaken by the Centre for Injury Risk Management should be to collect and analyse statistical information from police, insurance, health care, and road data sources regarding child pedestrian injury, so as to gain a better understanding of the interaction between the driver, the car, the environment and the pedestrian.

RECOMMENDATION 18: The Department of Health, the Roads and Traffic authority and the Motor Accidents Authority ensure that one of the first projects to be undertaken by the Centre for Injury Risk Management should be to collect and analyse statistical information from police, insurance, health care, and road data sources regarding child pedestrian injury, so as to gain a better understanding of the interaction between the driver, the car, the environment and the pedestrian.

8.13 STAYSAFE has concluded from this part of the pedestrian safety inquiry that there is no "solution" to the problem of child pedestrian injury and death. Ample evidence exists about how, when, where and to a degree why, such accidents occur, although as this report has stated, the Committee is critical of the lack of coordination in this area by the agencies involved. Methods for disseminating the road safety message are also well developed, if at times applied in a disorganised and underfunded manner.

8.14 The tools exist for tackling this serious problem, and the clear message from this report is that these tools need constant refinement and exercise. There are a number of established precedents in the road safety area which indicate that the driving and pedestrian public will respond to a clear, strong and coordinated message about road safety and children. The message needs constant refinement and reiteration, school education needs committed support, and the road safety agencies need encouragement to coordinate their efforts in the role of protecting our young road users.

APPENDIX A: STATISTICAL SUMMARY OF PEDESTRIAN CRASHES IN AUSTRALIA

Table A1 : Fatalities by road user category, gender and age, Australia, 1995

	0-4 years	5-16 years	17-25 years	26-39 years	40-54 years	55-69 years	70+ years	All fatalities (a)
Drivers								
Males	0	5	216	175	100	88	57	641
Females	0	3	66	63	49	25	27	233
Persons	0	8	282	238	149	113	84	874
Passengers								
Males	11	34	104	58	22	14	16	259
Females	14	36	54	24	40	25	39	232
Persons	25	70	158	82	62	39	55	491
Pedestrians								
Males	11	25	51	57	33	31	66	276
Females	3	15	7	16	16	20	43	122
Persons	14	40	58	73	49	51	109	398
Motor-cyclists (b)								
Males	0	7	85	74	22	6	1	195
Females	0	1	4	3	1	0	0	9
Persons	0	8	89	77	23	6	1	204
Bicyclists (c)								
Males	0	11	7	10	2	6	5	41
Females	0	1	2	4	0	0	0	7
Persons	0	12	9	14	2	6	5	48
All road users (c)								
Males	22	82	463	375	179	145	145	1,413
Females	17	56	133	111	106	70	109	604
Persons	39	138	596	486	285	215	254	2,107

(a) includes fatalities of unstated age; (b) includes pillion passengers; (c) includes fatalities of unstated road user group

Source: Federal Office of Road Safety, 1996 (a), Table 3

Table A2: Pedestrian fatalities by State/Territory, 1980 to 1995

	NSW	Vic	Qld	SA	WA	Tas	NT	ACT	Australia
1980	252	167	87	43	56	24	9	6	644
1981	267	177	66	42	43	20	11	3	629
1982	256	148	71	47	40	17	10	2	591
1983	212	148	61	37	36	6	7	5	512
1984	211	139	66	42	47	17	10	9	541
1985	223	134	72	38	47	11	10	3	538
1986	191	139	65	50	48	21	15	1	537
1987	178	136	73	37	38	11	14	6	493
1988	205	154	78	43	33	15	14	6	548
1989	173	159	68	47	33	10	6	5	501
1990	177	93	65	32	31	12	8	2	420
1991	119	94	66	24	16	12	11	1	343
1992	121	89	74	31	19	4	9	3	350
1993	117	73	49	33	38	7	10	4	331
1994	129	64	79	31	38	11	17	2	371
1995	130	82	92	39	29	8	15	3	398

Source : Federal Office of Road Safety, 1996 (a), Table 36

Table A3 Number of pedestrians hospitalised by age, states and territories, 1994

Age group	NSW	Vic	Qld	SA	WA	Tas	NT	ACT	Australia	%(a)
0-14 years	220	171	109	22	52	18	6	5	**603**	23%
15-29 years	288	221	153	33	78	16	15	5	**809**	30%
30-44 years	161	103	57	24	33	9	12	8	**407**	15%
45-49 years	124	91	36	7	12	6	4	3	**283**	11%
60+ years	265	149	61	27	36	11	2	1	**552**	21%
All ages (b)	1,086	775	417	147	221	63	45	23	**2,777**	100%

(a) Percentage excludes persons of unknown age
(b) Includes persons of unknown age

Source: Federal Office of Road Safety, 1996 (a), Table 13

Table A4 Number of pedestrians hospitalised by age, 1989-1994

Year	0-14	15-29	30-44	45-49	60+	All ages (a)
1989	860	983	458	325	641	**3,478**
1990	839	915	440	319	602	**3,283**
1991	697	780	386	287	597	**2,850**
1992	701	742	389	297	581	**2,826**
1993	610	726	383	290	564	**2,681**
1994	603	809	407	283	552	**2,777**
% change 93-94	-1%	11%	6%	-2%	-2%	**4%**

Source: Federal Office of Road Safety, 1996 (b), Table 3

APPENDIX B: RESEARCH RELEVANT TO CHILD PEDESTRIAN SAFETY

Submission to the inquiry into child pedestrian safety, 19 June 1995 by Associate Professor John E. Taplin, School of Psychology, University of New South Wales

Summary of major findings on child pedestrian safety

B.1 A disproportionate number of road accidents involving pedestrians concern children aged 3 to 12 years, particularly boys and children from lower socioeconomic suburbs (Jonah & Engel, 1983; Malek, Guyer & Lescohier, 1990). While children show limited ability with respect to several types of pedestrian skills (Vinje, 1981), the most frequent type of accident involving children is the midblock dart-out (Malek, et al., 1990).

B.2 Car drivers do not typically alter the speed of their vehicle in the presence of child pedestrians and attempts to draw their attention to the risks involved are likely to be ineffectual (Howarth, 1988; Lourens, et al., 1991; Thompson, et al., 1985). It is suggested that in high risk locations vehicle speed restrictions be imposed and enforced as other methods of education drivers are unlikely to succeed.

B.3 While young child pedestrians are safer when accompanied by a parent or older person, the evidence shows that parents sometimes do not monitor their children's behaviour completely and that adults often themselves do not set very good examples for children to follow. Moreover, children tend not to be involved in decision-making about what they should do on the road when accompanied by an older person and hence do not learn a great deal from such experiences (Van der Molen, 1982). When parents accompany their children to or from school, they should: (a) stop together with the children before crossing; (b) make the children look as well; (c) make children aware of the road crossing task at hand and obtain their active participation even when the child is led by the hand; (d) make sure that children do not lag behind or run ahead, either by holding hands or verbal instruction (depending on the situation and the child's tendency to conform with verbal instruction); and (e) avoid being on the crosswalk together with cars.

B.4 Many studies have shown that children, particularly those under 9 years of age, show poor judgment about where is the safest place to cross a road (Ampofo-Bopateng & Thomson, 1991; Ampofo-Boateng, et al., 1993, Demnetre & Gaffin, 1994; Thomson, et al., 1991). Improvements in this skill have been achieved through both individual and group training programs in both real-world and simulated traffic environments.

B.5 Children's judgments about whether they have sufficient time to cross the road before the arrival of some oncoming vehicle seem to develop at an earlier age and to be responsive also to a variety of training methods (Cross & Pitkethly, 1991; Demetre, et al., 1993; McKelvery, 1984; Young & Lee, 1987).

B.6 Behavioural learning (Limbourg & Gerber, 1984), simulation training (Lee, et al., 1984; Rebnaud & Stolovitch, 1988), and social modelling (Rothengatter, 1984) programs have been shown to produce improvements in road behaviour with either individuals or groups of children (Ampofo-Boateng, et al., 1993; Thomson, et al., 1992). What does not appear to be effective are road safety education programs which are aimed primarily at instilling rules of the road and which rely primarily on verbal methods of communication (Ampofo--Boateng & Thomson, 1989, 1991).

B.7 Media campaigns designed to increase awareness of road safety have had mixed success (Limbourg & Gerber, 1981; Preusser & Blomberg, 1984; Rothengatter, 1984), but are the only method reported to be effective in reducing the number of midblock dart-out accidents (Preusser & Blomberg, 1984). The effectiveness of traffic safety clubs for children also remains unproven (Gregerson & Nolen, 1994; West, et al., 1993).

Some educational objectives and their feasibility (Vinje, 1981)

TASKS	*TEACHING OBJECTIVES AND PERTINENT AGES*	*EVALUATION BASED ON MORE RECENT EVIDENCE*
Recognizing parts of the road	Teaching in traffic situations where the child will go on its own, is required	Achievable even with preschool children
Staying on the side of the road	Teaching objective up to age 4: stay well away from the curb (road) Required up to age 7 : automatic detection of the curb, automatized stopping reflex near the curb	Generally agree. The problem of midblock dart-out behaviour suggests that this is more important than previously realised
Stopping while watching	Necessary at least up to age 7, because children cannot very well divide their attention over two things at the same time	Generally agree
Detection of oncoming traffic	Because of lacking peripheral vision and possibly auditory localisation, head movements are necessary. Younger children should be especially trained to perform an adequate search using a strategy that is very well structured	Agree, but not entirely for the reasons given by Vinje

Judgements about meaning of information perceived	From age 4 or 5 on, speed can be estimated in a sufficient way, but judgement of distance is rather unreliable	Generally agree, recent research suggests that this is not the most serious problem facing children
Decision to cross	Up to age 7, no integration of information about distance and speed seems possible. Hence, the teaching objective should be to cross only when no traffic is coming	Disagree; see several recent studies which dispute this
Route planning	This should be better be undertaken by adults, at least for children up to age 7	May be a problem even for older children than this
Selection of a safe place to cross and of a safe place to stand	Places should be taught exactly for children up to age 6. In case of parked cars, the child must stand at the line of vision	Disagree; several recent studies show that this may be a difficult task for children up to 9 years of age
Crossing at a place with pedestrian lights	By the age of 5, children generally know the colours red and green. The tempo in which they have to perform the crossing procedure once the light is greed may cause problems	Agree
Priority rules	Children under the age of 8-10 give too rigid an interpretation of rules. Priority might then mean something they can count on and should therefore better not be taught	Generally agree

A broad framework for the prevention of accidents involving child pedestrians (adapted from Malek, et al., 1990)

Preventing accidents through education of the child pedestrian

B.8 Road safety education programs for children represent the conventional method employed in the attempt to reduce their involvement in traffic accidents. These programs may begin for children as young as 3 to 4 years of age, and should be available to all children by the time they commence primary school. As indicated elsewhere, these programs should involve parents at least as much as their school teachers, if they are to be maximally effective.

B.9 Educational campaigns directed at children from preschool age up can significantly contribute to their knowledge about safe behaviour on the roads. To be effective, however, this increased understanding of road-safe conduct must be translated into improved behaviour on the footpaths and roads. For this to happen, children need to acquire the skills involved in the identification of where and when it is safe for them to cross a road. This will be best achieved by supervised behavioural training methods. In general, the evidence suggests that children have the cognitive ability to master these skills by about 9 years of age, although some task components may be learned earlier.

B.10 The behaviour of crossing a road can be analysed into a sequence of steps -- (a) a search process in which the individual attends to environmental cues relevant to the safety of a crossing; (b) the detection of oncoming vehicles (including their speed, distance, and direction) plus the width of the road to be crossed, etc; (c) the process of judging or evaluating this information and deciding when to cross; and (d) the act of crossing itself. While children need to learn to perform all of these steps, it is inadequacies on the first step that is suggested to be the most frequent cause of unsafe behaviour by child pedestrians. For example, in one study in which accident victims were interviewed, it was found that 39% of the children did not pause to search at all before crossing and that 60% did not see the vehicle that hit them.

B.11 More than half (actually 55.2%) of the accidents involving child pedestrians have been classified as being of the mid-block dart-out type. This might be attributed to impulsiveness, in which training programs targeted at children should be designed to teach them self-control skills using something like a stop-think-act approach. It might also be attributed to a lack of awareness of risk factors on the road, in which case training programs should be focussed on the recognition of these indications of potential danger, including those that may be difficult to see. Or it might be attributed to the limited ability of young children to attend to many different things at once; this notion, that children may attend only to most salient aspects of a problem and to ignore others which may be no less important, is akin to the Piagetian characteristic of centering associated with the preoperational period of child development (roughly from 2 to 7 years of age). If an attention deficit is the problem for young children, then training programs should seek to automatise appropriate responding through frequent rehearsals of safe routines.

Preventing child pedestrian accidents by educating the driver

B.12 Improving driver behaviour has rarely been the primary emphasis in child accident prevention programs, although drivers could certainly reduce the risk of accidents by slowing down in areas where there are many child pedestrians, so that they have more time to avoid anyone who may unexpectedly dart out into the path of their vehicle.

Reducing the toll of child pedestrian injuries by altering the vehicle

B.13 Cars should allow drivers good visibility of what is happening in the vicinity of the road. Special consideration may be given to the difficulties involved in seeing young children when reversing the vehicle; perhaps cars, like trucks, should produce an intermittent sound signal as well as having reversing lights, when backing. Cars also need to be properly maintained so as to ensure good steering and braking capability.

The role of the political/legal environment

B.14 Traffic regulations need to be enforced, especially in areas where there is a significant risk of child pedestrian accidents.

The role of the social environment

B.15 Accident children tend to come from broken families and from families in which families are living in poor circumstances. Programs which target the needs of these families may also reduce the likelihood of child pedestrian accidents as well. Many road accidents involving children occur during outdoor play: efforts should be made to provide play areas for children which are off-street and away from traffic.

B.16 In some European countries, road safety clubs for children have been tried as a community-based, socially supportive approach to encouraging good behaviour in child pedestrians. The effectiveness of these clubs, however, is uncertain.

B.17 Media campaigns represent another method for raising pubic consciousness in ways to prevent child road accidents. The evidence on their effectiveness suggests that these campaigns need to be carefully planned, and should probably be coordinated with other interventions at a more local school or community level.

The role of the traffic environment

B.18 The installation of pedestrian facilities such as traffic signals, pedestrian islands, good lighting and visibility at crossings, warning signs, speed humps, clear separations between road and footpath, etc.. Monitoring of traffic volumes in areas in which there are many children should assist to identify locations in which the risk of accidents is greatest.

A selected bibliography

Ampofo-Boateng, K., & Thomson, J.A. (1989). Child pedestrian accidents: A case for preventive medicine. Health Education Research, 5, 265-274.

B.19 This paper reviews both the techniques and main content of current road safety education programmes. It also considers experimental and other research that has a bearing on these issues. The main conclusion is that current road safety methods are fairly ineffective in teaching the skills that pedestrians need to deal with in the road environment. Most road safety education is concerned with instilling rules and knowledge at a broadly conceptual level and relies primarily on verbal methods to do so. However, although superficially straightforward, road crossing in fact requires the integration of complex perceptual, cognitive and motor skills that frequently require practical training rather than verbal instruction. The paper reviews the evidence for such a skill-based approach and discusses techniques by which such skills might be developed in young children.

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

B.20 This study investigates the ability of children between 5 and 11 years to select safe places to cross the street. The children were presented with situations which were either extremely safe or manifestly dangerous and were asked to correctly identify these. In other cases, they were asked to choose for themselves routes across the road which they thought would be safe. The tasks were presented in various ways: by means of a table-top simulation on which traffic scenarios had been contrived; by means of photographs of road situations; and by taking the children to real-world sites in the streets near their schools. All the experiments showed a similar pattern of results. Five- and 7-year-olds exhibited very poor skill in identifying dangerous road crossing sites. Their judgments relied exclusively on the visible presence of cars in the vicinity. Other factors such as blind summits, obscuring obstacles or complex junctions were never recognized as threatening situations. They also showed an unwillingness to make detours when planning their own routes, even where the direct route was manifestly dangerous. Nine-year-olds showed a higher level of ability and 11-year-olds showed quite good skill in these judgments. No sex differences were apparent. These results suggest that young children up to about 9 years must often be at considerable risk as they do not have the ability to recognize a location as dangerous, even if they know the mechanics of the Green Cross Code. The implications for road safety education are discussed.

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

B.21 The sites and routes that children of different ages considered to be safe to cross the road were investigated. In Expt 1, children aged 5, 7, 9, and 11 years were instructed to choose 'the safest' crossing sites and routes to specified destinations. The results showed a gradual developmental shift with safer, more adult-like choices appearing with increasing age. Five- and 7-year-olds exhibited only a rudimentary selection procedure, choosing the most direct route as safest and showing a marked lack of awareness of the dangers posed by nearby roadside obstacles or other visual restrictions. In a further experiment, 5-year-olds were individually trained in finding safe places to cross. Training took place either in the real road environment or using a tabletop model of a traffic environment. A series of pre- and post-tests enabled the effectiveness of the training to be assessed. Substantial improvements following training were obtained in both groups. No differences were found between the two training methods. Though performance fell somewhat over the two months following training, trained children still outperformed their untrained peers eight months after the programme ended. The implications for road safety education are discussed.

Cross, R.T., & Pitkethly, A. (1991). Concept modification approach to pedestrian safety: A strategy for modifying young children's existing conceptual framework of speed. Research in Science and Technological Education, 9, 93-106.

B.22 Research suggests that many children have a concept of speed which is counterproductive to sound road crossing decisions. The research described here deals with an attempt at conceptual change through the teaching of a unit on speed to children in the second year of schooling. There is optimism that 6-7-year-old children can apply classroom experiences to real life situations.

Demetre, J.D., & Gaffin, S. (1994). The salience of occluding vehicles to child pedestrians. British Journal of Educational Psychology, 64, 243-251.

B.23 Young children have a disproportionate number of pedestrian accidents whilst trying to cross roads near parked vehicles. Three competing hypotheses as to the basis of this problem were tested under controlled conditions. Children aged 6 (N=32), 8 (N=30), and 10 years (N=36) were presented with a two-choice road crossing task, comprising a crossing point bounded by occluding vehicles and a crossing point providing a clear view of oncoming traffic. At 6 years, choices were random, whereas at 8 years, and especially at 10 years, the clear view crossing choice predominated. There was also a strong association between preference for the clear view crossing point and experience as an independent road user.

Demetre, J.D., Lee, D.N., Grieve, R., Pitcaim, T.K., Ampofo-Boateng, K., & Thomson, J.A. (1993). Young children's learning on road-crossing situations. British Journal of Educational Psychology, 63, 349-359.

B.24 Previous studies have characterised young children as unskilled road-users. Provision of training and practice in basic road-crossing skills may reduce children's risk on the roads, as increasing automatisation of these skills will free attentional resources for more demanding aspects of road-user behaviour. Previous work by Lee and colleagues suggests that training on a road-crossing simulation called the Pretend Road improves various aspects of young children's road-crossing skill. The investigation presented in this paper extends these findings by reporting on the generalisability and durability of these improvements. Five-year-old children were trained on one of two road-crossing simulations and assessed on three occasions after training. The results indicate that substantial transfer occurs between training tasks, but long-term retention appears to be weak.

Garling, T., Svensson-Garling, A., & Valsiner, J (1984). Parental concern about children's traffic safety in residential neighbourhoods. Journal of Environmental Psychology, 4, 235-252.

B.25 105 Swedish parents (aged 18-54 yrs) and non parents (aged 18-38 yrs) responded to a questionnaire consisting of (1) evaluative ratings (i.e., general evaluation, social status, safety concern) of 6 familiar residential neighbourhoods; (2) judgments of the traffic-accident risk children in the age ranges 2-4, 5-6, 7-9, and 10-12 years run in these neighbourhoods; and (3) ratings of the strengths attributed to causes of traffic accidents (i.e., environment, children, parents, drivers, chance). Results show that, across neighbourhoods and age range ranges of children, risk perceptions were related to the rated strengths of the causes. Low-traffic volume neighbourhoods were perceived as less risky and were attributed as less strong causes than high-traffic volume neighbourhoods. Perceived risk increased with the age of the child to a maximum at 7-9 years, then decreased. The same relationship with age was found for the attributed causes of environment and drivers. The strength of parents as cause was rated to decrease, while the strength of child as cause was rated to increase, with age. Chance was rated as the weakest cause, and the rated strength did not vary across neighbourhoods or age. Neither parentship nor gender, singly or in combination, had any clear effects. For both parents and non parents, the general evaluation of the neighbourhoods was influenced by safety concern but not by the particular aspect investigated (i.e., perceived traffic accident risk to children).

Gregersen, N.P., & Nolen, S. (1994). Children's road safety and the strategy of voluntary safety clubs. Accident Analysis and Prevention, 26, 463-470.

B.26 This study focuses on the problem of traffic safety among children and the effectiveness of voluntary traffic clubs. General doubts are growing in regard to this traditional strategy of teaching and training children how to act in specific traffic situations. It has been shown that their knowledge and behaviour improve, but the effect on accident risk is not clear. In this study, one model for traditional teaching of this type, a voluntary traffic safety club for children, is evaluated in terms of accident risk. The data have been collected through questionnaires to members and nonmembers of the club. Approximately 20% of Swedish children are members of the club. The results show that members do not have a lower accident risk than nonmembers. On the contrary, the risk in this nonexperimental study is found to be higher among members. The use of safety equipment is, however, higher among members. The results are discussed in terms of systematic differences between the groups, i.e., socioeconomics, and in terms of the possibility that the general strategy of the club leads to overestimation of the safety effect.

Howarth, C.I. (1988). The relationship between objective risk, subjective risk, and behaviour. Special issue: Risky decision-making in transport operations. Ergonomics, 31, 527-535.

B.27 Discusses evidence that the behaviour of drivers in the presence of child pedestrians is more closely related to low objective risk than to the drivers' high subjective risk. These relationships are believed to be explained in the same way as other discrepancies between tacit knowledge demonstrated in skilled behaviour and conscious verbally elicited knowledge. When behaviour is under practised and automatic, it does not require conscious control. Under these circumstances, conscious verbal knowledge may be a reflection of social stereotypes rather than having any close relationship with the tacit knowledge that is controlling the behaviour. It is argued that the most effective safety measures operate directly on behaviour, rather than directly through manipulating estimates of risk.

Jonah, B.A., & Engel, G.R. (1983). Measuring the relative risk of pedestrian accidents. Accident Analysis and Prevention, 15, 193-206.

B.28 This paper describes research which was conducted to develop a methodology for measuring the relative risk of pedestrian accidents. Accident and exposure data were analysed separately and then in combination to produce relative risks. The accident information (N=472) extracted from police accident report forms revealed that dartout and intersection dash accidents were the most frequent types of accidents with children more involved in the former and adults more involved in the latter. The exposure survey (N=956) of people aged three years and over indicated that adolescents (13-17) had the highest level of pedestrian activity in terms of number of trips, distance, duration and number of street crossings. The elderly (65+) and children (3-12) made more trips during daylight hours, were more often accompanied by others on suburban side streets and crossed streets more often at uncontrolled locations than adults. Examination of relative risk ratios revealed that children (3-12) and the elderly had the highest levels of accident risk but only when distance travelled, duration and number of streets crossed were used as the exposure index. The results demonstrated that exposure data is critical in defining target groups for pedestrian safety programs.

Lee, D.N., Young, D. S., & McLaughlin, C.M. (1984). A roadside simulation of road crossing for children. Ergonomics, 27, 1271-1281.

B.29 A simple and safe method is proposed for giving children practical experience similar to crossing the road and for assessing their performance. The method comprises a 'pretend road' laid out on the pavement, which the child crosses as if crossing the adjacent road in the face of oncoming vehicles. A comparison of adult performances in crossing through gaps in traffic on pretend and real roads indicates that the pretend task adequately simulates real road crossing. Similar experiments on pretend roads with 5-10 year olds crossing through gaps in traffic indicated that children are able to understand the simulation task and perform sensibly on it. Moreover, there were children of all ages who consistently performed at close to an adult level indicating that the visual timing required in the skill is not beyond young children. The results suggest that children should be trained in crossing in the presence of traffic at an early age. The pretend task could prove a valuable aid to training.

Limbourg, M., & Gerber, D. (1981). A parent training program for the road safety education of preschool children. Accident Analysis and Prevention, 13, 255-267.

B.30 A main goal of the research project reported in this paper was the development and the evaluation of a road safety training program for preschool children on the basis of behavioural learning theories and empirical research findings. This training program was tested in four pilot studies with 223 children and finally evaluated with 658 children, age 3-6. With this program, parents of children between the age of 2 and 7 learn how to teach their children safe pedestrian behaviour. The training program is a media package which consists of a film presenting the learning objectives and the training methods and a brochure giving concrete instruction about the training process. Both the film and the brochure describe the exercises which the parents should practice with their children directly in real traffic situations.

Lourens, P.F., Van der Molen, H.H., & Oude-Egberink, H.J. (1991). Drivers and children: A matter of education? Journal of Safety Research, 22, 105-115.

B.31 In a preliminary study, a combination of survey method and an experimental method was used to evaluate the reported and the actual behaviour of car drivers toward children in residential areas. This methodology was used subsequently to evaluate three different local information campaigns aimed at drivers. It was difficult to demonstrate any significant positive effects of campaigns, although there is some indication that information campaigns can work. A suggestion for a more promising approach to this matter concludes this paper.

Malek, M., Guyer, B., & Lescohier, I. (1990). The epidemiology and prevention of child pedestrian injury. Accident Analysis and Prevention, 22, 301-313.

B.32 Of pedestrian injuries that occur every year, approximately 50,000, including 1300 fatalities, are experienced by children between the ages of 1 and 14 years. Despite the importance of the problem, the pedestrian safety issue is often neglected in reports on vehicular injuries. Children between the ages of five and nine years, boys, and children in lower socioeconomic class are at higher risk of pedestrian injury than other children. Childhood pedestrian injuries take place predominantly in residential locations close to home and frequently occur while the child is at play.

The risk of pedestrian injury to children is higher than that of other age groups when adjusted for traffic exposure, and a variety of developmental limitations may account for this fact. In spite of these limitations, children undertake collision avoidance manoeuvres far more often than drivers do. Accident analyses have identified 15 different accident types, each reflecting a unique combination of human and environmental factors. Among children, the most frequently observed accident type is the mid block dart-out. Programs to modify pedestrian behaviour, driver behaviour, and vehicle design have met with modest success. In the United States, the cultural and political environments have not been favourable to the injury prevention effort. Urban designers and traffic engineers in Europe have undertaken a variety of modifications of the physical environment, and some of these have been successful in preventing pedestrian injuries to children.

McKelvey, R.K. (1984). Can children learn to discriminate safe road-crossing intervals? Journal of Safety Research, 15, 57-67.

B.33 An argument is presented for the substitution of a safe-road-crossing-interval judgment for the all-or-none conventional curb drill of child pedestrian training programs. A study in a suburban Melbourne primary school showed that children could understand such a concept as portrayed on motion picture film and that their performance reached adult levels by the fourth grade. While classroom tests failed to show positive transfer after film training with informational feedback, individual tests of a small sample of Grade 6 students in a controlled environment did produce evidence that such a benefit could be obtained. Classroom tests after training without informational feedback, on the other hand, showed a significant performance deficit. Ways to improve the training paradigm are suggested, and evidence is offered of applications to reveal and extinguish unsafe response habits.

Michon, J.A. (1981). Traffic education for young pedestrians: An introduction. Accident Analysis and Prevention, 13, 163-167.

B.34 This paper introduces a collection of six detailed studies dealing with various aspects of the traffic education of young children, between 4 and 8 years of age. Young children run disproportionate risks because their developmental possibilities and skills are limited. Yet they can perform reasonably well in certain types of traffic tasks. Also they can be taught in ways that will improve both their perception and choice of safe situations and their behaviour in such situations.

Preusser, D.F., & Blomberg, R.D. (1984). Reducing child pedestrian accidents through public education. Journal of Safety Research, 15, 47-56.

B.35 The objectives of this study were to develop, produce, and field-test public information and education messages to reduce mid block dart and dash accidents among child pedestrians. An in-class film, poster, and six television spots were produced in which children were told to stop at the curb or outside edge of a parked car and look left-right-left for oncoming vehicles before crossing the street. These materials were distributed to schools, movie theatres, and television stations, citywide, in Los Angeles, Columbus (Ohio), and Milwaukee. Survey results showed that children saw the materials and improved their safe street crossing knowledge. Behavioural observations showed that children crossed more safely. All three cities showed statistically significant pre versus post reductions in child accidents. Across the three cities, mid block darts and dashes by children 14 and younger dropped 21%, and mid block darts and dashes involving 4, 5, and 6 year-olds dropped 31%.

Renaud, L., & Stolovitch, H. (1988). Simulation gaming: An effective strategy for creating appropriate traffic safety behaviours in five-year-old children. Simulation and Games, 19, 328-345.

B.36 Tested the hypothesis that a simulation game that includes role playing/group dynamics and behaviour modelling/training would produce change in attitudes and behaviour as well as a transfer of learning. Using a post test-only control group experimental design, 136 5-year-olds attending classes in Montreal were assigned to one of three simulation games emphasizing traffic safety for pedestrians, or to a control group. Instruments were developed to measure attitudes, behaviour, and transfer of learning. Results suggest that the games did trigger changes in attitudes and behaviour and transfer of learning.

Rothengatter, T. (1984). The role of media in road safety education for young children. British Journal of Developmental Psychology, 2, 157-165.

B.37 This study compares the effectiveness of two videotaped traffic safety messages, both concerning crossing the road in the vicinity of parked cars. In the 'instructional' version the message was presented according to the principles generally used in media presentations for children. The 'modelling' version closely followed social learning principles. Both versions were presented to subjects 5 years of age. The subjects were pre-tested and post-tested on crossing the road and their comprehension of the film content was tested after presentation. The 'modelling' version resulted in a significant increase in the children's capacity to demonstrate the crossing behaviour, whereas the 'instructional' version did not. The comprehension test demonstrated that children exposed to the 'modelling' version also showed a significantly higher level of understanding. The conclusion is drawn that traditional media presentations are not successful in effectuating behavioural change in young children. Presentations which follow 'modelling' principles and are adapted to the developmental characteristics of the audience can improve young children's behaviour capabilities and can as such be an important part of educational programmes such as road safety which aim at causing behavioural change in young children.

Routledge, D.A., Repetto-Wright, R., & Howarth, C.I. (1974). A comparison of interviews and observation to obtain measures of children's exposure to risk as pedestrians. Ergonomics, 17, 623-638.

B.38 144 5-11 year-old children were discreetly followed home from school by female observers who recorded their behaviour at each road crossing on concealed tape recorders. The day after being followed, each subject was interviewed about his or her activities the previous day. Comparison was made between the subjects reported exposure to traffic and findings of previous studies, and between the subjects reports and observations of their journeys. The comparisons indicate that subjects slightly under reported their actual exposure but confirm earlier findings that there is a highly significant increase in exposure with age but no difference in exposure between males and females over the age range studied.

Thompson, S.J., Fraser, E.J., & Howarth, C.I. (1985). Driver behaviour in the presence of child and adult pedestrians. Ergonomics, 28, 1469-1474.

B.39 Vehicle speeds were measured outside junior schools and their distance from the kerb recorded. Mean speed of all observed vehicles was 28.4 mph (45.7 km/h) with 36% travelling faster than the legal maximum of 30 mph (48.3 km/h). The presence of children by the roadside had no effect on either the speed or position in the road of unobstructed passing vehicles. However, a mean speed reduction of 1 mph (1.61 km/h) was observed when large groups of pedestrians (i.e., 10 or more) were present. These observations suggest that vehicle drivers are inadequately prepared for the unpredictable behaviour of child pedestrians. The implications of this lack of care are discussed in relation to road-user education.

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

B.40 Young children show poor judgment when asked to select safe places to cross the road and frequently consider dangerous sites to be safe ones. Thus, a sharp bend, the brow of a hill or positions close to parked cars are considered safe places to cross by most children under 9 years of age. This study examined the effectiveness of two practical training programmes in improving the judgments of 5-year-olds. Children were trained in small groups either in the real road environment or using simulations set up on a table-top model. A series of pre- and post-tests allowed the effectiveness of training to be assessed. Significant improvements relative to controls were found in both groups following training. There were no differences between the two training methods. Improvements were robust and no deterioration was observed two months after the programme ended. However, the benefits of group training were less marked than in an earlier study in which children were trained individually. The implications for road safety education are discussed.

Van der Molen, H.H. (1982). Behaviour of children and accompanying adults at a pedestrian crosswalk. Journal of Safety Research, 13, 113-119.

B.41 Children and accompanying adults were observed while using a pedestrian crosswalk on the way to or from kindergarten or primary school. The results of this study corroborate earlier findings that accompaniment was less than complete, that adults can set much better examples in various respects, and that accompanied children often show no awareness of actively participating in the road crossing task. The solution provided by a two-dimensional scaling analysis of child and adult behavioural data illustrates that adults perform better in some respects than children, but not in all. From the results of this study, five recommendations are made concerning topics which need more emphasis in road safety programs aimed at parents.

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

B.42 The purpose of this paper is to present information on the feasibility of educational objectives in the field of traffic education for young children. In order to do so, it is necessary to answer four questions. These are: (1) Which behaviour is desired? (2) Which functions and abilities are required for a safe performance of the tasks described in question 1 ? On the basis of existing literature a large number of necessary functions and abilities could be distinguished. These were combined into four groups related to: the perception of oncoming traffic; judgments to be made, the decision-making process; and some additional tasks. (3) How do the necessary functions and abilities develop and at what age they can be used adequately? A survey of the traffic safety literature as well as the general child development literature forms the main part of this paper. (4) What implications does this development have for the teaching objectives? The results of the literature survey show that a great lack of relevant research does exist. The relation of most studies with the actual traffic task is often a very weak one, even within the traffic safety literature. Only a few studies have been carried out in actual traffic situations and even in these studies the relation with crossing behaviour has not been studied. Hence, it is not possible at present to give a detailed set of objectives feasible at a certain age. Although some objectives can be defined, much more research is necessary before final conclusions can be reached.

West, R., Sammons, P., & West, A. (1993). Effects of a traffic club on road safety knowledge and self-reported behaviour of young children and their parents. Accident Analysis and Prevention, 25, 609-618.

B.43 Children in seven counties in eastern England and in six counties in a control region were interviewed just prior to the start of the introduction of a major traffic club scheme. Similar interviews were carried out in the experimental and control regions one year later. The traffic club increased the extent to which parents attempted to teach road safety to their children. In addition, the proportion of children who were said by parents to run ahead was reduced in the experimental compared with the control region after one year of traffic club operation. However, there was no evidence that parents exerted closer supervision of their children's behaviour in the streets. Children from non manual socioeconomic backgrounds did considerably better than those from manual backgrounds in terms of knowledge of road safety and were less likely to be left to play or ride bikes unsupervised in the streets. Male children were more knowledgeable about road safety, but were more likely to engage in potentially dangerous behaviour when out than were female children. The results showed that the traffic club scheme in its first year of operation had some impact on the behaviour of its target group but probably did not affect parental supervision. To inform the development of future schemes of this kind, it may be necessary to find out more about why many parents exert limited supervision of very young children in the streets.

Young, D.S., & Lee, D.N. (1987). Training children in road crossing skills using a roadside simulation. Accident Analysis and Prevention, 19, 327-341.

B.44 Five-year-old children were trained in road-crossing skill using a new method which allows them to act safely in relation to vehicles on a normal road. The children learned to time their crossings of a 'pretend road' as if the vehicles were on this, rather than the on the adjacent road. A previous study, using a single lane of traffic, showed that many children performed well in this simulation with minimal instruction, but that five-year-olds were generally less proficient than older children. In the present study, the method was extended to the more realistic case of two-way traffic, and training programmes for five-year-olds were assessed. (In addition, the performances of adults in the two-way pretend task and in actually crossing the road were compared; the results confirmed the validity of the simulation.) After a few sessions of guided practice, the children's efficiency in making use of gaps by setting off promptly after a vehicle had passed improved markedly; in single-lane crossing they reached almost adult standard. In both single-lane and two-way crossings they became as successful as adults in completing their crossings before a second vehicle passed and they took account of the duration of the gap by crossing more quickly when time was short. They remained very cautious, rejecting many adequate gaps. The standard of performance after a few sessions of two-way crossing was maintained over a three week break in training. Practice with one-way traffic did not help them with two-way crossing. In sum, after practice in the simulation, five year olds develop a degree of competence normally shown by older children, whose experience on the roads puts them at lower risk. This suggests that the simulation, which allows children to safely explore and develop their capabilities more fully than when actually crossing the road, would be a valuable addition to road safety programmes.

APPENDIX C: PIAGETIAN THEORY

The following transcript is an extract from the evidence given by Associate Professor John Taplin of the School of Psychology, University of New South Wales, before STAYSAFE on 19 June 1995:

> **Mr GIBSON (CHAIRMAN)**: "In general, what is known about the skills and ability of children as they grow from infancy to adulthood? What sorts of major changes in their thinking and perceptual abilities occur over this period?"
>
> **Associate Professor TAPLIN:** "I guess the place to begin is to refer you to the theory of child development which was put forward by the Swiss psychologist Jean Piaget which dominated the field until the early 1980s. Some of the earlier research relevant to child pedestrian safety has been interpreted within that context of Piagetian theory. Piaget divided the developmental period from birth up to about 15 or 16 years of age into a sequence of stages. The stages range from the so-called sensory motor period in the first two years of infancy during which we see mostly perceptual motor changes taking place. These are of considerable significance for the interpretation of visual and other information that the child will encounter, be it on the road or anywhere else, and the kinds of motor responses to that visual information.
>
> Then Piaget takes us on through the so-called preoperational period, which runs from around two to seven years of age approximately. During this period the child is said to display an intuitive understanding of many things yet is unable to apply this understanding in a consistent way to a wide range of different problems. After the preoperational period we move into the concrete operational period, which extends up to around 11 or 12 years of age. During this period, according to Piaget, logical analysis or logical thinking is clearly evidenced. Finally he talks about the so-called formal operational period, which runs from 11 or 12 years of age upwards to maturity. This period characterises the development of what we might call adult-like thinking in which we see evidence of hypothesis testing behaviour and abstract propositional reasoning being demonstrated on occasions.
>
> That theory put forward by Piaget was in the ascendancy through most of the century but in the last 15 years or so we have seen a significant advance or development beyond that way of conceiving of the development of children. The Piagetic framework may still serve some useful heuristic value for interpreting evidence in the field but there are some advances to our understanding which are worth pointing out very briefly. First, some theorists interested in the nature of child development are known these days as neo-Piagetians, and they retained the idea that cognitive development proceeds through a series of stages, or growth spurts, if you like to think of it in those terms. They have elaborated on the nature

of the changes in information processing ability that accompany the cognitive growth spurts.

Various candidates have been put forward to account for these information processing changes that are associated with child development, the main ones being an increase in attentional and memory capacity such that the child can process more information at the same time and retain it over time; secondly, an increase in the speed or efficiency with which incoming information can be handled. As an analogy to what is going on we can look at the development of computers. We see a very similar process of development occurring within a technological context in that the increasing computational power of machines is due very largely to two things: one is the expansion of their memory capacities and the second is the increasing speed of their central processors. The same kinds of developmental changes seem to be characterising children as well and theories about the nature of that development.

So one of the major advances that has occurred since the early 1980s when Piaget's theory organised the literature, the research evidence primarily, is in this respect. The second major change that we have seen to the classic Piagetian account has been a deviation from the assumption that all aspects of development progress at essentially the same rate or in some sort of synchrony or lockstep with each other. Instead, today we now accept that much knowledge acquisition shows the characteristic of so-called domain specificity; that is, children's understanding of some things may be significantly in advance of their understanding of other things, even though logically they may appear to be related to each other. This again may be of relevance to our considerations with respect to children's understanding of road safety.

Many recent researchers have criticised Piaget's account of one of the stages of development of the child, namely the preoperational period, as being in effect an account of what the child cannot do rather than what he can do. We sometimes see the same kind of tendency in talk about children's understanding of road safety: that they cannot do these things rather than what they can do. Today we are much more inclined to emphasise what they can do rather than simply what they cannot do and to look for methods whereby knowledge can be acquired even in specific areas of learning. So when we are thinking about children's understanding of road safety this contemporary emphasis in many ways, I think, is a more constructive approach to this rather complex issue."

The Hon. J. H. JOBLING (STAYSAFE): "Looking at Piaget firstly, taking out of his basic theory, did he offer us a practical solution that may be used by this Committee? Secondly, what other academe challenges related to Piaget's theory and development, where there are major divergences in conclusions, which leads to the third part of question: how, for the purposes of this Committee, might we find a practical use to be adduced to put into practice on a general basis, bearing in mind the extraordinary difficulty of humans all being different?"

Associate Professor TAPLIN: "An enormous amount of data in this regard has been accumulated during the past century. One needs some way of summarising or interpreting that data, otherwise it is a completely overwhelming. Scientists approach this by developing theories which seek to accommodate the available evidence and they are modified in the face of new evidence. To the best of my knowledge, Piaget did not do any specific research on road crossing or pedestrian safety. However, other researchers have sought to do that sort of research and to interpret it within the context of the general developmental account.

I hope that answers the first part of your question. It is a theory which suggests that children can do certain things at certain ages or stages. However, there is an assumption that within a particular culture we can translate or identify the age range within which a child is within a particular growth spurt or stage. As Stacey said, it is an approximation. Piaget emphasised the stage notion rather than the age at which any particular skill is demonstrated. There is certainly a convention in all countries about what those ages should be. Piaget said that there are some things that children can do at some ages and other things that they can do at other ages.

I do not quite know how to explain to you why that theory was so dominant while Piaget was alive. All I can say is that he was obviously an incredibly powerful man. He very much controlled the flow of ideas in a way in which I think was rather unfortunate. When he died the dam burst, so to speak, and a whole lot of new ideas came into the discussion. New research was stimulated by those new ideas, as you can imagine. The upshot of all of that is that—I will not try to go through all the criticism or challenges that have been mounted against his theory because that would take too long—a lot of what has occurred in the last 10 years to 15 years has indicated that children have more capability than Piaget was prepared to give them credit for in his theory.

We now know that infants—that is, in the first two years—can perceive and understand things that was not believed to be the case as recently as in the 1970s. Likewise, there was strong opposition to Piaget's description of the pre-operational period—which seemed to be defined by way of contrast with the next major stage—as a stage where they cannot do these things; whereas in the concrete operational period they can. What is now happening in Australia and other parts of the world is that researchers are looking at what children can do. They are discovering that children can do a lot more than was previously supposed. It is not quite as simple as Piaget made out. It has heuristic values, but it needs to be seen at best as an approximation of the truth and generally an underestimate of the truth." (Minutes of Evidence 19 June 1995, pp. 6-11)

APPENDIX D: CHILDREN'S COMPETENCE AS ROAD USERS: THE RELEVANCE OF CHILD DEVELOPMENTMENT THEORY AND RESEARCH

This review paper was commissioned by the then Road Safety Bureau and completed in 1993. However, the review was not published until 1996 as a report of the Roads and Traffic Authority's newly formed Road Safety and Traffic Management Directorate. STAYSAFE notes the anomaly of the publication entry, which listed the review as 'Research Note RN7/94', implying a publication date of 1994.

The review into children's competence as road users—the relevance of child developmentment theory and research, was conducted by Ms Fay Pettit, formerly a Senior Lecturer in Child Development at the Institute of Early Childhood, Macquarie University.

CONTENTS

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EXECUTIVE SUMMARY

INTRODUCTION

When designing measures to improve road safety and reduce accidents involving young children, it is important to take into account the factors that influence young children's behaviour as road users. Young children do not have the ability and understanding to behave safely as pedestrians or cyclists, but often too much is expected of them. Research in child development indicates that it will take many years before they develop the necessary competence.

This report reviews a large body of research and theory on aspects of child development that can help elucidate the factors involved in young children's *limited competence in traffic, and in the significant changes that occur as they develop*. Information from this research has significant implications for new directions for road safety education, and for effective protective measures for children.

Child development research and theory is not a unified body of knowledge. There may be differences in both the descriptions of and the explanations for aspects of development. However, most theorists agree that it is the complex interaction between environmental and innate factors that brings about children's development.

Some attention is first given in this report to issues in child development relevant to protective measures and rules, but the main focus is on the various types of development necessary if children are to become independent in their attempts to negotiate traffic safely.

Protective measures and safety rules

In terms of protective measures and safety rules, three main issues are discussed in relation to relevant areas of child development:

a. Young children's lack of understanding of the reasons that lie behind protective measures and rules

b. Young children's lack of understanding of the factors of chance and probability in relation to accidents

c. The importance of trusting and democratic relationships with adults if children are to comply with the rules, and gradually develop an understanding of these rules

However, the main aim of road safety education is to equip children to behave safely and *independently* in traffic. It is believed that the judgment, decision making and actions required for safe behaviour are all aspects of the task of problem solving.

The problem-solving processes

The main question considered in this report is how the various stages in children's development relate to their possession of the problem-solving skills relevant for road safety. The following are the problem-solving processes related both to children's development in general, and to behaviour in the traffic environment in particular. Consideration of these processes forms the body of this report:

1. Realising that a problem exists and that steps have to be taken to reach a desired goal.

2. Searching for and perceptually identifying relevant information.

3. Drawing on existing knowledge and procedures in memory.

4. Interpreting information in order to understand, reason and predict what might happen.

5. Making decisions about direct action, or devising strategies or plans where appropriate.

6. Taking action to reach the goal, and monitoring and modifying actions as necessary.

TRENDS IN CHILDREN'S COGNITIVE DEVELOPMENT - AN OUTLINE

Cognitive development is of major relevance to the problem-solving ability. For this reason general trends in cognitive development, as discussed in the work of many different theorists, are identified. These trends, listed below, provide a background to the research studies that are reviewed in later sections of the report:

- From concrete to abstract thinking
- From surface to deep processing of information
- From centred thinking to complex integrated thinking
- From greater reliance on 'bottom-up' processing to more 'top-down' processing
- From egocentrism to an understanding of different points of view
- From a limited knowledge base to an extensive, well-organised knowledge base
- From relatively few to many automatic processes of thinking
- From slow to fast speed of processing
- From apparent lack of metacognition to increasing metacognition

CHILD DEVELOPMENT RESEARCH AND CHILDREN AS PROBLEM SOLVERS IN TRAFFIC

The report reviews research in different areas of child development that is relevant to problem solving in traffic. It also indicates some of the future directions necessary both for research in general, and for road safety education in particular.

REVIEW OF THE CHILD DEVELOPMENT RESEARCH RELEVANT TO THE VARIOUS PROCESSES OF PROBLEM-SOLVING IN TRAFFIC

1. Realising that a problem exists

Impulsivity

Research on *impulsivity* is highly relevant to this aspect of problem-solving in traffic. Children frequently act impulsively in traffic without making the necessary judgments and decisions, apparently failing to realise that there is any threat to their safety. Research and theory on a dimension described as 'impulsivity–self control' indicate that this is a many-faceted construct relating to many different types of situations where control of thoughts, feelings or actions is required. The development of self-control depends not only on innate factors such as the maturation of the nervous system and characteristics of temperament (probably genetically influenced), but also on appropriate experience.

Beginnings of self-control occur in infancy, but throughout childhood it develops only gradually, so that impulsivity in children is common in many situations. By the middle years most children are much less impulsive, but individual differences and differences in situations continue to have a significant influence on the degree of self-control shown. Research on impulsivity in traffic contexts has been very limited, and narrow in its theoretical approach. There is a need for well constructed studies, some of which should be directed to investigating factors in the development of self-control.

Concepts of safety, danger, accident

If children are to realise that a specific situation poses problems for their safety, they must have appropriate concepts of safety, danger and accident. These concepts are abstract, often ambiguous, and rely on inferences the individual must make about the possible outcomes of interactions with people and objects in the environment.

The limitations in thinking usually displayed by young children mean that they are likely to have very simplistic and inappropriate concepts. This is borne out by the existing research on children's understanding of these concepts in both traffic contexts and other situations. However, this research has been inadequate; further studies, focusing on a careful analysis of the concepts and of the basis of children's understanding, are needed.

Cognitive maps

If children are to understand the need to plan a safe route through a traffic environment, they need to possess some form of mental representation, or 'cognitive maps' of their environments. These maps facilitate the understanding that, in a particular environment, alternative routes are a possibility. Research indicates that, in line with trends in cognitive development, children under school age generally do not construct mental representations of environments much larger than their homes. Their journeys in the general environment tend to be guided by their knowledge of specific landmarks only, and not of spatial relationships. The indications are that, even for older children of primary school age, early cognitive maps are often very rudimentary, with poor understanding of the spatial relationships involved. Hence, when children plan routes, they require adult guidance combined with practical experience in order to plan safely.

2. Searching for relevant information

Searching for all of the relevant information in a traffic context is a highly skilled task that depends on efficient processes of attention and perception.

Visual and auditory acuity

A first question is how well young children can see and hear. By 3 years of age, most can see static objects at various distances almost as well as adults, but there are questions about dynamic acuity, not only for young children but also for older children, and even for adults. It appears that this type of acuity, which is involved when the observer or the object perceived are moving, is much less reliable.

Where hearing is concerned, the findings are that by 2 years of age children hear sounds in the middle frequencies as well as adults do, and for low or high frequencies their hearing is equal to adults by 5 or 6 years of age, or sooner.

Processes of attention

The limitations in the attentional resources of young children mean that the information that is perceived at any one time is only a very small part of what is available. Attention may be controlled in order to select consciously certain information in preference to other information, or it may be captured by changes in the environment such as movement or sudden contrast. It is very important to know just what influences children's attention in traffic contexts.

There are various modes of attention - scanning, focusing, maintaining attention etc. - as well as what is called a 'pre-attentional process', peripheral vision. The latter has received some considerable attention in road safety material and programs because it has been claimed mistakenly, without adequate consideration of research, that children have very poor peripheral vision, and this puts them at risk in traffic.

However, there has been a substantial amount of research on children's peripheral vision, both within the general child development field as well as that of traffic-related research. In spite of many methodological problems that have beset this research, most psychologists consider that young children are no less efficient than older children and adults, at least at the level of detecting stimuli in peripheral vision. What apparently varies is the higher-order cognitive processing of this information, which is much more limited in young children. They are less able to identify and attach significance to stimuli they detect in peripheral vision.

As far as the main types of attentional processes are concerned, young children have been shown to be much less efficient than older children and adults. Young children's scanning of a visual field to pick up relevant information is very limited indeed; they are less able than adults to focus attention and filter out irrelevant information; they are less capable of the conscious control required to maintain attention to areas that are not of intrinsic interest, and they are also less able to move their attention rapidly as required to monitor information coming from several sources simultaneously.

All these types of attention are influenced by developments in metacognition. As children become more aware of their own cognitive processes, attention being one of them, the possibility for exerting some *control* over these processes increases. There are individual differences, however, that persist into adulthood.

All of the processes of attention have very significant implications for children's performance in traffic, but as yet there is no satisfactory research in this area.

Perception

Perception involves discriminating, identifying and giving significance to the information from the environment registered by the senses. These perceptual processes become much more efficient as children develop, depending in part on the development of attention, but also on other maturational and experience factors. Younger children tend to miss many of the distinctive features and relationships available to perception, to process the information more slowly and to carry out less top-down processing. This means that they will often miss important information in traffic contexts, or even identify information incorrectly.

Some specific types of perception that are crucial for making judgments about movements of vehicles in traffic are perception of movement and its direction; the dimensions of velocity, 'time to arrive' and distance as a co-ordinated system; depth of field and distance; and constancies of size and distance. These rely mainly but not entirely on visual perception.

Visual perception

Only the *visual* perception of movement is relatively non-problematic for young children. Unfortunately, theoretical controversy has clouded the issues in relation to children's judgments of the interrelated dimensions of velocity, time to arrive and distance, which are of key importance for road safety. Many cognitively oriented psychologists have proposed that conceptual understanding of the interrelationship of velocity, time and distance is necessary for correct perceptual judgments of vehicle arrival times, and have claimed that this will not occur before late childhood. However, ecological theorists suggest that only direct perception is involved, and that even quite young children can learn with appropriate experience to make implicit, reasonably accurate judgments of vehicles' times to arrive.

There have been many studies that have investigated children's ability to judge when it is safe to cross; in effect, these have depended on estimates of a vehicle's time to arrive. This research has been largely a-theoretical in approach, but the researchers frequently take it as a given that children must have the understanding for co-ordinating estimates of speed, distance and time correctly in order to make their judgments. The studies have failed to produce clear-cut results. Younger children's performance tends to be more inaccurate, but quite variable, and the design of the studies allows no valid conclusions to be drawn about the basis of children's attempts at estimating time to arrive.

A few studies by ecological theorists have suggested, however, that it is possible to train even 5- to 6-year-olds in traffic contexts to make satisfactory estimates of when it would be safe to cross a road. They claim that their training provides the experience necessary to enhance children's direct perceptual capacity to estimate time to arrive.

Separate studies of children's perception of distance and depth of field have relevance, because it is important to know whether children will take more distant vehicles into account when making traffic judgments. Although research indicates that children make judgments of 'near' and 'far' in infancy, there are problems for maintaining constancy in perception of size of objects at a distance, and also for distances between objects when these are at some distance from an observer. Research indicates that the judgments of children below late primary school age are often quite inaccurate, with underestimates for size of objects and overestimates for distance.

Auditory perception

Auditory perception of direction, which is important for realising the likely direction of approaching vehicles, has been largely overlooked in research, with the only well-known study yielding inconclusive results. Research on the perception of the distance of a sound source from the hearer has also been neglected.

3. Drawing on knowledge and procedures existing in memory

Memory

Identifying and making sense of the elements of a traffic situation depends on holding new information in *short-term* memory, and recalling from *long-term* memory stores relevant knowledge that will give meaning to the situation being dealt with. Research indicates that young children can hold comparatively little information in short-term memory at one time, and this limits their information processing. Younger children will also be more limited in recalling relevant knowledge from long-term memory because they have less stored information; much of their rote-learning knowledge acquired through adult instruction has not been understood. Also, they may have been less able to make use of information that was available in earlier traffic contexts because it was not very meaningful or significant to them and so was not assimilated. Meaningful knowledge and comprehension are so strongly interrelated that it is not very helpful to treat them separately in research and theory.

4. Interpreting knowledge for comprehension, reasoning and prediction

Processes of comprehension

Comprehending a traffic situation in order to decide how to act requires *integrating currently perceived information* with relevant knowledge stored in memory. The most basic form of mental representation of knowledge is considered to be the 'concept'. Children and adults mostly learn informally the concepts that lie behind the majority of the tens of thousands of words they gradually acquire.

Owing to the trends in development outlined earlier in the report, children's and adults' concepts are likely to be very different even though they may use the same words. Children's concepts tend to be based not only on *fewer* of the attributes that are essential to a concept, but also on the very *concrete* ones. They have difficulty in acquiring concepts that are relational rather than absolute, and abstract rather than concrete. This means they will have difficulty with many of the concepts that need to be acquired for road safety; it also means that many misunderstandings between adults and children may occur in relation to comments about the traffic environment.

Another type of schema - mental representation - that is important for children's road safety understanding is the 'script'. Psychologists use this word to depict our mental representations of familiar repeated *sequences of events* in everyday life, together with the associated *objects and roles of the people* involved. It appears that scripts are used to guide our routine behaviour. They are relevant to road safety, because children apparently use them in running off the sequences of behaviour on familiar journeys within their environment, for example when they go to school each day.

Research indicates that younger children have fewer events in their scripts, do not usually understand many of the cause-effect relationships linking the events, and perceive fewer of the associated roles and objects. Their sequences are also inclined to be more rigid, allowing no flexibility in actions. Adults seeing children carrying out the actions may believe they have a greater competence than they actually do. In addition, if the routine breaks down for some reason and new actions are required, children's behaviour may become inappropriate and unsafe.

Making inferences

It is very rarely indeed that all of the information in a situation is explicit. In order to gain a reasonable degree of comprehension, the individual is usually required to make *inferences* that will fill gaps in information.

Far more important than the *logical* inferences that are so often emphasised are the *pragmatic* inferences that we mostly use to guide our everyday behaviour. These inferences are based on expectations that we develop from our experiences.

Many important types of inferences are needed in traffic, especially *causal* inferences and inferences about other people's *motives and perspectives*, which are the basis for predicting what might happen and for taking defensive action.

There is a considerable amount of relevant research on children's ability in these areas. Young children often fail to make inferences about what may happen, and their understanding of the causes of many events is very limited. They may sometimes make inferences spontaneously about the feelings of other people, if those people are of special relevance in their own lives. But they will be unlikely to infer what many other drivers or pedestrians might be thinking, feeling or intending, or what others might be seeing from their own visual viewpoint. Researchers appear to have ignored the question of children's inferential capacity in relation to their traffic behaviour.

Maximising comprehension in any situation requires putting together swiftly all the relevant information, current or stored knowledge, together with the necessary inferences, in a coherent whole. This is a task that will often be difficult for adults, so it is not surprising that it presents many difficulties for children and limits their performance.

Comprehension of road signs and symbols

One area of relevance for children's comprehension that has received little research attention is their understanding of road signs and symbols. This is a gap that needs to be filled.

5. Planning and devising strategies

In some traffic contexts, it is necessary to plan strategies for safe action, and sometimes also to set sub-goals for achieving the main goal. By the middle years, children become more capable of forming and using strategies, but young children rely a great deal on trial and error, and this of course is not conducive to safety.

6. Taking action to reach the goal

Risk taking

It is apparent that some people may comprehend the relevant factors in a situation and foresee threats to safety if they behave in a certain way, but nevertheless still take unnecessary risks.

Research on risk-taking behaviour in children and even in adults is very sparse. Children's risk taking may be due at least in part to a lack of ability to assess risks adequately, but other factors also seem to be involved, such as emotional control, social norms and characteristics of temperament. What studies there have been bear out the widely held belief that boys are more likely than girls to take risks, but much more research is need in order to clarify the factors involved.

Perceptual–motor skills

Taking action as a pedestrian does not just involve making the necessary movements - cognitive and perceptual processing have to be co-ordinated so that one's performance can be controlled. Children, like adults, must monitor incoming information from the context as well as cues about their own bodies' performance. Not only do young children move comparatively slowly, but their cognitive processing is also slow, and, as has been seen throughout this report, it is not always very efficient or relevant.

Conclusion

The report concludes with some suggestions for future research in four main areas:

- General aspects of child development, as well as gender and individual differences
- Specific aspects of children's knowledge, understanding and behaviour in tasks directly relevant to traffic behaviour and road use
- Ways of educating children to behave safely and with greater understanding in traffic
- Evaluating existing road safety training material and programs

INTRODUCTION: CHILD DEVELOPMENT AND ROAD SAFETY

Research on safety issues concerned with children and adults as pedestrians, bicyclists and road users consistently shows that, in general, *children* are less competent than most adults and *are at much greater risk* of road accidents and injury. This is particularly so for younger children, not only preschoolers, but also for children in the primary school years. Unfortunately, this is not surprising. It fits with our common-sense knowledge that young children lack the necessary understanding and experience and as yet only partially possess the necessary judgment and skills.

PROTECTIVE MEASURES AND TRAFFIC EDUCATION

The relationship between pedestrian and other road usage behaviour and relevant areas of child development needs to be explored and analysed in considerable detail, if traffic education and various other protective measures for children's safety are to be effective.

There have been some reviews, though not recent, of relevant aspects of child development, for example the report produced by Avery (1974) and the article by Vinjé (1981). Since then, there has been extensive work on theory and new research in child development that can throw new light on factors influencing children's road safety behaviour, and some of this raises doubts about some of the statements made about children's development in earlier reviews. There is a pressing need for a comprehensive report that will review and summarise both earlier and recent research, as a basis for more effective traffic education and protective measures. Too often these measures have been developed without sufficient consideration of the relevant knowledge about children's development.

It should be helpful, first, to distinguish between protective measures and traffic education, although both are intended to achieve the same end of children's safety. Both also require an understanding of child development.

Protective measures

Protective measures and rules are those *put in place and directed by adults*. They include physical requirements such as the wearing of seat belts or bicycle helmets, as well as other constraints such as insisting that young children be accompanied by an adult whenever they have to venture into traffic situations. The main demand on the child is for compliance with the adult's rules. Obviously it would be useful to know more about how children's conformity might be achieved. As will be discussed later, the child development literature suggests that simple reliance on reward and punishment for rote learning of the rules is often ineffective; the adult's whole approach to the child's behaviour plays a significant part in how the child responds.

Traffic education

Traffic education is very much more complex. It aims to increase children's knowledge and engage their understanding so that they will be able to *take some initiative* for their own safety. The objective, as defined by van der Molen, Rothengatter and Vinjé (1981), is this:

> *The child must select the traffic situations that are optimally safe for him and behave in those (and other) situations in a way resulting in optimal safety for the child.*

The traffic educator needs to know to what extent children's competence is likely to be influenced by development and experience as well as by individual differences and possible sex differences. As a further step, it is also important to be aware of research that suggests ways of enhancing competence.

The child's safety behaviour as a problem-solving task

The judgments, decisions and actions required for behaving safely in traffic can be regarded as part of a problem-solving task. As adults we might find this difficult to recognise at first, as a great deal of our problem solving in traffic depends very much on what psychologists describe as *automatic processing*. As a result of practice and experience, we carry out much of the required analysis without much conscious awareness. Many of the required judgments and actions are part of routines that do not require much effortful attention until we have to deal with the novel aspects of the situation. However, it is important not to underestimate the task, even for adults. As Leibowitz (1985), quoted in Warren (1990), points out, 'What might seem the simple task of crossing a road, even with traffic signs, is very complex.'

Children's ability to behave safely in traffic can generally be regarded as depending on problem solving that requires even more effortful processing and more conscious attention than it does for adults. The effectiveness of their efforts will be dependent to a large extent on their developing problem-solving abilities and on the nature of the specific cognitive processing in which they must engage in order to solve a particular problem.

Development in children's ability to solve many such problems satisfactorily will depend not only on cognitive development, but also on aspects of personality and social development such as temperament and self-control, and on specific aspects of perceptual–motor development.

Examination of child development research literature can provide many useful insights that can be related directly to children's traffic behaviour and problem solving. It can reveal significant aspects of children's development as well as relevant individual differences that can influence their competence and performance. It also raises issues related to possible sex differences, although these tend to be controversial.

Issues in using a child development framework

The limitations to date of research on children and traffic

Psychologists and others have thus far produced only a small body of research on the development of specific skills and behaviours that have been directly linked to children's road usage and their behaviour in traffic. The research appears on the whole to be very limited, in that it covers only a few of the relevant areas. In addition, it is rarely couched in any wider theoretical framework of development. This means that, while the research is useful as far as it goes, it cannot really be used to build up any consistent and comprehensive picture of children's developing competence as road users and the factors that influence this.

The need for a developmental framework

It would appear useful to provide a comprehensive theoretical framework that would give a relevant background relating to children's development. Such a framework would focus on development in some of the major areas relevant to pedestrian and road user tasks, and on the problem solving required for these tasks. It would include aspects of:

- *cognitive* development
- *perceptual–motor* development
- *personality* development
- *social* development

It would also incorporate, wherever possible, specific studies of children's development that have been related directly to road safety issues.

Such a framework should make it more

possible to understand and predict children's behaviour as road users. As a follow-on, it should lead to more effective protective measures and traffic education.

Difficulties of establishing a framework

However, establishing an appropriate framework is not a straightforward process. Major theoretical approaches to child development and research orientations vary, although all attempt to some degree to answer these two main questions:

1. How do children's behaviours, skills, knowledge, attitudes, emotions etc. change as they grow and develop, taking into account individual and gender differences?
2. How can these changes be explained? Or, what influences lie behind the changes?

The body of theory and research that attempts to answer these questions is varied and vast, and at times comes up with different answers. There is inevitably some conflict and controversy.

Answering the first question

The first question is not as difficult to answer as the second. It is easier to describe behaviour than to explain it. Nevertheless, descriptions of what children are capable of can vary because many different factors can influence human behaviour as it manifests itself in any given situation.

It is a very complex task, in any research study, to identify and then try to control the factors that could influence children's behaviour. Psychologists are becoming more and more concerned about making sure that children have the opportunity to demonstrate their actual competence in the tasks they are required to perform, free of confounding variables. However, this desire to save children from being assessed in terms of seemingly extraneous variables may sometimes rebound. In the everyday contexts that make many complex demands, such as traffic situations, children may perform at a lower level than the capability claimed for them by psychologists. Although we do not want to underestimate children's abilities, it is also important not to expect too much of them.

Answering the second question

The second question seeks explanations for children's behaviour, and is relevant for decisions about appropriate education and training. Such explanations should be inferred from well-controlled research studies that are sufficiently well designed to make such inferences possible. The chief general issue has been whether it is innate/biological factors or environmental/experiential factors that bring about children's development.

For most of this century there has tended to be a division between theorists, who have taken one of the above two extremes. One group of theorists, loosely grouped as 'traditional learning theorists', have put nearly all development down to learning as the result of external experience. Various other theorists, *maturationists,* however, taking a biological base, have put nearly all development down to inherited factors, and see changes in development as a process of unfolding due to a *biological clock.*

The former approach has carried with it the implication that adults can largely *shape* children's learning and development by providing the right environment and direct instruction and training. By contrast, the latter approach has implied that the adult's role is rather passive, and that adults must *wait* for the child's biologically programmed unfolding before they can introduce appropriate materials to enhance children's learning at the particular stage they have reached.

Over the last two or three decades, most psychologists have abandoned these extremes as being too simplistic, realising that either approach by itself is quite unable to account for the complexity of human behaviour. They favour, instead, what is called an *interactionist* framework. Here development is said to occur as a result of the interaction between inherited or biological factors and environmental factors.

The interactionist framework, however, presents the opportunity for a considerable variety of approaches, both in the emphasis given either to biological or environmental factors, and in the nature of the factors focused on.

For example, within the field of *cognitive development theory*, many psychologists who have followed the lead of Piaget consider that development is largely internally or conceptually driven. So the individual is said to construct his or her own knowledge, and children's development towards logical thinking proceeds along a path determined largely by biological maturation, regardless of their social/cultural environment. The physical environment, however, is important in that it provides significant general experiences that contribute to development, although it has been held that these are similar for *all* children. It is not until adolescence, in this view, that what Piaget called 'social transmission' by adults becomes important.

Another theoretical approach, that of the later *social learning theorists*, emphasises external social experience, such as the observation of others' behaviour and reinforcement received from others, as the main influence on development. These theorists agree that maturation may have some influence, placing limits on aspects such as physical capacity and memory capacity, but these aspects are usually not paid much attention, and research studies on children are frequently not developmental in approach.

At present the approach to development that is probably gaining most favour is one that is based on modifications and extensions of the work of a Russian psychologist, Vygotsky, sometimes called *social interaction theory*. This theory emphasises as the major influence on children's development the guidance of more knowledgeable and capable others. Unlike the social learning theorists, who tend to view the child as a fairly passive recipient of adult teaching and modelling, social interactionists view the relationship between the child and a more capable adult or a peer as an interactive one. The role of the adult is to guide, suggest, model and 'scaffold' children's development to help them reach a potential that may not otherwise be realised (Bruner, 1983; Resnick et al., 1992; Rogoff, 1990; Wood, 1988). The child's potential is set by maturation, and the adult must take into account the child's current level of development and his or her own contributions.

Unlike some of the other areas of research, it is well-nigh impossible to be definitive in research into humans. This is certainly the case for hypothesised factors relating to the causes of development. It is not possible to disentangle precisely the innate and environmental factors. There are two main reasons for this.

First, it is not possible to hold experience and other environmental factors absolutely constant for human subjects in a research study, while biologically programmed factors can be held reasonably constant only for identical twins. Second, development always involves a complex structure of interrelated factors; while statistical techniques are helpful in trying to parcel out factors that are innate and factors that are environmental and to identify some of the interactions, they have limits. They offer only pointers to possible cause–effect relationships, not conclusions about them. However, there are very many research studies that indicate that children's participation with a knowledgeable adult in a task can often lead to enhanced performance and further development.

Dealing with these issues in using research findings

The above issues need to be taken into account when considering the research to date on child development, whether it be descriptive, explanatory or both. However, where there has been a considerable body of well-conducted research in a particular area of development, it is possible to obtain a useful description of some of the trends in this development. There can be reasonable confidence in the findings if:

- they have been *well replicated*, that is, where other researchers have repeated the same type of investigation, with similar results
- they have taken into account a *complexity of factors* that could influence children's performance

Most current researchers consider that it is not appropriate to look for simple one-to-one cause-effect relationships where human behaviour is concerned - this was often the case with earlier research. They also consider that, if the findings of research studies are to be useful, such studies should have been designed to allow children to demonstrate their competence and understanding in tasks that have some meaningfulness for them rather than in very artificial laboratory tasks.

As a result of more effective research recently, some findings about children's development claimed in the earlier research have been overturned, even some of the research of the '70s and '80s. Before we accept the findings of some of the older studies, it is therefore necessary to check for more recent research. Nevertheless, some well-conducted research studies have withstood the passage of time well and continue to influence current work—for example, Bartlett's classic studies of memory (Bartlett, 1932) or Flavell's studies of *social perspective taking* (Flavell, 1974).

Where the issue is an explanation of development, consensus is less likely, although there are interesting suggestive studies in some areas. It is perfectly possible for there to be more than one way of explaining the same behaviour, and in fact this happens quite often because of different general theoretical approaches. The disparity in explanatory accounts may not always be so important when the aim is centred on *describing* development relevant to children's behaviour in traffic, but it becomes very relevant when attempting to *educate* children and *guide* their understanding and behaviour so it becomes safer.

The structure of this report

When adults set out to design and implement or produce protective measures for children's safety and to educate parents, drivers and others about children's competence, there is a need for some description of children's development relevant to the need for such rules and factors that influence their compliance. The first section of the review of child development research will focus fairly briefly on these issues.

The main body of this report will review the general child development and more specific traffic research relevant to children's developing competence for taking the initiative in traffic and carrying out their own problem solving. There will also be some discussion of issues relevant to traffic education for children. Much of this research should also be helpful to those designing protective measures, because it often indicates when children can be expected to have some competence to act with safety.

Children's understanding and acceptance of protective measures: Relevant research in child development

Relevant research on this issue needs to answer the following questions:

1. At what *stage in their development* are children likely to understand the reasons for protective measures and rules?
2. At what stage would children *understand*

the chance and probability of accidents occurring?

3. When children do not understand reasons for rules and protective measures, can research throw light on which factors increase the *likelihood of children's compliance* to adults' requirements?

Studies related to understanding reasons for protective measures and rules

At what stage in their development will children understand the reasons for protective measures and rules? This is an important question, because when children simply 'know' and repeat rules from memory with little understanding, they do not realise the risk, and their behaviour cannot be relied upon to be safe.

When adults insist that children must be accompanied when walking on streets and roads, it is because they realise that children do not yet have the understanding necessary to realise the risks involved and to be able to negotiate such dangerous situations successfully. Similarly, when they require young children to wear helmets and safety belts, many adults probably realise that children would not understand how these could prevent serious injury.

Most of the theoretical issues and research related to this question will be discussed below, in 'Child development research and children as problem solvers in traffic', where they are highly relevant. Here it is important to point out that, in the preschool years and in the years immediately following, children mostly require very simple, concrete explanations of reasons for rules of any type that they can readily relate to familiar circumstances and events. Unfortunately, however, reasons for rules for behaviour in traffic are usually quite complex, and beyond the young child's genuine understanding. Research indicates that children on preschool age may be able to repeat traffic safety rules correctly but usually cannot give any rationale for them that indicates understanding, and their behaviour is often unsafe and inconsistent with the rules (e.g., Russam, 1977). For example, if they know the rules about seat belts and helmets but have not experienced either being thrown forward and hurting themselves when a car comes to a sudden stop or injuring their heads in a fall from a bicycle, it is very difficult for these young children to foresee possible outcomes and to understand the necessity for seat belts and helmets. Anecdotal evidence suggests that some young children who do not have the necessary understanding of reasons for protective measures will, for example, just pretend to do up their seat belts, or will take off their helmets when out of sight. Bibace and Walsh (1981), in reviewing the related research on children's concepts of injury and death, point out that, as some studies show, many young children are unlikely to foresee the possibility of their own serious injury where there is no immediately apparent direct threat, unless they have had significant experience of illness or injury.

The later section in this report on children's concepts of danger is very relevant. As Grieve and Williams (1985, p. 391) point out, young children's 'ability to perceive a range of the dangers commonly involved in childhood accidents is unimpressive'.

Studies related to understanding chance and probability

At what stage will children understand the concepts of chance and probability? These concepts are necessary for understanding that they could be involved in an accident if certain factors happen to co-occur.

While there has been considerable research on adults' understanding of chance and probability, studies on children's understanding of these concepts are very difficult to find, and those that do exist are not very relevant to traffic situations (e.g., Kuzmak & Gelman, 1986). Piaget, a major theorist in the cognitive development area, is probably the only researcher who has investigated this topic in some depth. As he points out in his book *The Origin of the Idea of Chance in Children* (Piaget & Inhelder, 1975), the understanding of chance involves an understanding of causality. There also needs to be some sort of estimate of the more or less probable character of feared or expected events. It is interesting that Piaget relates this process of estimating to situations such as crossing a street and making judgments every moment about the speed and position of cars.

As will be discussed in a later section, concepts of causality pose many problems for young children. Piaget reports on his research that children do not seem to have any elementary understanding of chance events before the early school years. He suggests, as an example, that, if a young preschool-aged child has been hit by a door blown by a gust of wind, the child will probably find it difficult not to blame the door or the wind for the pain. Children of this age are unlikely to realise that two sequences of events, such as their own movement near the door and the gust of wind in this case, were unrelated. They do not understand the randomness of many events. They are unaware that some events can be predicted with a great deal of certainty, and yet others can be quite unforeseen.

However, Piaget's ideas may to a certain extent underestimate the competence of some children. This could particularly be the case for those in family or early educational settings where adults encourage a relatively large amount of discussion and exploration of events children encounter. Piaget's detailed research studies are based on his own theories about the essential operations required in the development of logical thinking. Most psychologists no longer accept his claims that the development of logical thinking depends on a certain kind of active manipulation of objects in children's environments independent of guidance from adults. However, his characterisations of the difficulties in understanding that we can expect of young children are close to the views of many other researchers about general trends in the cognitive development of young children.

In summary, it is apparent that children younger than primary school age will probably have a very limited understanding of the reasons for measures to protect them. They may be able to rote learn and repeat safety rules and show some verbal acceptance of protective measures, but without adequate understanding.

Studies related to compliance

It is important to know what factors influence compliance and internalisation of rules in children when they do not have the understanding to behave safely on their own. Theorists from within the 'learning theorist' tradition have suggested that compliance is a result of rewards and punishments associated with direct instruction or the observation of relevant models. Follow-up research, however, shows that it is not this simple. For example, findings from a large variety of studies have shown that punishment, and also threats and bribes, are *not* effective in obtaining compliance if they are used frequently. In fact, there is quite a strong tendency for children who are punished, threatened and bribed frequently to become non-compliant. Also, research shows that rewards are frequently not necessary for obtaining compliance. When rewards are used, they are usually more effective if they are not material but social rewards, such as affection or genuine approval. A reward–punishment approach is too simplistic, and other factors must clearly be involved in compliance.

Some of these other factors are suggested in the findings of many studies. For example, researchers such as Stayton et al. (1971), Ainsworth et al. (1974) and Lytton (1980) consider that there is probably an inborn disposition to compliance in very young children and in young animals - it is an adaptive device to help them to survive in a hazardous environment and have access to resources. These researchers also hypothesise that although the disposition to compliance is innate it is also influenced by learning. They have evidence to support claims that young children are more likely to be compliant when they are attached to their caregivers and have positive relationships with other adults who are reasonably sensitive and responsive to their needs (e.g., Schaffer & Crook, 1980). Such adults do not place excessive demands for compliance and control on children in relatively trivial situations, but exert strong, consistent demands for compliance when it is clearly necessary for the children's own safety and welfare and for that of others. It appears that children in such relationships develop a trust in adults that leads them to accept many of their instructions without the need for coercion. They are also more likely to imitate some of the relevant behaviours that they see the adults performing.

For example, Lytton (1980), in his study with 2-year-olds, found that where parents encouraged children to do things competently and independently with little scolding, the children were much more likely to make parents' standards their own.

This research on young children ties in with a large body of research on older children by Baumrind (1973) and many others (e.g., Maccoby & Martin, 1983; Lamborn et al., 1991; Steinberg et al., 1989). These researchers describe the components of what is called an 'authoritative style' of parenting and interaction with children. It involves treating children with affection and respect, giving, wherever possible, explanations for rules that are related to developmental levels of understanding, and setting clear limits where this is important and expecting them to be met, but not making unreasonable demands and entering into unnecessary power struggles. Physical punishment is usually avoided.

There is evidence to show that when this style is used with children it is quite strongly related to a tendency to abide by adult limits. In older children, the 'authoritative style' leads to a developing capacity for genuine self-regulation and responsibility for their own actions.

There, are nevertheless, temperament differences in children that can be relevant. For example, some children react more negatively to physical restraints on their behaviour, such as hand-holding and seat belts. In this case, the task for adults becomes much more difficult. As stated earlier, the research indicates that the adult who responds with frequent punishment will not be effective in gaining compliance. It appears important to work with the child's need for some control, however, as the evidence is that children in general require some sense of security and of predictability, both of which result from the setting of reasonable limits.

A summary of some of this research is provided in a major review article by Maccoby and Martin (1983), referred to above, which summarises research on parent–child interaction in the context of the family.

It is clear that it is quite inappropriate to rely on the instruction in rules for children's safe behaviour as pedestrians. Much more research is needed on their understanding of traffic rules and of factors influencing compliance with these.

Child development research and children as problem solvers in traffic

The majority of research studies on problem solving have not have been carried out in contexts that are directly analogous to traffic situations; nevertheless, general implications for the cognitive processing and actions required in traffic can be drawn from these studies. If problem solving is analysed into its components, and these in turn are related to the situations children face as pedestrians and in other traffic situations, it will be found that there is a great deal of useful research on a variety of aspects of children's development.

The problem-solving process: A model

Following are some of the components of the process of effective problem solving. This model and its components serve as a first and major step in helping to decide what aspects of child development are relevant to children's traffic safety.

Not all components or steps necessarily arise for each particular situation. Also, there is frequently movement back and forth between steps as required. Further, it is important to recognise that some of the individual steps within the overall problem situation can themselves require the entire problem-solving process. For example, a problem could exist at step (b) when it is not easy to identify perceptually or locate an object that is relevant.

Although problem solving is a topic treated mainly by cognitive psychologists, it is unlikely that cognitive development alone is relevant to the process of problem solving, as factors such as motivation, emotion and temperament will also be significant.

Below are major components in the problem-solving process:

(a) *Realising that a problem exists* and that steps have to be taken to reach a desired goal that is not immediately attainable. (Situations that we can deal with entirely by following routines or habitual sequences of behaviour are not problems.)

(b) *Searching for and perceptually identifying all the information* in the current situation that is available and relevant to the solution.

(c) *Drawing on existing knowledge and procedures in memory* that appear relevant.

(d) *Interpreting information* in order to understand, reason and predict what might happen.

(e) *Making decisions about direct action* where appropriate, or *devising strategies* and/or plans to achieve the goal where this is appropriate. (Planning may necessitate processes such as searching for new information or forming subgoals as preliminaries to achieving the main goal.)

(f) *Taking action to reach the goal*, monitoring progress towards the goal and adapting to changing situations as required.

The various cognitive processes required for these steps are not independent. However, they are usually treated somewhat separately by cognitive theorists, otherwise they would be too complex to handle.

Before going on to outline and then discuss research areas in child development that appear particularly relevant to the various steps in problem solving, it seems useful to discuss some general trends in cognitive development that will play a significant part in all aspects of problem solving.

TRENDS IN COGNITIVE DEVELOPMENT RESEARCH RELEVANT TO THE PROBLEM-SOLVING PROCESS

Children's cognitive development is the area of development most closely linked to their problem solving practices and their behaviour as road users. There has been a very large body of research for a number of decades on this type of development.

Until the late 1960s, the whole field of cognitive development had only one key figure, Piaget, although there were also contributions by others such as Werner (1957) and Bruner et al. (1966). Since the mid-1970s research on cognitive processes has been dominated by researchers within the *information-processing framework.* They draw analogies between the processing by the human brain and the serial or step-by-step processing carried out by computers. Using the terminology of information processing, they seek to describe the ways in which children receive, encode, store and retrieve information, and the operations that result in the output necessary to solve problems and function in the everyday environment. More recently, some researchers have developed a *connectionist* framework, to supplement or replace the limitations of the serial-processing approach. In this model, the brain is conceived of as capable of parallel processing through neural networks, that is, through the interconnections between neurons.

In both these models, the emphasis is on separate processes of attention, perception, memory, comprehension and problem solving as the brain handles and operates on information. The theoretical orientations of the researchers can vary widely. Nevertheless, there do seem to be some significant general trends in the description of the cognitive development of children that many current theorists and researchers would accept, although the terms used may not be the same and the explanations for the trends, where offered, may differ. These trends influence the nature of children's processing in the various aspects of problem solving.

The trends selected and described below are those that have had fairly widespread acceptance as a result of research and theoretical contributions by many psychologists. (It is fair to say, however, that there would certainly not be complete consensus.)

Most of the trends described pertain especially to situations that are complex, unfamiliar and/or perhaps not always very meaningful for children. Where contexts are very familiar and children through repeated experience have developed some knowledge and understanding of relevant relationships, they will show greater competence (Donaldson, 1978; Rogoff, 1990; Smith, 1988). In general, older children and adults can usually deal far more effectively with complex, unfamiliar situations. Their performance is less dependent on the context than that of younger children, who will often show many more limitations.

Many of Piaget's theoretical concepts remain relevant, and appear in the trends described, although often their original form has been modified. Also, while Piaget would have claimed that there are discrete qualitatively different stages in cognitive development, by far the majority of psychologists today would insist that development is much more uneven, is possibly specific within different domains (such as, say, map reading, mathematics, interpersonal understanding, language), and is affected far more by the actual environment and experience of children.

A description can be given only of trends or tendencies in children's development - there are no absolutes. Within specific areas of development there appear to be smaller developmental steps and more continuity in development, rather than the major stages described by Piaget, for instance, where thinking proceeds from lack of logic to formal logical ability in four stages. Individual differences and differences in experience, whether of groups or of individuals, also mean, of course, that it is unlikely that steps may be linked clearly to specific ages of children. Ages when mentioned are only a very approximate guide.

The following trends take as their starting point the preschool-aged child of 3 to 4 years, and show development up to the late primary school years or early adolescence. By the early school years, 6- to 9 -year-olds will be showing greater competence and fewer limitations than younger children. They will show some ability to deal with more complex situations. By late childhood and early adolescence, in the 10–14 age group, thinking will be more context free, better organised and related, and more similar to that of adults. (This is not to say, though, that adult thinking is always free of limitations.)

TRENDS IN CHILDREN'S COGNITIVE DEVELOPMENT - AN OUTLINE

From concrete to more abstract thinking

Thinking is very concrete at first in young children. It then becomes more abstract, especially during adolescence, when children become more able to deal with concepts that have no direct link to the sensory world and rely more on mental reflection and hypothesised relationships.

Because terms such as 'concrete' and 'abstract' are difficult to define adequately and are not discrete categories, but placed towards opposite ends of a continuum or dimension, discussion of this trend appears relatively infrequently in current psychological research. However, experience with young children's thinking convinces many psychologists that there is a valid dimension here, although it may not be easy to describe completely objectively. Nelson (1977), for example, in exploring children's acquisition of concepts, briefly illustrates some of the issues related to labelling thinking as 'abstract' or 'concrete', but retains the terms as useful.

Discussion of children's greater ability to think more abstractly as they develop occurs not only in Piaget's theory of cognitive development (e.g., Piaget, 1970), but also as an important component in Werner's theory (Werner, 1948; Glick, 1983). These theorists suggest that young children's cognitive processes tend to be based on objects and events, and on the characteristics of these objects and events that have a concrete reality or can be perceived directly by the senses. It is only gradually that children develop the ability to deal with more abstract concepts, until eventually they are able to deal with the highly abstract ideas embodied in many scientific concepts and in concepts involved in higher levels of human thought, such as 'justice', 'government', 'progress', 'communication' or 'freedom'. Many researchers studying children's concepts in a variety of areas have confirmed these types of findings, although they may not necessarily have used the terms 'concrete' and 'abstract' (e.g., Bruner et al., 1966; Flavell, 1977; Clark, 1983; Anglin, 1985).

One of the major claims of Piaget's theory is that children do not think logically in the formal abstract sense before adolescence, because logical thought requires the ability to deal with abstract relationships between symbols, and with relationships between relationships, rather than with mental representations of concrete objects and events. In their primary school years, however, children often do demonstrate simpler forms of logical thinking that are fairly concretely based. The research of later psychologists indicates that children may at times demonstrate both types of logical thinking, concrete and abstract, at earlier ages than Piaget would have thought possible, but this type of thinking is usually only in relation to objects and events that are a very familiar part of their experience (Bryant, 1974; Donaldson, 1978; Gelman, 1979; Gelman & Baillargeon, 1983; Gelman et al., 1986).

From surface processing to deep processing of information

Younger children tend to take objects and events very much at face value. Unless they are specifically prompted, or unless a matter is of particular interest to them, young children tend to make relatively few attempts to go beneath the surface of events or situations in order to construct other realities, infer causes or reasons that can account for surface appearances, or predict future events and relationships. They may ask 'what?', 'when?' and 'how?' type questions frequently, but are far less likely to ask genuine 'why?' or 'what might be?' questions.

Again Piaget's work is of major relevance here, particularly where he talks about *static* or *non-transformational* thinking. However, his findings have been modified by the work of more recent theorists who in some circumstances find greater competence in young children and prefer terminology such as 'surface' and 'deep' processing (e.g. Flavell, 1977).

Piaget considers that before the age of 6 or 7 years children's thinking tends to be static or non-transformational, as noted above: it deals largely with mental representations of what is currently perceived, not with other possibilities and relationships not immediately apparent. He holds that young children are unable to mentally manipulate relationships between items of perceived information, or to consider other simple logical possibilities that could exist or could have preceded the present situation. Their reasoning would therefore not be logical, and would often lead to invalid conclusions because events would be linked on an ad hoc basis to what was currently observed to co-occur.

Follow-up research by many other psychologists has shown that young children are capable of making inferences about events and relationships they have not perceived directly (e.g., Paris et al., 1977), especially if prompted to do so. However, these inferences are frequently not necessarily logical, but are simply based on their own individual expectations as derived from past experience. As a result, a large proportion of young children's inferences may be inappropriate overgeneralisations, or may be based on inadequate consideration of relevant factors.

Young children are most likely to make spontaneous inferences in situations that are significant to them and can be easily related to past experience. As children develop they become capable of making more inferences, and inferences become more complex and more logically based.

However, recent studies by psychologists investigating comprehension and school learning have found that there tend to be individual differences here. Some children will continue, in adolescence and then adulthood, to rely greatly on surface processing rather than the deeper processing and analysis of the meaning and significance of events (Entwistle & Ramsden, 1983).

From centred thinking to complex integrated thinking

References to this tendency keep appearing in the work of many different theorists under different labels. However, the basic idea is the same.

Piaget talks about young children's thinking being 'centred', by which he means that both their perception and reasoning deal only with very limited information from all that is available. They 'centre' on only one or two aspects of a situation that are salient to them, and may not notice more subtle information. Hence they often relate together just one or two features, without being aware of the relevance of other information that could be differentiated and related together in an integrated whole. As children develop, however, their thinking becomes less centred, and they become capable of relating more information to a logical whole.

Werner, in his writings (1948; 1957), describes children's thinking in the early stages as 'global', 'diffuse' and 'undifferentiated'. Development leads to a state of increasing 'differentiation, articulation and hierarchic integration'.

According to Gibson's account of perceptual development, one of the major changes is that perception becomes more differentiated. Children become capable of detecting more of the distinctive information and 'affordances' offered by the environment and of the structural relationships that exist between items of this information (Gibson & Spelke, 1983). The 'affordances' of the environment are what it 'offers' the perceiver. Places, objects and events all offer affordances. For example, a fire affords warmth, a shed affords shelter, an apple quarter affords juiciness. As children develop, they differentiate more of the distinctive invariant properties of places, objects and events, and the higher order relationships that exist in the flow of stimulation.

In all of these accounts there is the notion that children's pick-up of information is very inefficient at first, being either global and non-differentiated in novel, complex situations, or else centred only on a few details. As children become capable of detecting and relating more of the parts to each other and to a relationship within the overall whole, their perception and thinking become less random and more goal-oriented and strategic. They are more likely to know what is relevant and to be 'conceptually driven' in their tasks, rather than gradually building knowledge from the bottom up.

From greater reliance on 'bottom-up' processing to more 'top-down' processing

When we are identifying and interpreting any situation or event we generally use both top-down and bottom-up processing. Top-down processing is also known as 'conceptually-driven' processing, and bottom-up processing is also known as 'context-driven' or 'data-driven' processing. In the former, the attempt to find meaning is guided by already existing cognitions such as concepts and hypotheses; alternatively, a cue or cues within the context may set up an expectation as to what is to be identified or understood. In bottom-up processing, there are no preconceived ideas, and the search for meaning is more laborious, requiring the linking of various stimuli in the external context until recognition or interpretation is gradually built up. This notion of the two different types of processing (which are nevertheless complementary) has been found very useful by researchers in fields such as perception and attention, comprehension, planning and problem solving (e.g. Karmiloff-Smith, 1984).

Older children and adults tend to use top-down processing much more often and more effectively than young children. Because of their greater experience and knowledge, their processing is more organised and goal oriented. However, younger children may also use top-down processing—this is revealed, for example, in their attempts to identify the meaning of an unfamiliar word by relating it to the context of the whole sentence rather than by letter-by-letter analysis.

From egocentrism to an understanding of different points of view

One of the concepts made famous by Piaget is *egocentrism.* He did not originate the concept, but made it a central feature of his early theorising. He suggests that young children are so centred on their own perceived experience and so static in their thinking that they are unable to make the mental transformations necessary to work out what someone else's point of view or inner experience might be when it is different from their own. In addition, they may often explain events in terms of their own experience without the realisation that other factors are necessary for appropriate explanation. This egocentrism is never fully overcome, even by adolescents and adults, but, as children become capable of logical thinking, they usually become capable also of going beyond their own viewpoint to work out that of others.

Over the decades a very large body of research has been sparked off by this concept (e.g., Flavell et al., 1968; Flavell, 1974; Chandler, 1976), which has led to its being much modified and refined. It appears that egocentrism is not a global response to all situations, but depends very much on task demands. These may vary very greatly, and may often be very complex. Flavell (1974), for example, has analysed what is required in taking the viewpoint of another. He has suggested that there are three main steps involved (a fourth step, initially mentioned, is omitted in later work):

1. *Existence* - Knowing that there is such a thing as an inner experience or perspective, and that the perspective of others may be different from our own.

2. *Need* - Knowing that an analysis of another's perspective is called for in a particular situation and needs to be inferred.

3. *Inference or prediction* - Possessing and using the necessary knowledge and intellectual skills to analyse and infer accurately another's perspective, which will be quite variable in different situations; very complex mental manipulation may be involved in analysing and inferring.

These steps are all necessary at any one time, and are not developmental steps.

Flavell's many follow-up research studies, as well as those of other researchers, have drawn attention to the variety of factors that could influence the steps involved in taking another's viewpoint, including the complexity and the familiarity of the situation and its significance for the child. The studies have found that young children are certainly not always egocentric when the demands of the situation are relatively simple. A great deal depends on the level of difficulty involved, especially in making the actual inferences at step 3.

As children develop they are able to make more spontaneous and appropriate inferences about other people's inner characteristics, experiences and perspectives, making use of more subtle cues and using more complex reasoning. However, older children and adults will often continue to show egocentrism at times when their own experience and viewpoint are very compelling.

From a limited knowledge base to an extensive, well-organised knowledge base

As children develop, their knowledge base stored in long-term memory becomes not only more extensive, but also more refined and interrelated. Many psychologists use the term 'schema' to refer to any inferred organisation of information in memory. Schemas include not only 'knowledge that', but also 'knowledge how', which includes procedures, rules and strategies.

As children develop, more items of knowledge get related into schemas and more relationships are forged between schemas. To quote Thomas (1992):

> *In a sense, the young child's knowledge base is like a small, very loosely woven fabric, knit with only a few strands of memory traces and with the simplest of stitches. In contrast, the adolescent's long-term memory is more like a widespread fabric of intricately interwoven strands forming complex patterns.*

All this of course means that in any situation an adolescent can bring far more appropriate knowledge to bear than the young child, including a variety of mental strategies and procedures.

From relatively few to many automatic processes of thinking

Adults depend to a large extent on automatic processing in the performance of cognitive skills, and indeed for any type of skilled procedure or routine performance. Only recently has this been considered in relation to children's cognitive skills, although some psychologists during the 1970s had recognised automatic processing as relevant to children's motor skills, using the term 'subroutine' to refer to a component of a motor skill run off apparently automatically (Bruner, 1970; Connolly, 1970).

The whole topic of automatic processing is very much of current concern to cognitive psychologists within the information processing framework, and some issues relating to clarifying the concept have not been resolved. However, a distinction is generally made between 'automatic' processing and 'controlled' processing (Schneider et al., 1984; Logan, 1988; Bjorklund, 1989). Automatic processing is fast, is usually fairly effortless, is not usually available to conscious awareness, and occurs in parallel with controlled processing. Its very big advantage is that it does not make demands on attention and working memory, and so frees the individual to process more information at any one time. It develops as a result of learning through consistent practice. The more a mental or motor operation is used, the less effortful it becomes.

Most tasks, both cognitive and motor, probably require a combination of automatic and controlled processing. Automatic processing covers the habitual skills required, while controlled processing is needed to deal with change and novel aspects. Controlled processing is slow, effortful and conscious, and makes demands on working memory and attention that may be difficult to meet. It is required whenever we must deal with novel situations or novel components of a situation. Consider, for example, learning to drive a car for the first time, with all the demands for cognitive processing and rapid sequencing of actions such as changing gear, accelerating, and monitoring traffic, pedestrian signs and signals, etc.

Young children have of course not had the experience and practice necessary for developing many automatic processes of thinking. What might appear to the adult to be simple tasks can be very demanding cognitively for the young child, for example getting a spoonful of food to the mouth without spillage while watching what someone else is doing. As automatic processes gradually develop with experience, they free up the child's mental capacity to devote effort to other areas (Case, 1985). This means that older children, in comparison with younger children, can deal with far more complex situations. They do not have to pay attention and devote working memory capacity to the processes that can be run off automatically without conscious awareness. They can process far more information at any one time.

As a process becomes automatic, it can be carried out in parallel with other processes. As a result, the child can deal with two or more tasks at a time rather than one at a time.

From slow to fast speed of processing

Research by information-processing theorists (e.g., Kail, 1986; Kail, 1991; Stigler et al., 1988) indicates that there is a consistent increase with age in the speed of processing. This appears to influence all aspects of cognitive processing and many different types of tasks. It appears to influence the initial encoding of information, the processing the information receives and the response time for action following the processing. The longer the time taken for that processing, the fewer resources or capacity for other information. It is possible that many cognitive limitations in younger children, as compared to older children, may be due in part to this factor.

Researchers do not agree about whether maturation is responsible, as Kail claims, or whether other factors could influence the speed of processing. It appears, for example, that practice in and familiarity with a particular task may lead to some automatic processing, freeing up mental resources and so leading to greater speed of processing overall (e.g. Roth, 1983).

From apparent lack of metacognition to increasing metacognition

The term 'metacognition' came into use in psychology in the 1970s. This concept has two interrelated aspects. It refers both to knowledge of one's own thinking processes and the contents of thought, and to the ability to exert some control over these processes. It is shown, for example, in reflective mental processes such as planning, devising strategies, monitoring, predicting and evaluating.

There is some controversy over just how conscious metacognitive processes must be. There is no doubt that the ability to verbalise aspects of one's own thinking processes indicates metacognition, but sometimes there seems to be a more implicit awareness that may be difficult to express in words. So, while metacognition probably does not always require a consciousness that can be verbalised, there must be evidence of control of thinking processes.

Research indicates that higher levels of skill in cognitive processing, including all but the simplest levels of problem solving, appear to depend on high levels of metacognition in order to regulate thinking appropriately and effectively (Brown et al., 1983). The component cognitive processes involved in problem solving, for example memory, perception, attention, comprehension and prediction, frequently require problem solving in themselves, with attendant demands on metacognition. To illustrate, perception may involve the problem of trying to identify an approaching object; memory may involve the problem of trying to recall information relevant to the current situation. When situations that originally posed problems become familiar, they can be dealt with by routines and habits. As soon as novelty is introduced, however, problem solving and metacognition are again required.

Metacognitive knowledge involves not only awareness of one's own thinking processes, but also knowledge of some of the factors that *influence* these. Flavell and Wellman (1977) have suggested that there are three types of factors involved here: knowledge of person variables, knowledge of task variables and knowledge of strategy variables.

The person variables include knowledge of one's own thinking abilities as well as of the abilities of others. For example, this could include knowledge of how good one's memory is, or of how well one has understood a chapter in a book. Knowledge of task variables includes knowledge of the demands of the task, such as whether it is novel, complex, lacking in specific information and so on. Knowledge of strategy variables involves a knowledge of strategies and procedures, such as those of using trial and error, conducting an organised search for further information, or concentrating one's attention fully. Of course, as well as knowledge of strategies, there must also be active use of these, which is where the self-regulatory function of metacognition comes in.

As children develop, metacognition also develops. They become more aware of their cognitive processes and thought content and become capable of exerting greater control over these for more efficient problem solving and reasoning.

Much of the current research on children's metacognition is carried out in relation to specific cognitive processes. However, research on metacognition is also a feature in the studies in a newer area of research called 'Theory of Mind'. This is a topic that in general covers areas that used to be discussed under headings such as 'Egocentrism versus social perspective taking', as well as under more general coverage of metacognition. It involves study of both one's own mental processes and the mental processes of others.

Three- and 4-year-olds seem to have very limited awareness of mental processes. It is apparent, though, that they have some awareness of their ability to remember, to dream and to have intentions. But they may sometimes confuse these, and do not always distinguish between internal mental events and external events. It is also fairly rare for them to attempt to control thinking spontaneously, although they may sometimes, for example, make efforts to remember in response to specific requests from adults. In this preschool age group, children are also starting to be aware of differences between their own mental processes and those of others, especially those processes relating to simple visual perspectives.

As children develop during the school years they become able to distinguish more effectively between different mental processes. They also become aware of task factors that make processing either easier or more difficult, and of their own competence in various areas such as memory. For children to control cognitive processes, much depends on the degree of familiarity or complexity of the task and its meaningfulness for them. Even 5- and 6-year-olds will often show some attempt to control attention in some classroom tasks, and may make attempts to make memory tasks easier by using concrete cues to remind them. Often they will also engage in some simple preplanning before carrying out tasks, but it is usually not until late primary school age that planning becomes more detailed and co-ordinated. The 5- and 6-year-olds tend still to engage in much overt trial and error for complex problems. They engage in little prediction, and, for tasks requiring more complex processing, do not usually monitor how well they are succeeding.

Summary

All of these trends are significant for cognitive development in general. They lie behind many of the findings in cognitive development research that show evidence of increasing competence with age. They are also relevant to the problem-solving processes involved in the tasks that children face as pedestrians. The concepts discussed here will reappear often in this report.

GENERAL EDUCATIONAL IMPLICATIONS

The limitations in young children's knowledge and in their ability to solve problems as efficiently as older children lead to the question: how can adults best equip them to deal with traffic and behave safely? The answer would be to combine realistic expectations of what they can accomplish with attempts to help them become more proficient.

Having realistic expectations about young children means taking into account many of the general aspects of development. It also means keeping in mind more specific aspects revealed by the research. These will be discussed in this report.

Helping children to become more proficient in traffic contexts involves not just helping them to acquire more knowledge, but also helping them to become more efficient problem solvers. Probably the majority of theorists and researchers currently working in the field of cognitive development would agree that, for young children, what can be accomplished by direct instruction is limited.

The research suggests that children's learning and their further development are most likely to occur when they are *actively* involved in constructing their own knowledge. They may do so either by individual effort, or in co-operation with a more experienced partner, usually an adult. Children do not passively absorb direct instruction, but must fit it into their own existing knowledge and understanding, making of it something uniquely their own. They often devise their own strategies and draw their own conclusions about relationships that may not always fit with adult ideas or what adults think they have taught children. However, if adults can take this into account and gain insight into what children's current levels of understanding and ways of processing information are like, they can act in co-operation with children to provide subtle guidance, support and suggestions, and to model appropriate ways of processing information designed to fit with the child's current level of thinking.

This means that, if children are to develop an understanding of the risks involved in traffic situations and to solve problems in order to behave safely, they need guidance by adults within actual traffic contexts.

CHILDREN'S PROBLEM SOLVING AS PEDESTRIANS: REVIEW OF CHILD DEVELOPMENT RESEARCH

INTRODUCTION

The main part of this report, which follows, reviews a considerable body of specific research on child development that is relevant to the various components of the problem-solving task for children as pedestrians. It includes, also, a comparatively small number of studies that research children's traffic behaviour and understanding more directly. There have been very few direct links made between child development research findings and children's competence as pedestrians. Even when links are made, the discussion of children's development is often too brief to contribute greatly to further understanding.

As stated previously, while there is relevant research in many areas of child development, the most relevant research is that in the area of cognitive development. The developmental differences reported in these studies will be seen to reflect many of the general trends in cognitive development discussed earlier.

The research is reviewed under the headings of the problem-solving components:

- Realising a problem exists
  - in the immediate context
  - in contexts extending over time and space
- Searching for relevant information
- Drawing on existing knowledge and procedures in memory
- Linking information to comprehend, reason and predict
- Planning and devising strategies
- Taking action to reach the goal

REALISING A PROBLEM EXISTS: IN THE IMMEDIATE CONTEXT

When children are negotiating traffic situations, constant reflection and monitoring is necessary to assess what is happening in the current context, and any problems that arise. If children act impulsively, that is, they do not use the monitoring process, they may fail to realise there is a problem, and a potential threat to safety. There is reason, therefore, to consider the research on impulsivity in children.

Impulsivity and self-control

The concept of impulsivity has attracted some attention in child development research recently. Block, who is a major researcher in the area of 'ego control', defines 'impulsivity' as 'acting on impulse', (1980), but this is simply a rewording that does not help to define the concept more specifically. Impulsivity is a complex concept embodying a number of related but different meanings relevant to a variety of different situations. Some of the situations are more emotionally involving and require controlling actual behaviour as in resisting temptation, while others are more cognitively involving, such as making the effort to work through a puzzle carefully.

Various researchers use the concept rather differently and also use different concepts, not just self-control, as the other end of the continuum to impulsivity. For example, Kagan et al. (1988) refer to the reflection–impulsivity dimension. For researchers such as Kopp (1991) or Harter (1983), impulsivity is contrasted with self-regulation as well as self-control. Harter considers that self-regulation involves taking organised action to reach a goal, while self-control involves inhibiting an action. Other psychologists describe self-regulation as meaning regulating behaviour to conform with adult expectations, while others again seem to use the two terms interchangeably.

A reading of the research on impulsivity shows that it covers both mental processing and physical actions where little or no control is exerted, such as:

- *failing to stop or slow down* activities where necessary
- demonstrating an *inability to tolerate frustration*
- *failing to exert control over the expression of impulses and emotions*
- carrying out *activities* to reach a goal *without planning or organisation of responses*
- *acting without forethought*
- demonstrating an *inability to delay immediate satisfaction* in favour of more distant rewards
- *allowing attention to be distracted* by irrelevant stimuli
- *paying insufficient attention to relevant aspects* of a situation
- *failing to comply with adult standards for 'good' behaviour*

In the variety of situations where impulsivity can occur, some or all of these components may be included. In traffic situations where children act impulsively by darting out onto the road, all of these problems may occur and children will neither realise that a problem exists nor attempt to control thinking and action appropriately. Research on impulsivity can throw some light on some of the developmental and individual difference factors involved, together with possible sex differences.

European and American research on traffic accidents involving children pedestrians indicates that the most common cause is impulsively 'darting out' into traffic without taking sufficient care. This is claimed as a cause of up to 80% of the accidents involving children of preschool age. There tends to be a gradual decrease with age, but darting out is still a major problem for secondary school children. It is also an important cause of accidents in child bicyclists (Sandels, 1970, 1975, 1979; Grayson, 1975; Van der Linden & Goos, 1975; Russam, 1977).

At those times when children dash out between parked vehicles it may be that they simply have not realised that their vision is blocked and that there could be traffic approaching that they have not seen. This may be related to young children's limited processing of a situation, where they centre on what is immediately apparent and directly perceptible, without considering what lies beyond. However, impulsivity of behaviour is also likely to be a major factor in such cases.

Impulsivity is clearly evident in contexts where children simply dart onto the road to chase a ball or to meet up with a friend on the other side, or simply step onto the road to cross it without any attempt to ascertain whether it is safe to do so. There is an immediate response to a desire or compelling motive, without any forethought or attempt to monitor for safety. The situation is similar when children ride a bicycle or in-line skates straight out of a driveway onto a road. This impulsivity in young children is well recognised - younger children are said to be more impulsive than older children, adolescents and adults (e.g. Vinjé, 1982) - and is often cited as one of the most likely causes of accidents.

Research on impulsivity and self-control

Although the impulsivity–self-control factor is such a complex topic, the research has made some attempt to explain development as well as to describe it. In general, researchers suggest that the development of the ability to control impulsivity is influenced by three main factors:

- *Innate factors:* these include both maturational factors common to all children, and genetically influenced individual and sex differences. For example, there appears to be a need for maturation of the nervous system before children can successfully inhibit and slow down actions. This begins to develop in the preschool age group, but development is slower in some children than in others. Some children, from a very early age, appear to be more impulsive than others and remain so as they develop.

- *Developing cognitive ability:* this aids children in foreseeing outcomes, anticipating future goals and using verbal and other strategies to guide their control, organisation and inhibition of behaviour.
- *Experience,* particularly the guidance of adults: this is necessary at first until children become more autonomous, and aware of the advantages of self-control. As discussed earlier, many studies have shown that young children's compliance with adult standards and expectations about control depends heavily on their having trusting relationships with caregivers who are sensitive to their needs and respect their developing understanding.

The development of self-control

Aspects of the development of the impulsivity–self-control dimension that seem relevant to children's traffic behaviour in general and to dart-out behaviour in particular are studied in some research. This research is related to:

- delay of gratification
- inhibition of motor responses
- control of impulses and emotions
- control of attention

All of these aspects are relevant to the likelihood of the child's stopping and thinking before entering traffic. The control of attention is a major topic in its own right, and discussion of this topic will be reserved mainly for a later section on attentional processes.

The beginnings of aspects of self-control appear in infancy and develop gradually throughout the childhood years. By 2 years of age, many children start to comply with adult requests or commands to refrain from action or to wait for brief periods. Some of these children direct their interest to other activities for short periods. Others, however, may become impatient or angry if their immediate wants are not satisfied.

During the preschool years most children can tolerate some delay and frustration of immediate impulses without anger, but may need to have their attention diverted. By 5 or 6 years, children become more capable of consciously looking for alternative activities to fill in a waiting period. They are also able to think ahead more often and to anticipate mentally the future satisfaction of their needs. However, this ability is fragile and can easily be disrupted even in older school-age children. Some adolescents and adults also have a low tolerance of delay or frustration, owing to the nature of their experience as well as aspects of temperament.

Inhibition of motor responses also develops gradually during the early school years, as Maccoby (1980) points out. Children younger than 5 years, and even some older children, have trouble with 'ready, set, go' signals. They frequently 'jump the gun'. In addition, several researchers have found that once preschool children have initiated an activity they often find it difficult to stop (Miller et al., 1970). Similarly, preschoolers can often carry out a motor task such as walking a path at a moderate pace, but have trouble carrying out the same activity slowly.

Over the years between 3 and 6, there is a gradual increase in the ability to moderate the pace of actions (Ward, 1978). Maturation seems to be an important factor in this area.

Modulation of emotions and of the behavioural expression of these also begins during this period. Young children seem much more aware of emotions than of other 'inner experiences', probably because of the physiological components of strong emotion such as increased tension and heart rate. In addition, adults are also uncomfortable with strong emotion displayed by children and try to tone down a high degree of anger, upset or excitement. As a result, preschoolers start to show some signs of control over the more negative emotions, and this control continues to develop into the later years.

Although the research has not focused strongly on the lability and intensity of emotions, these have been recognised by many psychologists as an aspect of individual temperament. Some children have more difficulty than others in controlling emotions.

Two aspects of self-control are closely related to cognitive development. These are the delay of immediate gratification, which is related to future-time orientation, and the selection of relevant information from competing information, which is particularly related to cognitive development, as children develop over time an understanding of their own cognitive processes and the need for some control and organisation of these.

The ability to delay gratification is dependent on the ability to think ahead to some more desirable goal rather than centring on immediate impulse. Children in the preschool years are capable of anticipating some future goal, but usually not in any logical, planned way, and with very immature concepts of time (Piaget, 1962). Mischel carried out many studies in this area (e.g., Mischel & Metzner, 1962). He found a markedly age-dependent trend in children's ability to wait and control their impulses. While only 28% of 5-year-olds were able to wait for a reward that was larger than an immediately obtainable reward, 62% of 11- and 12-year-olds were able to delay. As Karniol points out, 'Self-control (in these situations) appears to depend on one's ability to cognitively manipulate the values of different outcomes' (Karniol & Miller, 1981).

In many cases, the amount of self-control used will depend on the demands of the situation. Younger children will of course have difficulty in weighing up outcomes when more abstract concepts are involved, such as those related to safety.

Although most of the research on self-control has naturally not been directly related to traffic situations, it is apparent that many of the findings have significance for such contexts. There appears to be a clear developmental progression throughout the childhood years in the various components of impulsivity–self-control, as well as specific situational variables that will influence the child's behaviours at any stage in his or her development. Younger children, who act impulsively in response to immediate desires, motives, and emotions, or who cannot readily inhibit actions once started, cannot be expected to be aware of many of the problems posed for the safe negotiation of traffic.

Individual differences

There is a large body of research on individual differences in impulsivity that requires some discussion. Kagan, mentioned earlier, was one of the first to describe a reflection–impulsivity dimension. He considered that there is a cognitive style, what he calls a 'conceptual tempo', that varies from individual to individual over and above developmental differences. Children who have a very quick decision time and make many errors are categorised as impulsive. Those who have a slower decision time and make few errors are regarded as reflective. In order to assess this style, he used a perceptual task, the Matching Familiar Figures test, where children had to pick a match to a standard from among an array of many similar figures. It involved making a decision where there were many choices, but only one was correct.

There are, however, problems with this test, and the concepts of reflection and impulsivity remain controversial to some extent. For example, a child who gives quick, accurate responses does not fit either category, reflective or impulsive. It is the number of errors alone that seems to indicate the degree of reflection or impulsivity. The error measure is also more likely to correlate with other variables relating to both personality and intelligence. The swiftness of response does not on its own correlate highly with either of these. It appears, then, that intelligence could be a confounding variable in this type of test, although it is not sufficient in itself to account for all of the differences between individuals (Bjorklund, 1989, pp. 272–4).

Although the concept of impulsivity in this type of research study is somewhat 'fuzzy', there have been a large number of studies to investigate impulsivity using the Matching Familiar Figures test. It has been found that there appear to be stable differences between individuals over time. It has also been found that boys are more likely to be assessed as impulsive on this measure than are girls, particularly in the earlier years.

There have been strong correlations with other tests designed to measure self-control. The Matching Familiar Figures test seems particularly relevant to situations where perceptual and cognitive judgments are important and emotional and motivational factors are less important.

It may be that the aspects of self-control assessed in reflection–impulsivity studies are more relevant to the decision-making processes involved in making judgments in traffic than to darting-out behaviour. The latter behaviour may, at least sometimes, be the result of a lack of decision making, and is possibly more affectively based.

Sex differences

In reviewing a variety of broadly based research studies on sex differences in impulsivity in children, Block (1983) concludes that boys are less able than girls to delay gratification and tolerate frustration, are more likely to take risks, and have more difficulty in controlling impulses. These claims are still causing controversy, as are the possible factors involved in sex differences. There continues to be a major split between those who assign the causes solely to experience and those who assign it to innate factors.

Research on impulsivity specifically related to children as pedestrians

As a result of her comprehensive research studies in the 1960s and 1970s, Sandels (1975) claimed that many traffic accidents involving children could be related to children's greater impulsivity compared to adults'. She did not, however, investigate impulsivity specifically as a factor in road crossing and other traffic behaviour.

In order to investigate this hypothesised relationship experimentally, Vinjé (1982) devised and carried out a small set of tests and experiments with young children. In these experiments, Vinjé's major hypothesis was that impulsivity in the children in her sample, aged 4 to 8 years, would lead to unsafe road-crossing procedures.

She compared children's behaviour in control and experimental conditions in actual road-crossing tasks on a quiet street. In order to gain some quantitative assessment of their impulsivity, she also measured their performance on a reflection–impulsivity scale (similar to Kagan's) and in a battery of paper-and-pencil tests intended to measure control of attention. The selection of tests is rather narrow; as has been discussed, the construct of 'impulsivity' is much broader than this.

In the experimental conditions of the first study, children aged 4–6 years were variously distracted when crossing by:

- a passing jogger

- a promised reward
- two additional tasks to carry out for the experimenter as their purpose in crossing

These were intended to bring in motivational and interest factors as variables. There were no distractions for the control group.

Performance in crossing was measured by awarding points for walking tempo, stopping at the kerb, looking left, looking right. Children in the experimental condition performed less well than children in the control group. There were no developmental differences in this 4–6-year age range, but girls performed better than boys. The 'distraction' provided by the jogger did not appear to affect performance, but the other distractions did.

In a subsequent small experiment with 4–6-year-olds, a child using a 'tooter', or calling out, was used as a distraction, since the jogger had been ineffective. However, the performance of children under these conditions was not significantly different from that of the control group.

A third study with the same conditions compared children in the 5-to 8-year age range. Here the performance of the older children was of a significantly higher standard.

The crossing performance of children in the experimental groups was compared to their performance on the various tests. There was no relationship with the reflection–impulsivity scale, but a factor analysis of the other tests and performance showed a relationship with a factor Vinjé calls 'distractibility'.

While these experiments of Vinjé's are useful in that they actually measure children's performance in crossing when distracted and suggest some of the deleterious effects of distraction, they also indicate the difficulties of investigating impulsivity, especially in constructing operational definitions that capture some of the complexities of the concept. Attempts to divert children's attention by introducing a passing jogger or a child using a 'tooter' seem only remotely relevant to real-life conditions that are likely to cause children to act impulsively when crossing roads. Examples of the latter include trying to pick up a ball that has rolled onto the road or responding to a friend who is calling from across the street.

The tests used by Vinjé to assess impulsivity do not allow conclusions to be drawn about impulsivity as such, but point, rather, to the narrower concept of distractibility as a factor involved in some inappropriate, unsafe behaviour in traffic. Distractibility, which is a failure to control attention, will receive further discussion in a later section.

Implications for future research

There would appear to be an urgent need for well designed studies assessing children's impulsive behaviour and relating this to their problem solving and general performance in traffic. It is important to analyse the concept of impulsivity very carefully and consider all of the other aspects of impulsivity that, in addition to distractibility, are likely to be specifically relevant to the traffic context. How do these vary with development, and in what ways are they, perhaps, a result of individual and sex differences? It is also important to know which factors within a traffic context are likely to prompt children to act impulsively, and how these vary among individuals.

Implications for traffic education

In order to discover what is required in educational programs aimed at lessening children's impulsivity in traffic, there is a need to build on research findings from the type of study suggested above. In the meantime, however, even without a full understanding of causes, it would be worth exploring techniques devised by some psychologists for helping children to develop self-control, and applying them to real or simulated traffic situations.

Psychologists such as Kendall and Finch

(Kendall 1985; Kendall & Finch 1979) have been involved in self-control studies with children over a number of years. Their techniques are directed to the whole problem-solving process, not just the identification of a problem. They rely on children observing adults who both model appropriate self-control behaviour, and provide guidance indirectly through verbalised self-instruction techniques. The aim is for children eventually to incorporate such techniques spontaneously into their own behaviour. The focus has been on trying to get children to stop and think before acting, and to consider the possible effects of their actions. These researchers have had some success with their techniques, and have been able to show that children may continue to use them in situations that vary in some aspects from the original situation. In other words, there does seem to be some transfer of learning.

As discussed near the beginning of this section, while control of impulsivity appears to be dependent in part on biological factors such as maturation and temperament style, guidance from trusted adults who can serve as a model also seems to have a significant part to play. This would be an important area for further research in relation to traffic education.

Concepts of safety, danger, accident

Behaving cautiously and safely requires understanding that there is a problem – that there could be a variety of threats to safety that must be considered and dealt with. The question is, when do children have the concepts of safety, danger and accident necessary for safe pedestrian behaviour, and how do these develop? As stated in the section on protective measures, it is because adults realise that very young children do not have appropriate safety concepts that they make rules and devise protective measures. But it is important to discover how and when mature concepts develop. Expectations of young school-aged children are often much too high.

Having a general conception of 'danger' involves understanding that, if the individual enters a situation inappropriately or interacts inappropriately with objects or people, situations or objects in the environment have the potential to cause harm. It also involves understanding that some situations are less predictable than others. If the danger involves the actions of other people, unpredictability is a much greater factor. Then understanding danger means realising that it is not necessarily known whether and how another person might act to cause harm.

For pedestrians, danger is due mainly to the possibility of injury or death resulting from collision with a vehicle. For drivers of vehicles, vehicle passengers or cyclists, the danger is due not only to the possibility of collision with another vehicle, but also to other forms of impact if there is a loss of control of the bicycle or vehicle.

The concept of safety is somewhat ambiguous in relation to the concept of road safety. While the usual meaning of 'safe' is 'free from harm', the concept, in the context of road safety, safety belts, safety helmets and safety procedures, is more variable, and includes meanings such as 'avoiding harm', 'making harm less likely', or 'lessening the degree of harm'. It is doubtful, in fact, whether there are many traffic situations that could be regarded as completely safe and free from possible harm.

The concept of 'accident' is also not simple, and is frequently ambiguous. An accident could be due to a chance happening, but more often, in the case of a road accident, it is an incident that is not intentionally caused but where there has not been enough care exercised by one or more of the people involved.

If children do not have valid concepts for all of these and other relevant terms, their problem solving and their behaviour in traffic are often likely to be inappropriate, and they are unlikely to understand fully what safety measures mean. A frequently reported example of the effect of children's misunderstanding of concepts is evident in a related area of concern for children's safety. When they are being warned about 'stranger danger', anecdotes reveal that many young children have very inappropriate concepts of this. They do not know to whom to apply the label, nor the nature of the actual danger. For example, a mother of a 5-year-old reports that, after a police safety lesson at school, her child described a stranger as 'a man who gives you lollies'.

Many of the general trends in children's cognitive development outlined earlier are relevant to an understanding of the nature of their development of concepts. If these trends are taken into account, it would be expected that young children's concepts would be rather concrete, and centred on only some of the criterial attributes or components of the meaning. These few components might not be very relevant to an overall understanding of the concepts, while significant attributes might be missed. It would also be expected that an understanding of deeper underlying causes of events would not be part of younger children's concepts.

Research on children's concepts of safety, danger, accident

The research here appears inadequate and lacking depth, because it is not related to factors in children's development. A few studies look at children's concepts of danger in general terms, and only one or two look at children's concepts of danger in relation to traffic. The related concepts of 'accident' and 'safety' also appear to have been largely neglected in the research.

Research on the danger concept

A recent example of research on general concepts of danger is an Australian study (Grieve & Williams, 1985) where children aged 3 to 6 years were simply asked to identify, from a set of pictures depicting both non-dangerous and dangerous situations, the potentially dangerous ones. They were shown pictures (photographs of drawings) of situations such as a baby crawling towards spilled medicine capsules, a toddler poking a pen into a power point, a child near a saucepan with handle protruding from a stove, and a boy chasing a ball on the road in front of an oncoming car. The 3- to 4-year-olds performed relatively poorly in comparison with the 5- to 6-year-olds. The younger children apparently did have some beginning concepts of danger, as they identified as dangerous some situations such as the presence of snakes and running on the road, but performed poorly on half of the tasks, where they did not appear to recognise the potential dangers depicted. There were no sex differences in understanding of danger.

Such a study, however, tells very little about the nature of children's concepts of danger. It does not indicate why children saw some situations as dangerous, nor on what they based their judgment, or what could have influenced them. For example, was it simply an object labelled by parents as dangerous that they recognised? It is also possible that the material in these tasks, photographs of drawings, were not always adequately perceived and comprehended by these young children.

The question also arises as to what possible harm to self children of this age are capable of understanding. In studies cited in Bibace's review, mentioned in an earlier section, preschool children's concepts of death and injury, for example, often indicated that they considered these were either readily reversible or easily treated (Bibace, 1981).

In a Scottish study with older children (Dickson & Hutchinson, 1988), 9- to 12-year-olds were given booklets that required written answers to questions about actions they would take to avoid risky situations. They were also questioned about how risky selected situations were. Their responses showed that they were more likely to take action to avoid risk to property than to life, but judged risk-to-life situations as more dangerous. This result the researchers found difficult to explain, although paper and pencil tests are remote from real situations. There were no sex differences in the results. The study raises more questions than it answers. The researchers did comment, however:

> *Encouraging children to be aware of risky situations, as in the case of safety campaigns, is no guarantee that they will understand what kind of response is appropriate.*

Research on the danger concept specific to child pedestrians

Research specifically related to child pedestrian behaviour has been more useful in offering some insights into children's concepts of danger, especially that of Sheehy and Chapman (1985; 1986) and of Ampofo-Boetang and Thomson (1991). However, this research does not go far enough in investigating the nature of the concepts.

Sheehy and Chapman, in reviewing some of the previous research on children's perception of hazard or danger, suggest that psychologists have not been sufficiently analytical. As a start they distinguish between structural and functional concepts of hazard. With *structural* concepts, children focus on an aspect of the environment in *isolation* from other circumstances; with *functional* concepts, account is taken of structural and circumstantial factors that influence whether a *sequence* of actions will be dangerous. Sheehy and Chapman suggest that younger children's concepts of danger may be largely structurally based. Some of the research they review supports this suggestion.

In their own study, these researchers used videos of pedestrian behaviour in order to achieve more realism in the tasks. In studies by other researchers included in their review, drawings and photographs were used, which pose greater problems for children's comprehension. Sheehy and Chapman's subjects were 7-year-olds, 11-year-olds and adults. They used 19 video sequences of child pedestrians, stopping the sequences when the children depicted were 30 cm from the kerb. Subjects were asked to describe what they had seen, especially behaviours of the pedestrian, to predict what the pedestrian would do, and to say whether he or she behaved in a way that was safe or dangerous. They were requested to give explanations for the behaviours they observed.

Contrary to expectations, adults regarded fewer of the 19 videoed situations as dangerous than did children, and boys regarded slightly more situations as dangerous than did girls. Significantly, even when adults and children agreed on the situations that were dangerous, for 12 out of the 19 situations the explanations for the danger given by adults and by children were very different. They agreed on only two of the situations.

Unfortunately, in their report Sheehy and Chapman do not discuss these differences adequately. They point out that explanations could be of three types:

- not genuine explanation, but further description
- social-psychological explanations in terms of motives, intentions etc.
- explanations based on known rules for behaviour, including moral rules

They do not expand on these in relation to children's responses. Findings could also seem problematic in that the experimenters simply asked subjects to say whether situations were safe or dangerous. As pointed out previously, 'safe' is ambiguous in relation to road safety.

It would have been very useful if the researchers had related the subjects' responses to theoretical underpinnings in child development, but this did not occur, nor were the responses related to their theoretical distinction between structural and functional concepts. Did children judge more situations as dangerous simply because they contained salient objects children regarded as dangerous in themselves? And could it have happened that complex situations were too difficult to judge easily and so were labelled 'dangerous' without adequate understanding?

Knowledge of child development would certainly suggest that young children's responses in such situations would be influenced by their tendency to be concerned with concrete, more superficial aspects of a complex situation, as well as their tendency to centred thinking. The responses of the older children - 11-year-olds in this study - would be expected to be more capable, and based on more appropriate concepts. Much more needs to be known about the reasons for the differing interpretations. Follow-up research with a more theoretical child development framework and refined research methods should certainly produce valuable information.

The series of four studies by Ampofo-Boetang and Thomson appear to be very well designed and were carried out in a variety of settings. Again, however, hypotheses about and discussions of children's behaviour would have been more valuable if they had been adequately related to a developmental framework. There is a need to know much more about what lies behind children's behaviour and judgments, and how these change with development.

The main aim of these researchers was to investigate the ability of children aged 5, 7, 9 and 11 years to select safe places to cross the street. As the researchers point out, the British Green Cross Code contains instructions for children to find a safe place to cross, but the crucial question that arises is whether children can judge safe places. Do they have adequate concepts of safe and dangerous places?

The researchers tested groups of children in four different situations. As each study was carried out, the next one in the series was then designed to eliminate variables in the previous study that could have influenced the results. For example, they found that, for the child subject, viewing a table-top model with a doll pedestrian could have caused a possible conflict between his or her own perspective and the line of sight of the doll used as a pedestrian. The second experiment therefore used photographs of the table top taken from just behind the doll. In the third experiment, because younger children persisted in identifying too many situations as safe, the children now had to make choices between pairs of photographs, containing one safe and one dangerous situation. In the final experiment, children were taken to a real traffic environment.

In spite of all of these different task methods, the groups of 5- and 7-year-old children in each experiment consistently identified most situations as safe, including dangerous ones. Their criterion for 'safe' seemed to be 'no cars in view', and for 'dangerous' it was 'car in sight', even if the car was too remote to present a problem. Verbal explanations, which were given readily by children, coincided with this finding: younger children relied on the presence of cars for judgments, and rarely mentioned the other relevant features. Their concepts could be seen as structural, not functional, in Sheehy and Chapman's terms. The researchers report that the only situation the younger children 'correctly' recognised as safe was the zebra crossing. However, this raises an issue worth exploring: zebra crossings are not always safe if drivers do not stop as required.

The 9- and 11-year-old children were able to make much more appropriate judgments, based on more complex concepts and on the recognition that cars obscured from view could present a problem.

Although the authors do not relate their findings to child development, the children's responses in this study appear to tie in with the tendency to centred concrete thinking in young children, and the tendency to consider only the here and now rather than predicting and anticipating possible movements of cars not directly in view.

Implications for future research

Further research is needed on children's concepts of safety and danger at different ages and in different situations. For effective education, it is important to be able to identify the changes in thinking about these concepts that occur as children develop. It is also clear that, depending on the context, children's concepts of danger might vary, but reasons for the variations have not been analysed. For example, in Meyer and Vinjé's study (Meyer & Vinjé, 1978), as reported by Sheehy and Chapman (1985; see above), children aged 4 to 8 years judged three situations as dangerous: running onto the motorway, running onto the street, and running into the playground. Most children considered the first two situations dangerous, and the third was judged dangerous by 61% of the children. The question needs to be asked, 'What was the basis here for children's concepts of danger?', especially for the third situation.

Isolated studies without an attempt to build a coherent picture of children's developing concepts are not adequate. There is also a need for more research that takes account of the possibility that children's concepts and judgments of danger might be different in real situations, as opposed to videos, photographs and drawings.

Implications for traffic education

It is apparent that there is a pressing need to educate children further about the nature of the potential dangers they could face in traffic. It is possible that young children's concepts of traffic danger are based on simplistic interpretations of adult instructions that, for example, forbid running or crossing when any car is nearby. Children need guidance to extend their thinking about issues of safety and danger, and they need to be encouraged to consider interrelated factors that could influence road safety. Children are often instructed to 'Stop, look and listen', or to 'Stop, look, listen and think', yet young children would very likely be unaware of what makes a situation dangerous, and so would not know what to look for or what to think about.

As part of the first and second experiments by Ampofo-Boetang and Thomson in the series discussed above, children were asked to construct routes that they thought would be safe. The necessary scene was before them either as a table-top model or as a photographic representation of the model taken from a position showing the restricted view of the doll pedestrian.

This request was a realistic one, as, in addition to the need to understand the existence of a problem within the immediate context, children in traffic situations will also be in contexts where they will be required to anticipate problems at some later stage, and plan and construct routes accordingly.

REALISING A PROBLEM EXISTS: IN CONTEXTS EXTENDING OVER TIME AND SPACE

As suggested above, on some occasions, child pedestrians need to be aware that they will have to plan a safe route in order to reach a particular destination. Such planning could cut down both the number of crossings required and the accompanying decisions that would need to be made about safety and risk. They could take account, for example, of quieter streets and the available traffic lights and zebra crossings - even younger children would probably regard these as safer for crossing.

Cognitive maps

To plan a safe route, cognitive mapping skills are required: children would need to have the ability to represent mentally the spatial environment involved, and the possible routes. To be aware of the *need* to plan a safe route, they would also require not only appropriate concepts of safety and danger, but also some ability to represent alternative routes to themselves. They would need *knowledge* of neighbourhoods and of spatial relationships between streets and significant aspects of the environment. These hypothetical knowledge schemas are called cognitive or mental 'maps', but of course they have no reality as such. It is thought that individuals do not have an actual mental image in the format of a map, but rather a form of mental representation of some of the relationships and physical details, varying from a representation that is very simple and lacking in detail to one that is quite complex and integrated. The more sophisticated cognitive maps of older children and adults would represent not only individual routes and landmarks but also the relationships between these.

At what stage could it be expected that children might have 'mental maps'? A considerable amount of research has been done on the development of cognitive maps in the child. As a basis for discussion, we distinguish between what Piaget calls 'practical space' and 'conceptual space' (Piaget, 1954). The ability to act in practical space is the capacity to act in space, while acting in conceptual space is the ability to represent mentally, reflect on and manipulate spatial relationships.

Young children of preschool age possess practical spatial ability. They can move around in their immediate environment, return to previous locations, and look for objects, people etc. with relative efficiency. The research indicates that they do this by moving between specific landmarks they have identified (Spencer et al., 1989, review some of this research). At first young children appear to move through home, school or neighbourhood step by step from one landmark to another. In line with the general developmental trends in their thinking, gradually, with experience in a particular environment, they build up schemas for routes which serve to link landmarks. However, the landmarks that children use are often temporary, whereas permanence is required if a landmark is to be used efficiently. Many studies have shown that, when adults accompany young children on walks in a small neighbourhood area or other small-scale environment and point out landmarks, the children learn the routes faster (Herman et al., 1982).

By early preschool age many children can make some links between adjacent routes and spaces in a very small environment such as home or preschool, but do not have a representation of an overall spatial framework in which various non-adjacent routes and spaces in the environment can be appropriately located. As a result of this lack of a wider spatial framework, they are usually unable to infer with accuracy where they are on a route relative to other routes or locations. This is a difficult area to research, however, as young children usually show greater competence practically rather than in terms of verbalisation or another form of communication (Hazen, Lockman & Pick, 1978).

Many 5-year-olds, however, have developed the ability to make simple inferences of this type in a setting with which they are very familiar - though accuracy is not of a high degree. For example, in one study in their own school setting, children used a pointer to indicate with moderate accuracy the direction of a room not adjacent or directly observable (Herman et al., 1985).

The ability to construct and apply mental-spatial reference frameworks to the large-scale neighbourhood of the local area and beyond continues to develop throughout the primary school years and through adolescence. Even a great many adults are not very skilled in this area, and have difficulty orienting themselves in terms of an accurate cognitive map of the environment.

The above findings for children do not mean, however, that young children do not understand aerial photographs. Recognising a spatial environment is much less demanding than representing it mentally without any cues present. Preschoolers can frequently identify some objects in aerial photographs, and by 5 or 6 may be able to interpret them fairly accurately.

The gradually developing ability to represent a spatial framework for large environments ties in with the tendency for thinking, as it develops, to become less centred, and more abstract, integrated and related.

These findings have implications in terms of the planning of safe routes. While children may be able to function quite well in finding their way on familiar routes, it is unlikely that before late childhood most would be able to plan independently alternative routes with safer crossings.

Implications for traffic education

The research indicates that adults could play a positive role in helping school-aged children to develop simple but useful cognitive maps of their nearby environments and the routes they have to travel within these. The role could be both a practical one for parents and teachers and a classroom one for teachers. They could accompany children on different routes in their environment, pointing out landmarks and identifying the most appropriate route for safety. They could also use photographs taken from high vantage points, or aerial photographs if available. This would lead later to the showing of simple maps to assist children's understanding of their neighbourhood. This guidance could be tied in with further guidance relating to the many aspects of safety involved in various routes, and with assisting children to make safe choices of route.

SEARCHING FOR RELEVANT INFORMATION: PROCESSES OF ATTENTION AND PERCEPTION

When children are in traffic situations, there is a great deal of information that must be perceived and attended to. As a first step in our understanding of what they have to deal with, it is important to examine how well children can perceive and discriminate the objects and events in their environment, near and far, that need to be taken into account.

Visual and auditory acuity

The first question to be answered concerns the capacity of children's sensory organs: their visual and auditory acuity. Do their eyes and ears function as well as those of adults?

Visual acuity

There has been a considerable amount of sophisticated research assessing infants' and young children's sensory acuity. Most researchers agree that young children's eyes have matured sufficiently by 3 years for them to demonstrate visual acuity that is close to an adult's; this acuity is fully mature by 5 or 6 years (e.g., Maurer & Maurer, 1988). (Incidentally, their colour vision for the primary colours - red, green, blue and yellow - is well developed by 3 months of age (Teller & Bornstein, 1987)).

However, research results for visual acuity in young children are available only for static, not dynamic, visual acuity. *Static visual acuity* is required when both the observer and the object of observation are stationary, and *dynamic visual acuity* when the observer or the object or both are in motion.

Williams, the author of a text on perceptual–motor development (Williams, 1983), claims that dynamic acuity is less advanced than static acuity and continues to develop through the first 20 years of life, with boys' acuity being better than girls'. It is not possible to assess Williams' claims, as her text does not provide any details of her experiments. She may be underestimating children's acuity to some degree, as she states that static visual acuity in children is not fully developed until they are 10 years old. Nevertheless, as shown in research on adults related to dynamic visual acuity, this skill is frequently much less developed than static visual acuity - even in adults.

Studies by Ludvigh and Miller (1953) and by Burg and Hulbert (1961) indicate that, in adults, visual acuity declines markedly as the angular velocity of an observed object increases. The greater the velocity, the less relationship there is between static acuity and dynamic acuity; that is, dynamic acuity for objects moving at very slow speeds is similar to acuity for static objects, but the faster an object moves, the less relationship there is to performance on tests for static visual acuity. There is a very marked fall-off in acuity for fast-moving objects. This relationship holds whether the object of observation (Sanderson, 1972) is on the horizontal plane or the vertical plane. It is suggested that dynamic acuity involves the efficient co-ordination of the whole extraocular muscular system, and that there are possibly large individual and developmental differences. It is relevant that Burg and Hulbert's study was carried out as part of ongoing research to investigate driver efficiency. They believe that, for car drivers, dynamic visual acuity is at least as important as static visual acuity.

There is, therefore, clearly a need for research investigating dynamic visual acuity in children, and the changes that occur with development, for if it affects driving performance, it must also affect pedestrian performance.

Visual limitations due to body size

The fact that young children's small stature will often limit their visual range should not be overlooked. They will not be able to see over parked cars, for example. A separate issue is, of course, that they may often be unseen by drivers.

Auditory acuity

The auditory capacities of children have not been researched to the same extent as have the visual. Research studies of auditory thresholds have been conducted for young children up to 2 years (Schneider et al., 1988), but it is difficult to find research on older children.

For both children and adults, the loudness of sounds necessary to make them audible depends on their frequency. Sounds at low and high frequencies need to be louder than middle-frequency sounds in order to be heard. By 2 years of age children's hearing for middle frequencies is equal to that of adults, but sounds need to be louder for them at low or very high frequencies. Hearing appears to reach adult level by 5–6 years.

An issue that is relevant here, although unrelated to child development literature, is the frequency of ear infections in young children due to their immature Eustachian tube structure. As well as emphasising the need for adequate treatment, it would also be important to examine the potential loss of hearing that may be caused by such infection, and describe this in relation to auditory acuity and traffic management skills.

Processes of attention

What we consciously perceive is dependent on processes of attention and pre-attention such as *alertness, peripheral vision, scanning, focusing,* and the *maintenance and breadth of attention.* Because children are endowed with similar sensory capacities to adults and because perception to an adult seems instantaneous and comprehensive, without gaps, it is frequently not realised that children and adults often perceive differently.

Children's perception undergoes development through the interaction of brain maturation and experience. It is important to emphasise, however, that the *development* of perception in children is to a significant extent dependent on the development of attentional processes.

At any one time there is too much information impinging on all of our senses for us, whether adults or children, to be consciously aware of all of it. We may register much of it relatively unconsciously in what psychologists call the 'sensory register', without its coming to our conscious attention. This also applies to information impinging on single senses such as hearing or vision, which often receive a great deal of complex sensory stimulation that can be only partially dealt with. We therefore select for attention only some of the information available at any one time.

There are variations in the types of attentional processes involved. As mentioned above:

- we *scan* the available information to select what seems relevant
- we *focus* on what is relevant and attempt to filter out what is irrelevant
- we *maintain* attention to particular stimuli over time where necessary
- we *deploy attention rapidly and broadly* when attention must be paid to various competing areas almost simultaneously. The latter process is sometimes called 'time sharing'.

There is also variation in how much *control* we exert over attentional processes. Our attention may be captured involuntarily by sudden change, such as a sudden movement in peripheral vision, or by the intensity of stimulation, for example a loud thunderclap. Of course, too, attention frequently follows our interests and motives fairly unconsciously. It is well known, for example, that in a shopping complex the attention of a hungry person is more likely to be taken by food, while a young child will probably attend to the toys on view. However, we also deliberately exercise control over attention in order to perform some task. For example, while driving a car we may pay no attention to what a passenger is saying at times when attention must be paid to the complex traffic situation.

Many different factors will influence children's and adults' attention, although adults will usually be able to deal more efficiently with these than children. These factors include:

- *interest* and self-initiated activity
- the *meaningfulness of the task* and its components
- the *novelty* versus the familiarity of the task
- the *complexity*, and the presence of conflicting clues
- the *ease with which components can be differentiated* from each other
- the intensity and type of *distracting influences*
- the effort involved in *using and maintaining a strategy*

There is significant development in attention as children gain metacognitive awareness of their own capacity for attention and become able to exercise more autonomous control over it, rather than just responding to something that interests them or to adult direction.

The experimental studies on attention generally involve fairly artificial laboratory situations using two-dimensional visual fields and mostly static stimuli. Tasks involving auditory attention are relatively few. Nevertheless, the research does give insight into children's basic competence, as well as developmental and individual differences. Researchers distinguish many different but interrelated aspects of pre-attention (see below) and attention. Development in these are highly significant for children's behaviour in traffic.

Pre-attention

Researchers sometimes use the term 'pre-attention' to refer to the fact that attentional processes themselves are preceded by certain states or processes that affect the amount and the quality of the attention paid to the environment.

These states or processes are:

- alertness
- orienting to cues in peripheral vision

Alertness

'Alertness' or 'arousal' is a prior state of receptivity to stimuli, a precursor to attention in most situations except where attention is captured involuntarily by sudden change or intense stimuli, as described above. Alertness is most likely to be at its highest in novel situations, and decreases with familiarity. However, this decrease is usually compensated for by the greater ease of processing familiar stimuli. There do not appear to be developmental differences in alertness, but there has been some study of individual differences (Smothergill & Kraut, 1989).

Individual differences

Researchers on temperament styles in individuals name one of the categories of temperament 'threshold of responsiveness' - a category that appears relevant to alertness. It refers to the fact that some children appear to require a fairly intense or highly salient stimulus before responding, while other children can be easily aroused and can be more responsive to far more subtle stimuli (Thomas & Chess, 1977; Thomas, Chess & Birch, 1963). While it used to be suggested that perhaps hyperactive children may be over-aroused, too receptive to any variation or change in stimuli, some psychologists now consider that hyperactivity is more likely to be a problem of under-arousal, so that attention to a stimulus is not sustained and other stimuli are sought instead (Henker & Whalen, 1989). These issues have not been resolved; hyperactivity is in any event a controversial topic.

Orienting to cues in peripheral vision

Orienting to peripheral cues is a very important pre-attentional process. Efficient visual perception depends on the observer detecting stimuli in the periphery of the visual field and bringing them into focus in the foveal region by eye movements, the fovea being the very small area of the retina at the back of the eye that is most sensitive to pattern details.

Because infants and preschoolers have shown such restricted eye movements when looking at a visual field, it has been suggested that they have very limited peripheral vision, and that this develops only gradually throughout childhood (Mackworth & Bruner, 1970; Miller, 1985). If this were so, it would have very important implications for children's ability to detect efficiently the relevant information available in traffic situations. However, current research is indicating that such claims are invalid and that children's visual field is probably larger than was once thought. It is essential that this issue be clarified, because there are many misconceptions. In fact, there is much incorrect information disseminated in current road safety material, claiming that young children's peripheral vision is very poor compared to adults'. Museum displays have been set up to demonstrate misleading representations of children's so-called 'tunnel vision'.

It is very difficult, nevertheless, to assess orientation to peripheral cues accurately, because many different variables can influence performance. For example, in reviewing research, Maurer and Lewis (1991) point out that adults' ability to detect a peripheral stimulus depends on:

- its *size*
- its *intensity*
- its *contrast* with the background
- its rate of *movement*
- the *level of* background *illumination*

- their *previous experience*
- *other task demands*
- *competing stimuli*

Sandels, one of the first researchers to investigate children's peripheral vision, compared the visual fields of adult and 6-year-olds by use of a perimeter, an instrument designed specifically for her experiments (Sandels, 1975). Subjects were required to focus straight ahead and to say 'now' when they saw a white disc introduced into the field of vision. This researcher found significant differences between the peripheral vision of adults and children. However, she later pointed out that many factors could have influenced children's performance, including failure to comprehend and comply with instructions and the very long duration of the task for a child - 45 minutes.

Since that time there have been a large number of studies of children's peripheral vision, most of which have been included in an excellent review of the research by Akhtar (1990). He points out that it is difficult to come to firm conclusions about children's peripheral vision because of so many flaws and methodological variations in the studies. It would, however, be surprising to find material differences between children and adults, as there are no significant physiological differences between children's eyes and adults'.

In the various studies, the range of retinal eccentricities for peripheral vision has been from 4 to 88 degrees. (Retinal eccentricity is the distance from the fovea.) The age of subjects has varied from 2 to 11 years for children, although adults were always included. The stimuli have included variations in luminance, and variations in stimuli such as letters, geometric shapes, and lights in a traffic scene. Even more importantly, the task requirements for the subjects have ranged from making eye movements, pressing buttons and visually indicating the presence of the stimulus to matching and precisely identifying stimuli. It is unlikely that many of the stimuli would have been either familiar or interesting to young children.

In discussing the variations in the studies, Akhtar points out that peripheral vision may involve three separate processes:

- *locating* stimuli
- *consciously detecting* stimuli
- *identifying* stimuli

Following is a summary of research investigating the three separate processes involved in peripheral vision.

Location studies

Research suggests that localising target stimuli in the periphery involves quite a different neuroanatomical system from that used for the conscious detection of targets. Most of the studies of localisation of targets in peripheral vision use eye movements to assess competence. In spite of some flaws in the methodology of the experiments, these show no age differences. For example, a study by Whiteside (1976) required children to look towards anything they saw in the visual field. What they saw were light flashes that varied in location and luminance. Sensitivity to the light flashes declined equally for adults and children as retinal eccentricity increased.

It should be pointed out that research on what is called 'covert orienting' indicates that location of targets in the periphery can be registered unconsciously without any eye movements being involved (Weiskrantz, 1977; Posner & Cohen, 1984). This orienting is called 'covert' because there are no eye movements to make it obvious that an individual is actually detecting information. Eye movements, or 'overt orienting', however, indicate that the stimuli are being consciously attended to. Children as young as 3 years have shown covert orienting in tasks requiring a manual response (Enns, 1990; Enns & Brodeur, 1989). Maurer and Lewis (1991) report that even infants can locate stimuli in the periphery at similar retinal eccentricity to adults if the lights used are not too small and there are absolutely no competing stimuli. Nevertheless, there are developmental differences. Children up to around 6 years indicate the ability only when cues are predictable and there is a lack of competing information.

Detection studies

The research most often referred to in discussions of peripheral vision in children is a detection study by Lakowski and Aspinall (1969). Many claims for children's poor peripheral vision have been made on the basis of this study, but it is very flawed indeed. In the study there were only 12 subjects, ranging in age from 6 to 11 years. They were required to fixate a central spot while stimulus lights varying in intensity were flashed in the periphery, with eccentricities from 5 to 60 degrees. They had to say when the light appeared or disappeared. Over the age range there was a significant increase in the size of the visual field. The one 6-year-old's response indicated a visual field extending only 15 degrees on either side of the fovea. However, there were too many flaws in the experiment, similar to those in the Sandels study, for it to be at all satisfactory. The children found it difficult to fixate centrally and had difficulty understanding of what they were required to do. There was only one 6-year-old subject, as most young children could not understand the instructions. No check was kept to see if the children maintained a central fixation. In discussing the results, Lakowski and Aspinall themselves point out that there are no physiological differences in children's and adults' eyes that could explain the different responses.

A study by David et al. (1986) that also involved detection is discussed below, in the section relating research on peripheral vision specifically to children in traffic.

Matching and identification studies

In two separate experiments (Fisher & Lefton, 1976; Cohen & Haith, 1977), children were required to match peripheral stimuli by making 'same/different' judgments. Cohen and Haith found no age differences for their task, that of matching *geometric* forms, but Fisher and Lefton found age differences for the task in their experiment, that of matching *letter pairs*. Akhtar suggests that one reason for the difference may be not so much an inability to detect peripheral stimulation as the difficulty, for the younger children, in identifying letters that were not as familiar to them as they were to older children.

In a number of other experiments where children had to identify by name what they saw in the periphery, there were no age differences. However, Akhtar concludes that this is not definitive evidence of lack of age differences, because there were too many flaws in the design.

Research on peripheral vision relating to child pedestrians

A series of experiments carried out by David and colleagues has investigated orienting and peripheral vision and related concepts in a number of different tasks that can be directly related to children's traffic behaviour. Subjects were children aged 7, 9 and 11, as well as adults (David et al., 1986a; David et al., 1986b; David et al., 1990). The peripheral stimuli in the tasks were, variously, moving lights, a film of moving traffic where a car appeared in both foveal vision and peripheral vision, a projected slide of a busy traffic scene where stimulus lights were embedded in the scene as parts of vehicles or on a cyclist's arms, and 48 photos of a road junction where cars appeared in various photos of the visual field. Some tasks required detection; others required identification. In some experiments the stimuli were static, while in others they were dynamic.

Responses measured included:

- *detection* of the stimulus
- *speed of detection*
- *speed of reaction* in making a movement following detection of the stimulus
- *speed of judging* whether a stimulus (a picture of a car) was probably hazardous
- *identification of the type of car* detected in peripheral vision

Hazardous cars were those approaching, while non-hazardous cars were those receding. It should be noted that the last two requirements, judging whether a stimulus (a car) was hazardous, and identifying the type of car, are cognitively much more demanding than detecting peripheral stimuli. They are not tasks relating to preattentional processing, but are mentioned here because they were part of these studies.

A general summary of the findings indicates, first of all, that, across the ages, there were no major sex differences for any of the subjects' responses. Younger children were not relatively worse at peripheral detections. The 9-year-olds, surprisingly, fared better than both the 11-year-olds and the 7-year-olds, and, like the adults, showed no decline in performance for peripheral vision compared to foveal vision. The decision times of the 9-year-olds were as fast in peripheral vision as in foveal vision, and faster than those for both 7- and 11-year-olds. The 9-year-olds also identified as many potentially hazardous cars in the periphery as in the foveal region. The researchers find this superior performance of the 9-year-olds compared to the 11-year-olds in two different experiments somewhat difficult to explain.

Decision times in all groups were faster for hazardous scenes in foveal vision than in peripheral vision. However, it is significant that adults were faster and more accurate than all the groups of children at identifying hazardous vehicles in both the peripheral and the foveal regions. With the maximum possible score being 32, adults correctly identified 23.24; 11-year-olds, 21.23; 9-year-olds, 20.56, and 7-year-olds, 20.5. Perhaps what is more noteworthy is the result that approximately one-third of hazardous situations were not identified by either adults or children.

Overall, there is no consistent trend indicating that younger children are less efficient than either older children or adults in *detections* in peripheral vision. What did appear, though, especially for the 7- and 11-year-olds, was that children process less efficiently the information *obtained* from peripheral vision. Processing information requires higher-order cognitive processing and it is in this, apparently, rather than in simple peripheral detection, that children have limitations. Such results fit in with the more general findings on cognitive development that the information processing of younger children is slower and less efficient than that of older children.

Implications for traffic education

There is need for caution in making statements about children's peripheral vision, and basing road safety material on it. While there is no clear evidence that younger children fail to locate or detect peripheral stimuli, the suggestions of David et al. are relevant. It may be that younger children are less able to process this information efficiently, and this is related to more general cognitive development.

Types of attentional processes and developmental changes

As mentioned previously, attentional processes involve the selection of particular information for attention through processes such as scanning, focusing, maintaining attention and broadly deploying attention.

Scanning processes

In visual perception, *scanning processes* are highly important. When we perceive something visually, our eyes make rapid scanning movements over the available visual field (though we are not usually aware of these movements) to bring different aspects into focus in the fovea. We are unable to pay attention to all aspects simultaneously, but must successively select. Different situations require different scanning techniques, and different patterns of search. However, scanning might often be guided by the pre-attentional process known as 'covert orienting', as discussed in the preceding section, where it was pointed out that a stimulus in the peripheral field can be located automatically before any eye movements take place. Eye movements may then be made to locate this stimulus and bring it into clearer focus in the foveal area of the retina. Any developmental changes in covert orientation will be among factors influencing eye movements in visual scanning.

In both children and adults, the nature of scanning will vary, depending on whether the situation is familiar or novel. It will also vary depending on the reason for the search. For example, the aim may be to identify and evaluate the significance of a whole situation, or it may be to locate or identify a particular target within the visual field.

Familiar objects, situations and events with well-recognised distinctive features require only brief scanning of a few significant areas, but less familiar situations require more comprehensive scanning to pick up what is significant. However, even in many novel situations, adults and older children often know where to look for relevant information, and their scanning is efficient. It is goal directed and conceptually driven, in the sense that there is already an idea of where to look and what to look for. Adults and older children often process very swiftly in this way.

By contrast, research shows, as would be expected, that the scanning of younger children of preschool age in such situations is frequently very inefficient, bottom-up processing. It is not usually conceptually driven and there is no overall strategy. The 3-year-olds will often look at just a few areas of the visual field and make small eye movements in just some parts rather than broad sweeps across the field. By age 4 or 5 children make larger eye movements and scan more widely, but they still neglect much relevant information. Usually by 6 or 7 years children show more signs of organised scanning of relevant areas and pay less attention to irrelevant aspects. Their search is more exhaustive and faster, and they know more about the aspects that are most informative. The efficiency of scanning continues to develop throughout childhood (Day, 1975), but, as Day points out, it is also affected by the individual's:

- *comprehension* of the task requirements
- *knowledge* of the visual environment
- *strategies* for encoding that knowledge
- general *cognitive ability*

Of course, scanning or visual search of the environment for relevant information is of major importance for children in traffic. In traffic environments that are familiar, children's scanning becomes more efficient once they have, over time, differentiated information about significant aspects. However, they may still overlook significant less familiar or new information. It is relevant, though, that, right from birth, children seem especially primed to attend to moving objects. This may be an innate characteristic because perception of movement and change is necessary for survival in many environments.

However, this characteristic cannot be relied upon where objects are static but may soon move, for example where a driver getting into a parked car will soon move out into traffic. In addition, in situations where many objects are moving, it may be difficult to select the most relevant.

It has been suggested (Akhtar & Enns, 1989) that inefficient visual searching by young children may be due in part to physiological factors. Their eye muscles are less well developed and this results in poor control of eye movements. Eye movements also seem to be initiated more slowly in young children.

Searching for the appropriate visual information is a type of problem-solving task within the larger problem-solving task of working out how to act to achieve safety. So, in this task within a task, all of the factors influencing the larger task can also influence the subsidiary task. The trends in cognitive development discussed earlier will all be relevant.

Individual differences in scanning

Visual scanning is also an area where individual differences in cognitive style play an important part. For example, a person with a more impulsive style would be expected to scan less efficiently.

As was alluded to in the earlier discussion of impulsivity, concepts of cognitive style are not free from controversy. For example, the actual components of reflective and impulsive styles and their relationship to personality and to intelligence are still at issue. Researchers in a recent study (Smith & Nelson, 1988) have made a useful contribution in suggesting that children who show an impulsive style tend to approach tasks more impressionistically, more holistically and with less effort. Children with a more reflective style are more analytic and exert more control and effort in their cognitive processing. The original and most frequently used test to investigate reflection–impulsivity, Kagan's Matching Familiar Figures test, referred to earlier in the discussion of impulsivity, requires subjects to scan the visual field carefully and analytically. There is evidence for stable differences in style that continue as individuals develop, although with development children generally do show the tendency to become more reflective (Kogan & Saarni, 1990).

The child who shows a more impulsive style would seem likely to put less effort into visually searching traffic, missing important information that could lead to errors in judgment. However, it must be realised that it is not possible to generalise across all visual search tasks. Children may behave less impulsively or reflectively in some situations, depending on task or affective demands.

Another main area of research on cognitive style that has relevance for visual search is *field dependence–independence*. This concept was originally introduced by Witkin (Witkin et al., 1954), but he and his colleagues have revised it over the decades since. The concept of 'field dependence–independence' originally referred only to perception. Those with field-dependent style were said to have considerable difficulty in perceiving parts of a perceptual field as separable from the whole. Individuals who were more on the field-independent end of the continuum could analyse the discrete parts and separate them out from the whole. Later the concept was extended to cover a much more comprehensive aspect of personality. Field-independent personalties were said to be autonomous in processing information, and capable of cognitive restructuring, but less socially sensitive, while field-dependent personalities were said to be reliant on others and external references, but more sensitive to social cues.

Famous research studies used to measure this style include the Rod and Frame Test and the Embedded Figures Test. In the first test, subjects sit in a darkened room, and see a luminous rod moving independently of a luminous square frame. The frame is tilted and the subject is instructed to adjust the rod so that it is straight in relation to his or her body, not the frame. Subjects who persist in giving the rod a large degree of tilt relative to their bodies are said to be field dependent. Those who adjust the rod so that it is straight or nearly straight are said to be field independent, able to be independent of the external field by relying only on inner mechanisms. There are other, similar tests, involving tilting the room and tilting chairs, etc.

The paper-and-pencil Embedded Figures Test is a different type of test, and can be adapted for children as young as 3 years. Subjects must search for a simple geometric figure embedded within a large geometric figure. Those who can detect the embedded figure are field-independent.

The research indicates that field dependence is a fairly stable style over time and fairly consistent in many different situations (Witkin & Goodenough, 1981). There appear to be sex differences in that boys tend to be more field-independent, although the causes of the difference are not known, and again are a controversial topic. It is possible that both biological and experiential factors play a part.

The field dependence–independence dimension has been shown to be relevant to various attentional processes. Conklin, Muir and Boersma (1968), as reported in Davis and Cochran (1990), found that, in visual search, the eye movements of field-independent subjects travelled over greater distances between fixations, were more frequent and were fixated on areas having higher information value than those of the field-dependent subjects.

Shinar et al. (1978) examined adult eye movements under simulated driving conditions. Field-independent individuals needed less time to process information when the visual display was changing, and they did not confine their visual search to small regions, as did the field-dependent individuals. Barrett and Thornton (1968) also investigated the visual search of adult drivers and found that field-independent individuals were more efficient in detecting a pedestrian moving into the path of a moving vehicle.

This cognitive style would appear to have particular relevance for traffic situations for both children and adults, in that it would affect the efficiency of their overt visual scanning. There does not appear to be any research relating this style to children's visual scanning in traffic, and there is clearly a need for research of this type.

Focusing or filtering

The processes of *focusing* or *filtering* are involved when the individual must ignore irrelevant information in order to select and process efficiently only the relevant information. Many visual and auditory tasks require adequate attention to the centrally important aspects without distraction from irrelevant stimuli. It is more efficient to leave distractions unprocessed. This requires conscious effort to control attention and to develop strategies to facilitate this. A review of research studies (Lane & Pearson, 1982) indicates that in the majority of studies there were findings of marked developmental differences in the ability to filter out irrelevant information. Preschoolers (3- and 4-year-olds) are usually very easily distracted and find focusing very difficult. Performance tends to improve with age up to the end of the primary school years. This applies to both visual and auditory tasks such as looking only at relevant aspects of a visual field, listening to competing messages, or listening to information while loud noise or music acts as a distraction.

This area has been a difficult one to investigate, as there are many possible confounding variables. Some of these include:

- the *familiarity* of the material
- the *interest and motivation* of the child
- the *complexity* of the material
- additional cognitive requirements such as *memory* and *verbal fluency*
- the degree of *differentiation between* the relevant and irrelevant *information*

The influence of metacognition

It is clear that an important aspect of the development of filtering ability is the development of metacognition. This makes for awareness both of the nature of and influences on attention and the ability to devise appropriate strategies to control the deployment of attention. This would appear highly relevant for children's *selective attention* in traffic situations. We need to be aware of at what age it is that children know that their attention may be distracted and that they must make efforts to avoid this.

One of the researchers who has investigated metacognition comprehensively in relation to attention is Miller (Miller, 1985; Miller & Weiss, 1982; De Marie-Dreblow & Miller, 1988). In a series of studies, she has investigated children's knowledge of factors that could distract them and affect performance in focusing tasks. She finds that 3-year-olds understand that noisy surroundings may affect their attention, but this is about the limit of their understanding. By 6 years children seem to consider lack of interest more important than noise in affecting their attention.

This consideration of a psychological factor rather than an easily perceived external factor by 6-year-olds goes against the usual trend in cognitive development. Miller believes this may be due to an exaggerated sense of *personal causality*, or to *egocentrism,* as described by Piaget. However, it is plausible that children's own school experience could be a significant factor here. Teachers make constant calls for children's attention, and children become very much aware of how difficult this is when the material is boring.

Awareness of likely distraction by television or by friends playing is not usually evident until about 9 or 10 years. Children have learnt by this age that attention can be distracted, and that it helps to remove temptation if possible if they want to avoid being distracted. Nevertheless, they may still fail to control attention and may allow themselves to be distracted on some occasions. The 10- to 12-year-olds, however, begin to use more spontaneous strategies for dealing with distracting events, although they do not usually generalise them to a variety of tasks.

Miller also points out that there tend to be cultural differences in the development of attentional strategies. Children in some cultures develop these much earlier than those in cultures where application to tasks is not so strongly stressed. This suggests that the adults in the child's environment may have an important part to play in encouraging selective attention.

Failure to control attention and ignore irrelevant stimuli could have very serious consequences for children's behaviour in traffic. Therefore children's limitations in this area should be taken into account in road safety education programs.

Individual differences in focusing

As with visual scanning, the cognitive style of field dependence–independence is relevant. Studies reported by Davis and Cochran (1990) indicate that, in both visual and auditory tasks requiring focusing on relevant information, the field-dependent individuals made more errors and preferred a slower pace for presentation of stimuli. When there were interruptions to tasks, field-dependent individuals were more likely to shift their attention to these irrelevant stimuli.

Maintenance of attention - attention span

'Attention span' refers to the ability to maintain attention to a task over an extended period of time. It is also called 'vigilance', or, in everyday terms, 'concentration'. There is also the connotation of *intensity* of attention.

However, not all psychologists distinguish between filtering and sustaining attention. Those who attempt to differentiate maintained attention usually do so by requiring subjects to maintain vigilance in a situation where nothing much is happening. There are few research studies related to attention maintenance in children, but Akhtar and Enns (1989) report the results of two studies where the younger children in the study were unable to sustain attention to a given task. Kupietz and Richardson (1978), in a study of vigilance with children with reading problems ranging in age from 7 to 12 years, found that although the younger children could maintain attention to simpler tasks, they had great difficulty doing so with more difficult tasks. There was improvement with age. There is a need for further research with 'normal' children.

It must be pointed out that, where children's own interests and motives are involved, it is usually not so difficult for them to maintain attention for relatively long periods. Difficulty occurs, however, when tasks are set for them by others. This requires conscious strategies to control attention, and again this is dependent on metacognitive development, and the many other factors, such as motivation. In the school situation, teachers rely considerably on rewards and punishment to enlist children's attention (not necessarily with success), but in traffic situations, of course, there are usually no adults to monitor their attention.

Individual differences

It has long been recognised that there are individual differences in temperament relevant to the maintenance of attention. In some of the earliest and best known research on temperament by Thomas et al. (1963; 1977), a category of persistence is distinguished that is relevant to this aspect of attention. Children were characterised as more persistent if they were able to maintain attention to tasks and activities for relatively long periods of time.

Studies reported by Davis and Cochran (1990) found that field-independent individuals were much more efficient in their vigilance performance and could pay attention to stimulus displays for long periods of time.

Breadth of attention

This refers to the ability to deploy attention swiftly in very complex situations to more than one area of incoming perceptual information. It also includes the metacognitive awareness of how well one is monitoring the situation and paying attention to all of the necessary but often competing areas. Attention has to be switched rapidly between different areas of the perceptual field. While the visual and auditory senses are usually involved, other senses, such as the kinaesthetic or proprioceptive sense, taste, and smell may be involved as well. An everyday example is eating, talking and walking along the street at the same time. Driving a car is another frequently given example that makes considerable demands on breadth of attention. In fact, behaving safely in most traffic situations requires attention to many different aspects of the situation, and rapid switches of attention between aspects of visual information and of auditory information and the monitoring of one's own behaviour and movements, the latter relying heavily on kinaesthetic cues. The kinaesthetic senses convey information from our muscles, tendons, joints and skin about the relative position of body parts, the direction and extent of movements, their speed, and the force of contraction of the muscles (Laszlo, 1990).

The task demands may be lessened when some processes have become automatic and do not require conscious processing. For example, walking does not usually require much monitoring for both adults and children, but, if the path is uneven and potholed, more attention must be given.

There are a number of developmental aspects that limit younger children's breadth of attention at first; tasks become accomplished more efficiently with development. The limitations of younger children may be summarised as follows:

1. Young children, those under 5 or 6, *cannot switch rapidly between areas of information* competing for attention (Guttentag, 1985). As with other information processing, their reaction times and actual processing are slower.

2. Younger children's *switches in attention tend to be more random* and not related to an overall strategy or goal. Attention is not as conceptually driven as it is in older children and adults.

3. Younger children also have *fewer automatic processes*, so that attentional demands are heavier. For example, upon crossing the road older children and adults often switch visual search automatically between left and right directions and adapt their actions without much conscious effort, while younger children need to pay much more attention to their crossing actions and may not even make the conscious effort to watch for further traffic movements to left or right. This problem will be exacerbated if they are running. Also, young children usually have to pay more attention to physical requirements, such as holding objects more tightly as they move swiftly.

Breadth of attention is therefore a major factor in children's traffic safety and should be included for discussion in education materials on road safety. There is also a need for research to investigate how widely and efficiently children are able to deploy attention to the many competing but relevant demands for attention in traffic situations.

Visual perception

Perception is defined as the process by which information from the senses in the current environment is discriminated, recognised, identified and given significance. The efficiency of perception will have very significant implications for the behaviour of children in traffic.

Although, as discussed earlier, the sensory capacities of young children are basically equivalent to those of adults, their perception is not as efficient and there are important changes with development. These perceptual changes are clearly interrelated with attentional development: what is perceived depends on what is attended to. As well as recognising and identifying important more concrete aspects of traffic contexts, children also need to be aware of significant *spatial relationships*. There are also the questions relating to perception of *speed, distance* and *time to arrive* - judgments here may also involve conceptual aspects. Because judgments of speed, distance and time are so important for many sporting activities and for other perceptual–motor skills, some of the research on perceptual–motor development is also relevant to performance in traffic.

As children develop, their perceptual processing becomes more efficient. Some psychologists would say that learning and experience are all that need to be taken into account in these changes, as perception is a direct process. However, many developmental psychologists would consider that there is also an interaction with neurological maturation, and that the ability to carry out much perceptual processing is dependent on maturation because higher levels of brain function are involved in supplementing, structuring and organising the input from the senses.

Some time ago Wohlwill (1962) took an intermediate position, suggesting that there are three dimensions along which perception and the more reflective processes of cognition and conceptualisation may be situated. They are not discrete categories. Many psychologists find these suggested dimensions still relevant:

1. *Redundancy* - As processes become more conceptual rather than perceptual, the amount of redundant or excess information required decreases.

2. *Selectivity* - In deeper cognitive processing, more irrelevant information can be

tolerated.

3. *Continuity* - In deeper cognitive processing, the spatial and temporal separation of stimuli increases, but can still be integrated.

In essence, the more we rely on reflection and on information not immediately available to the senses, but stored in memory, the more we move away from perceptual processes to higher-order cognitive processes.

Accurate perception of objects and people, situations and events requires perception of their distinctive or invariant features, and of the invariant relationships between these features. For example, a bicycle is recognised and identified on the basis of distinctive features such as two wheels, handles, pedals, and chains, but it is more than a sum of these parts. There is also a distinctive relationship between all of the parts (Gibson, 1984). There must be some form of representation of these features and relationships in memory which is depended on for recognition.

Perception of spatial relationships and of other aspects of the environment such as movement or time probably require their own forms of representation. For example, in order to reach out, grasp and lift a coffee mug, a detailed representation of the precise distance of the mug, its relative surface layout and its probable weight will be needed so that the task can be achieved successfully. Such a task is logically independent from knowing that the object to be grasped is a mug, as opposed to a teapot, and may rely on different kinds of representational systems (Bruce, 1988). This point is very relevant to the perceptual tasks children face as pedestrians. Not only must they identify objects, places and events, but they must also make perceptual judgments about aspects such as relationships of speed, distance, time, and direction, in relation to self and others. The information necessary comes not only from vision but also from hearing, kinaesthesia, and the other senses.

Most of the trends for cognitive development in general are also relevant for perceptual and attentional development. The following examples relate the relevant trends specifically to perceptual and attentional development:

1. Where young children are faced with a novel, *complex visual field*, their *perception* of it will tend to be *global or holistic*, though some of the parts or details will probably be discriminated.

   As children develop and also become familiar with frequently experienced objects, places and events, they will *discriminate more* of the parts or *detail*. They will also become more aware of the relationship between the parts and also between the parts and the whole.

2. At first the younger children will *perceive fewer* of the distinctive features and *invariant characteristics*.

3. Because they note fewer of the subtle distinctive features and the relationship between them, younger children *need more redundancy of information*. They find it difficult to deal with the gaps in information and may often make inaccurate recognitions and identifications.

   Older children can deal with more uncertainty and gaps in information and are more accurate in their perception.

4. When situations are complex and unfamiliar, younger children's *processes of attention and of perceptual recognition and identification* are more likely to proceed step by step in a relatively unorganised manner. They are more likely to be *stimulus driven, using bottom-up processing*. The processing of older children is more likely to be conceptually driven or top-down processing, and organised in relation to a concept or strategy. They tend to have sufficient knowledge relevant to the current situation that can lead to relevant expectations about what is to be perceived

and where.

5. With the *development of metacognition*, children become more aware of their attentional and perceptual processes and exert control over them.

6. Young children's *perceptual and attentional processes* are *much slower* than those of older children and adults.

These trends are relevant to the areas of perceptual development children need to utilise in traffic situations. It is important that road safety materials and programs emphasise the limits of young children's ability in processing perceptual information effectively, and recognise that these limits will gradually be overcome with development.

Perception of whole scenes and components

In perceiving a visual scene in front of them, such as a street traffic scene, preschool aged children, in comparison with adults, are likely to perceive it inefficiently, and miss many important aspects.

Young children are unlikely to have the goal of carefully scanning the environment in order to perceive all the information that is relevant to their safe management of traffic. They usually scan unsystematically, and pick up only some of the significant information. They are likely to perceive only some of the important components such as cars and other vehicles, other pedestrians, etc., and may easily be diverted into paying more attention to what is of interest to them rather than to aspects significant for the scene as a whole. They may not perceive significant relationships such as that between vehicles and pedestrians, may identify some aspects incorrectly, and may not notice small but important details. They may not take account of cars and people partly obscured by other objects, but possibly having a significant effect on events soon to occur.

By 6 or 7 years, children are likely to perceive more of the relevant information through more careful scanning, although they may still miss some of the more subtle cues. Older children will be more likely to be conceptually driven, in that they will know what to expect and where to look for relevant information. By 11 or 12 years, perception of complex scenes should be quite efficient. Children will now be more skilled at detecting more subtle distinctive features and relationships and will be more likely, when making perceptual judgments, to relate together much more of the available information.

Safe behaviour in traffic is highly dependent on careful and accurate perceptual processing of the current scene, but there does not appear to be any research directly related to children's perception of traffic scenes. It would seem essential to carry out research in this area in order to identify any developmental trends in both the *content of information* children perceive and the *type of processing* apparently involved.

Perception of movement

Some of the most significant types of cues alerting perception in traffic are the cues for perception of movement. Not just for animals but also for humans, the detection of movement is often essential for the first indications of potential hazard.

Psychologists concerned with perception first of all address the issue of how it is that we perceive motion of objects external to us when the retinal images themselves are constantly moving owing to our continuous eye movements. Not only do we make the eye movements known as sacchades when we attempt to bring an object into focus, but our eyes also tend to drift slowly and smoothly, albeit unconsciously, across the visual field. The conclusion has been drawn that the most important determinant of movement perception is *the change of location of an object* relative to other objects in the field. If the moving object surrounds a stationary one so that it becomes the frame of reference, it will generally induce a sense of movement in the stationary object. When two or more objects are both moving in relation to one another, the actual path of movement is then often dissociated into two perceptual components, the more salient one being that based on the objects' approach to or separation from one another rather than to or from objects in the background (Rock, 1984).

Displacement of an image of an object on the retina is neither a necessary nor a sufficient condition for seeing movement. Perception of movement depends on the perception of relationships between objects as they move relative to each other.

The perception of movement does not have to be learned. It is present from birth, probably because, as mentioned above, as an indicator of potential hazard it is adaptive for survival. Infants tend to show consistent preference for moving rather than stationary stimuli. They detect movement and turn their eyes and heads towards it to bring it into focus. However, as Vernon points out, studies with adults show that, if there is continuous movement of stimuli in the periphery, individuals rapidly habituate to it and fail to perceive it or attend to it consciously (Vernon, 1970; 1971). The further out on the periphery, the earlier the habituation, but there is no habituation in foveal vision. There does not seem to have been research on this aspect in children, but it could be assumed that there would be similar habituation. In traffic situations where there may be a considerable amount of movement in all areas of the field, it may be that older children and adults may make more conscious efforts than younger children to monitor events on the periphery, compensating for habituation.

Perception of the direction of movement

The visual perception of the direction of movement does not appear to be particularly problematic. From early infancy, as seen above, children are capable of tracking moving objects and responding appropriately to the movement of objects. However, there does not appear to be research that evaluates children's ability to predict trajectories and paths of movement, which would be valuable for predicting traffic movements.

However, children's comprehension of terms such as 'left' and 'right' as used in verbal instructions to direct their perception in traffic adds an extra dimension of cognitive processing to a perceptual task. This will be discussed in a later section.

Perception of three interrelated dimensions: Velocity, 'time to arrive' and distance

This section is the longest one in this report; it would be difficult to overemphasise the importance of this type of perception for road safety. Children's perception of velocity, 'time to arrive' and distance in relation to moving vehicles is highly significant for their performance in traffic. It also affects their performance of a variety of perceptual–motor and sporting skills, including, for example, ball interception, and many other sports such as hurdling. All of these require judgments of speed and distance, estimates of trajectories of objects or people, and the time to arrive or contact of objects. In spite of many research studies, little is as yet known about how skill in these judgments develops in children. There is not only a lack of sufficient fundamental research, but also difficulties caused by major differences in theoretical approach.

As mentioned earlier, many cognitive psychologists consider that there can be no direct perception of the environment, but that perception must be mediated by internal mental representations and higher-level cognitive processes such as inferences, which are not necessarily always conscious. So, when it comes to making judgments of speed, distance and time in relation to moving objects, these psychologists would consider that we must rely on more than perceptual processes, and supplement perceptual input with knowledge not available in the immediate-stimulus situation. They conclude that children can only make accurate judgments relating to these three interrelated dimensions when they have reached a stage in conceptual development where they have acquired valid concepts of the dimensions and fully understand their interrelationship. As Acredolo (1989) points out, speed, distance and time form a closed system which must be understood if there is to be genuine understanding. If one of these dimensions is held constant, then a change in one of the remaining two dimensions means that there will be a change in the other. For example, if the duration of time a ball moves on different occasions is held constant, greater speed of the ball means greater distance is covered. There is in this case a direct metrical relationship of multiplication: distance equals time multiplied by velocity. For the other two dimensions, if held constant, there is an inverse metrical relationship where velocity equals distance divided by time and time equals distance divided by velocity.

Cognitive psychologists have undertaken a number of studies of children's concepts of speed, time and distance. Following on from the work of Piaget (1946), they have required children to verbalise their understanding in relation to the movements of model cars and trains or animals in very small-scale environments. They have asked children, for example, to compare movements of two cars travelling from different starting points and then say which has travelled for a greater time. Children were not, however, actually required to estimate metrical relationships between the dimensions. The earlier studies of this type agreed with Piaget's findings, and researchers concluded that children younger than 9 or 10 years do not even begin to understand and reason logically about the interrelationship of time, distance and speed, but centre on one relationship (e.g. Berndt & Wood, 1974; Levin, 1979; Siegler & Richards, 1979). It was found, for example, that young children consider that an object going for a longer distance than another object always goes for a longer time, regardless of speed. Similarly, they judge speed by time of arrival, ignoring distance covered.

More recently, cognitively oriented researchers have attempted to overcome some deficiencies in the method of the earlier research, and have devised methods to assess children's understanding of the metrical relationship between the dimensions. But here there have been further methodological problems that make it difficult to summarise the results. In general, though, the findings have indicated there is an elementary understanding by about 7 or 8 years that there is some correlation between pairs of dimensions such as distance and duration, but that understanding of the correct metrical relationships and of the integration of all three dimensions develops only later. Even some adults do not understand the metrical relationships, when there is an inverse relationship rather than a direct one. (Wilkening, 1981, 1982; Acredolo, 1989; Acredolo et al., 1984; Matsuda, 1991).

The emphasis on conceptual understanding as an essential basis for the ability to estimate speed and distance and time to arrive in practical situations such as traffic and sporting skills has meant that children below adolescence have generally been judged as quite incompetent in these areas. However, this is very difficult to reconcile with most children's consistent gradual improvement with age in perceptual–motor and sporting skills requiring such estimates as one set of relevant factors. There is no doubt, for example, that, while allowing for individual differences in levels of competence, there is steady progress in ball interception skills from failure to catch any balls at 2 years to quite skilled performance by most 12- to 14-year-olds.

The alternative theoretical approach, *direct perception* or *ecological theory*, points out that it would not be adaptive for survival if the approximate estimates of speed, distance and time to arrive of various objects and people so often needed in everyday life could not be made very swiftly, without engaging complex logical reasoning ability (Gibson, 1979; Lee, 1974, 1980). As well as humans, of course, many animals and birds also require some way of judging speed, distance, and time to arrive reasonably accurately, in order, for example, to intercept prey or to avoid collision in flight.

In its most extreme form, ecological, or direct perception, theory considers that both animals and humans register all the information relevant to such requirements (that is, patterns of light) directly on the retina, and this can directly trigger action without cognitive mediation. With experience, the necessary information to be picked up in the environment becomes more and more differentiated. For example, in terms of this theory, adult drivers usually acquire, after sufficient experience, practical knowledge that enables them implicitly to estimate perceptually the necessary distance that they must keep between themselves and another vehicle in front, in order to avoid collision were the front car to brake suddenly.

As is so often the case, it seems likely that neither theoretical approach is sufficient in itself to account for all performance. Some tasks may seem more amenable to an ecological interpretation, some to a cognitive interpretation, and many to both (Laszlo & Bairstow, 1985; Roth & Frisby, 1988; Harvey, 1988). It has been suggested that the ecological approach is particularly useful for explaining performance when individuals have little choice over their actions and where action must be taken almost immediately upon perceiving the stimulus. A cognitive approach to explanation is important, for example, when decisions have to be made about different courses of action, and account has to be taken of various other factors that could influence how the stimulus is perceived in a particular situation. Examples of direct perception that have been given include a pilot landing a plane or a tennis player returning a shot. However, most situations, including these examples, probably require both direct perception and cognitive mediation. A skilled tennis player is likely to take account of other factors before taking direct action, such as the spin on the ball or the strength of the opponent's backhand and/or present position on the court.

Most developmentally oriented psychologists emphasise increasingly cognitively controlled and mediated perception with development, but have failed to consider the possibility of direct perception and the implicit processing of information.

In the following sections, research that comes from differing theoretical orientations is discussed. We will look first at general research related to each of the dimensions, and then at studies related specifically to traffic.

Research on perception of velocity

For perceptual–motor theorists for whom this type of perception is an important consideration, the perception of velocity of an object is often assumed to depend on two major factors:

- *perceptual estimates of the distance* traversed by that object within a certain time
- *the rate of relative displacement* of the object over that time in relation to a frame of reference linked to other objects in the visual field

When relatively large distances are involved, perception of *size constancy* also becomes a factor. This concept will be discussed below.

As pointed out by Laszlo and Bairstow (1985), perceptual judgments of velocity are rarely completely accurate, and can be biased by many factors, such as:

- the *size and orientation of the object*
- the *direction of its movement* relative to the observer
- the *status and density* of *other* stationary or moving *objects* nearby

- the *size* of the *frame of reference*

For there to be any degree of certainty in the perception of the velocity of an object, the general properties of the visual field must remain constant and the eyes must remain stationary or in pursuit of an object. In everyday life this is unlikely to happen, so that adult perceptual judgments tend to be a series of judgments or approximations that may at times be considerably inaccurate, depending on conditions. An observer needs to be aware of the way perception can be biased if estimates are not to be quite inaccurate.

There is a lack of useful general studies bearing on children's judgments of speed. However, knowledge of trends in children's cognitive development and in attentional processes would make it seem unlikely that they would be aware of the various factors that could bias their perception. It is also unlikely that they would always focus attention effectively and ignore distracting influences.

There have been some studies investigating children's judgments of speed specifically in relation to traffic contexts. These will be reviewed in the section focusing on traffic research. It is worth pointing out here that a judgment of speed only is not what is required for judging when to intercept objects or to cross in front of vehicles. The judgment of 'time to arrive' is the one that needs to be made—this depends on all three factors, speed, distance and time.

Research on perception of depth of field and distance

The research on children's perception in this area centres on how distance is perceived as 'near' or 'far', and on descriptive *estimates* rather than on metrical judgments of distance.

In the view of psychologists and philosophers, the ability to perceive three-dimensional relationships in the environment, that is, depth of field and distance, has always been an issue that requires explanation. They question how it is that we can experience a world of three dimensions when the image that is projected upon the retina as a result of stimulation from the environment is a two-dimensional one. As is common with so many psychological controversies, in the past explanations have tended to be black or white, putting down the perception of three dimensions largely to experience on the one hand or inborn capacity on the other. Research has now indicated that we probably rely on a combination of cues that are innately pre-programmed, and cues that, as a result of experience, are recognised as indicating depth of field and distance. (e.g. Rock, 1975; Bruce & Green, 1990).

The biologically based cues for depth include:

- binocular disparity
- binocular convergence
- lens accommodation
- motion parallax

The brain apparently constructs depth of field from this information, usually without our conscious awareness. 'Binocular disparity' refers to the fact that the two eyes receive from the same visual field slightly different images that, when put together, produce an experience of three dimensions. This is the same principle by which stereoscopes work. 'Binocular convergence' refers to the muscular movements involved in turning the eyes to focus on objects at varying distances from the observer. When the objects are close there is a marked convergence of the eyes that provides useful cues to distance. However, when objects are distant, there is little convergence, and this cue is probably not very helpful. There are probably also cues to the brain when the lens in the eye accommodates while focusing on objects at different distances; that is, the way the lens of the eye focuses on objects at different distances gives cues to the brain on how to perceive dimension.

Cues for recognising motion parallax arise when objects move in relation to each other and when we move our eyes or whole bodies while viewing a particular visual field. In successive retinal images, the distance between objects is decreased or increased in different directions and at varying rates, depending on spatial position. Motion parallax cues are probably perceived without conscious awareness most of the time, but sometimes may be deliberately used.

Research has indicated that babies in the newborn period are probably able to use such biological cues to perceive depth of field and distance (e.g. Bower, 1966). In one study, for example, babies made reaching-type movements for a nearby object, but did not attempt to reach for a more distant object that projected a retinal image the same size as the nearby object. The distance vision of infants is unlikely to be fully accurate, and does not appear to extend to objects at distances in the visual field greater than a few metres. Babies also show distress reactions and rudimentary avoidance movements to objects that appear to be coming close to them on a collision path (Bower et al., 1970). Ecological theorists suggest this indicates that babies may have innate direct perception of information relevant to distance (Bruce & Green, 1990).

As children develop they come to be able to use what are called the 'pictorial cues' that are probably learned through experience. These cues are called 'pictorial' because they are also available in many two-dimensional pictures to give cues to distance and depth of field. They include:

- *shadow*
- *overlap or occlusion* of one part of a field by another
- *lack of clear definition* of more distant objects
- *higher or lower position* in the visual field
- the *apparent convergence of parallel lines* leading towards the horizon

There is also a very important cue of textural gradient, identified by husband and wife team Gibson and Gibson, ecological theorists (Gibson, 1950; 1979). In textural gradient, the components of a regularly patterned background, such as a tiled floor, carpet or grass, become consistently smaller as the horizon is approached.

Experiments with a different research orientation indicate that young children, 4- or 5-year-olds, can make fairly accurate descriptive estimates of the distances of comparatively close objects from their own position as observer or when place markers are used to indicate distance (e.g. Smith & Smith, 1966). However, their ability to judge distances beyond a few metres develops only gradually as they begin to traverse longer distances themselves and are active in their environment (Vernon, 1971; Cohen, Weatherford & Byrd, 1980).

Apart from the ability to estimate distance perceptually, there are other important aspects involved in distance perception, including *perception of size constancy* and the *perception of relative distance* involved in the perception of distance constancy.

Research on the perception of size constancy

Size constancy has frequently been the subject of research on perception. This phenomenon occurs when we continue to see an object as maintaining its size even when it is some distance away from us. For example, we do not see a person walking away from us as becoming smaller, even though the retinal image projected by that person is becoming smaller.

Nevertheless, there are some occasions when perception of size constancy is not maintained, and *underconstancy* results. With underconstancy, observers apparently perceive a distant object as smaller than it is, and more in accordance with the projected retinal image.

For example, we may see an object as tiny if it is a very long way off, if we look down on it from a height or if there is no surrounding context to which to relate it, as happens when viewing a plane in the sky. With *overconstancy,* the object is sometimes perceived as being larger than it is, but this is probably owing to the viewer's knowledge of such effects, which leads to overcompensation.

Research indicates that, in the perception of size constancy, both biological and pictorial cues are involved. When these cues are diminished or lacking, as, for example, with planes in the sky, we tend to make cognitive judgments based on experience rather than relying on perceptual cues (Vernon, 1971; Tronick & Hershenson, 1979; Gibson & Spelke, 1983).

The research on children indicates that even infants of 4 months apparently perceive size constancy for objects up to 3 metres away (Day & McKenzie, 1981). During childhood, there is development as size constancy is perceived for objects at greater distances. Younger children tend to show underconstancy at first, for objects at greater distances, while for older children and adults there may be a tendency to overconstancy. It is possible that younger children do not have the experience necessary, while older children and adults may use their acquired knowledge that objects at long distances look small to make cognitive judgments that overestimate size. Older children and adults may also use perspective and shadow cues that are not recognised as significant by younger children.

It is not possible to draw conclusive implications from the research, because studies have shown that many factors can influence children's responses. Gibson (1969) points out that, as early as 1946, Lambercier discussed some of the problems that could cause inconsistency in results. Factors that Lambercier and other psychologists mention include:

- the *familiarity of objects* to be perceived
- the *height* of the individual/perceivers
- the *background texture* that gradients present
- the *viewpoint* from which observations are made
- the *number of judgments* experimenters require subjects to make

There may also be variations in the way the task is presented, and these variations may have a significant effect. For example, in some tasks subjects have to make judgments about two objects at different distances to say if they are the same, while in other tasks subjects must pick an object from a sample to match an object perceived at a distance. Instructions can also influence performance of the task. Does the task require reporting on how things *seem,* or on how they really *are?* Young children frequently do not understand that there is a difference between how things really are ('objective reality') and how they appear ('apparent or projective reality' or 'visual angle size').

In spite of the difficulties in conducting this research, there seems to be foundation for the claim that in general children up to 9 or 10 years of age are likely to have difficulty with size constancy when distances beyond 10 metres are involved. There are also considerable individual differences. Some young children may show reasonably constant and accurate perception of size constancy, while some are quite inaccurate or perhaps very variable in their estimates. Factors leading to these differences have not been suggested, apart from differences in experience, which seems unlikely for objects in the near environment. It would seem that the cognitive style of field dependence–independence would also be relevant, although research here appears to be lacking.

The findings of the research suggest that many children in traffic would have difficulty estimating the size of vehicles at a distance. This is very significant when it is considered that for many young children 'big' equals 'faster' and 'small' equals 'slower'. In addition, in a complex traffic situation with many competing cues, not just vehicles, young children may be less inclined to take into account the approach of a more distant vehicle that at a glance appeared small.

Research on the perception of distance constancy

Gibson (1950) pointed out that it is not only the size of objects that is subject to different perceptions of constancy—in some situations, *distance constancy* may also be a factor. For example, the distance between two fence posts in near space may be the same as the distance between two fence posts in far space, but the projected image of the latter distance will be much smaller, and constancy may not always be maintained. Similarly, two objects may maintain a constant distance apart as they move closer to a viewer, but a perceiver's estimates of this distance may vary even though it remains constant.

There has been very little research on distance constancy, and what does exist, as with research on size constancy, is problematic overall due to differing methodologies. For example, children were asked to judge the relative distance of a pair of objects the same distance apart, but one pair was set at, say, 1 metre from the viewer, and one at 4 metres (Denis-Prinzhorn, 1959, referred to in Wohlwill, 1960). The distance between the pair in far space was likely to be judged as smaller. In a different type of study (Collins, 1976), children were asked to observe two nearby toy train carriages that were set apart at a standard distance on a railway track. They were then asked to apply this distance to two other carriages in far space on a parallel railway track. There were mechanical means for positioning the second pair of carriages, so that subjects did not have to move through space themselves. There were several judgments to be made at varying distances. In this case, underconstancy involved making the distance in far space too large, as a result of underregistering the distance of the faraway objects. Using this technique, Collins found underconstancy in all of his age groups - 5–7 years, 9–11 years and adults - at all distances. However, there was a significant difference for the 5- to 7-year-olds, who showed much greater error in their judgments than the 9-11-year-olds, whose judgments were similar to those of adults. With the younger children in the study, the amount of underconstancy increased markedly for objects placed at the greater distances, between 3-metre and 6-metre markers. These results agree with those of another study by Harway (1963), which also found greater underconstancy in children, although in this study the errors were larger.

The research on distance constancy suggests that, in traffic contexts, even adults are likely to be inaccurate at judging distances between stationary vehicles at varying distances from the observer, and this inaccuracy is likely to be very much increased for young children. These difficulties are compounded by the fact that in real life the distances are often very much greater than those in the research studies. In addition, moving vehicles are also involved in traffic contexts, and it is likely that the observer's viewpoint would not usually allow an unobstructed view of the distance between vehicles.

Perception of 'time to arrive'

There are many conceptual and perceptual aspects of time, but the most important, or indeed the crucial, one for traffic behaviour is 'time to arrive', or 'time to contact', which refers to the arrival of a vehicle or pedestrian at a crossing or possible collision point. In order to judge this, there must be some form of estimation of speed and the distance to be covered, and the time that will be taken. Similar judgments are also required for many perceptual–motor skills and sports where, for example, balls must be intercepted in their flight by being hit or caught, or body actions must be completed before entering the water in a dive. In order to act appropriately and/or safely, the person about to act must time his or her actions to co-ordinate with the estimated arrival time of the object and/or his or her own approach to it.

As yet there has not been much general research on children's perception of time to arrive or contact. Theorists who stress the role of cognition in perception focus not on actual *judgments* but on conceptual *misunderstandings* of the interrelationships of the three dimensions.

Perceptual–motor theorists are very much aware of the importance of perception of time for motor skills, and in fact define perceptual–motor behaviour as being concerned with 'the controlled spatial and temporal patterning of movements' (Connolly, 1970). However, there is a lack of fundamental research on the timing component of the motor skill, a point made by Laszlo and Bairstow (1985). One main approach to perceptual–motor development in children is task oriented rather than process oriented, and simply describes changes as children develop, without any real attempt to explain these changes (e.g. Gallahue, 1989; Cratty, 1979). Another group is much more concerned with theoretical analysis and modelling the components of perceptual–motor skills in general terms, but as yet the model has not often been applied to specific skills. One factor contributing to the paucity of research on time to arrive is that there are many other variables that often confound results, such as in ball interception tasks, where the trajectory of the ball or deceleration over time are also involved.

There is, however, a very significant body of research, some relating to children, that has been and continues to be carried out by ecological theorists such as Schiff and Detwiler (1979) and Lee and colleagues, who have been investigating the possibility that direct visual information to the eye provides the basis for both animals and humans to judge time to contact or arrive in a variety of situations (Lee, 1976; Lee, 1990; Lee & Reddish, 1981; Lee et al., 1983; Lee & Young, 1985). Lee hypothesises (1976; 1990) that we can estimate when to act, for example when to jump to catch a ball, when to take off when ski jumping or when to brake in driving, by means of ratios available from information in the changing retinal image. This ratio is worked out implicitly by the observer, not by explicit computation of distance and speed. There is support for this hypothesis in Schiff and Detwiler's experiment where two-dimensional computer and movie displays were used to simulate approaching objects, but contained no information about the distance or velocity of the objects. The adult subjects were able to estimate when an object on an approaching collision course would have hit them, even when this was filmed against a blank background.

As an object approaches us or we approach an object, the retinal image of the object expands rapidly. It is hypothesised that this is the basis for calculating time to contact, which is derived from the rate of change in size of the expanding image and the velocity with which it expands. Reports of Lee's studies using many different tasks add further support for this theory.

Lee suggests that, although the velocity of approach of an object may not be completely constant, the formula will give an estimation that is frequently accurate enough for many contexts. However, if there are changes in acceleration and the span of time or distance increases too much, estimates of time to contact will become inaccurate. There will also be problems if part of the approach is occluded or if the path is curved.

In further support of his claims that cognitive computation is not necessary and that sufficient data must be available directly in the optical flow of information at the retina, Lee cites the research of other psychologists on infants and young children. The ability to time the approach of objects moving very slowly has been shown to occur very early - in infants aged between 4 and 9 months (von Hofsten, 1980; 1983). By 12 months they can intercept slowly moving objects fairly accurately (von Hofsten & Lindhagen, 1979), but cannot intercept objects moving at 30 cm per second. Children 4 to 6 years of age can catch slowly moving objects, but do not anticipate arrival of balls moving at 100 cm per second nearly as well as do 9-11-year-olds (Forsstrom & von Hofsten, 1982).

Lee has not carried out any general research with children that directly investigates their ability to perceive time to arrive, but considers that the research with adults and animals and the research of von Hofsten with infants gives adequate support for his theory. He has, however, carried out experiments with 5-year-olds, training them, in 'pretend traffic', when to make crossings, and this will be discussed in the following section. The training is based on his belief that children this age have the necessary perceptual ability, which can be co-ordinated with other timing abilities. While this theoretical approach offers interesting possibilities, it does not deal with the complexities involved when other variables, such as changing patterns of movement of one vehicle or competing movements from different vehicles, enter the situation. In addition, it does not indicate what changes occur as children develop that will result in an increase in efficiency. Is it simply a matter of maturation of the nervous system and learning from experience to control attention and to differentiate the necessary information in the optical flow, or are cognitive mediations also required, especially in the more complex situations? Schiff and Detwiler also found some individual differences in the accuracy of their adult subjects' judgments, and the reasons for these are also speculative.

Research related directly to children's traffic judgments

Because judgments of speed, distance and time to arrive of vehicles are understood to be crucial for safe traffic behaviour, there have been a large number of studies based directly on simulated (modelled or filmed) or 'actual' traffic situations. The majority of these have not been concerned with theoretical issues related to child development in fact, they are quite a-theoretical, and have simply concentrated on comparing different types of judgments about safe crossing made at different ages, and the accuracy of these. First of all, a brief discussion of just a few of the many studies, carried out in 1980 or earlier, will indicate some of the types of tasks and the approaches used.

Many of the early traffic studies tended to look only at subjects' verbalised separate judgments of speed, or of distance of vehicles. However, verbalised judgments of speed or distance may not bear a strong relationship to implicit estimates of time to arrive, which appears to be the significant factor. Early research such as that of Salvatore (1973) is therefore limited in its usefulness. Children were simply expected to classify approaching vehicles' speed as 'slow', 'medium' or 'fast', and this conveys little of value.

A Japanese study by Kobayashi et al. (1971), where 3rd to 6th grade students at a roadside site judged speeds of approaching cars metrically (in kilometres per hour), appears, by contrast, unusually demanding. Many adults have difficulty estimating speeds in these terms, and yet behave appropriately.

A second experiment by this group, however (referred to in Hoffmann et al., 1980), asked children from the 1st, 2nd, 3rd and 6th grades to estimate the last instant at which it would be safe to cross the road in front of approaching cars whose speed varied from 30 to 50 km/hr. The estimates of the children in the 1st grade were unsafe. They would accept timing for making an attempt to cross when a car could only avoid colliding with them by making an emergency stop. With increasing age, children allowed a greater margin of safety, but those in the 3rd grade and younger had difficulty in understanding the concept of a safety margin. In this research there is no consideration of factors influencing children's judgments, or of theoretical underpinnings in developmental theory.

Hoffmann et al. (1980) designed a task for a sample of subjects that included children of 5–6 years, 7–8 years and 9–11 years, and adults. The subjects viewed film clips of a vehicle approaching, filmed from the side of the road. The film was stopped at various distances before the filmed vehicle reached the child observer. Subjects were required to estimate when the vehicle would have reached them if it had continued. The method of indication was by pressing a buzzer attached to a timer, to register estimated arrival time. All subjects were cautious and underestimated time to arrive, with the youngest children making the greatest underestimation. There was a large amount of scatter in the predictions of the 5- to 6-year-olds, indicating that they could not reliably predict arrival time. However, the results for 12-year-olds were very similar to those for adults. Females were more conservative than males in that they underestimated to a greater degree.

Hoffmann et al. make the important point that findings from a laboratory task cannot be extrapolated directly to real situations. They suggest that there is no guarantee that findings from a simulation will be directly applicable to actual traffic behaviour, and that individuals will necessarily act with caution.

This point was made by Ebbesen et al. (1977) in an earlier study with adults only. Subjects' performance on a simulation using model cars and roads was compared with performance in real traffic. In the simulation task, in contrast to the findings of Hoffmann et al., subjects appeared to judge risk in crossing as an additive function of distance and velocity, taking into account both the speed of the approaching vehicle and its starting distance. The faster the car travelled and the closer the starting distance, the greater they judged the risk. They were also more likely to take risks in the simulated situation. In the real situation subjects were considered to judge by a single dimension, which Ebbesen calls 'perceived temporal distance', and they took much less risk.

So, while Hoffmann's child subjects were conservative in judgments based on videos and not risk taking, Ebbesen's adult subjects were not conservative but risk taking in approach when faced with simulations using models. It is apparent that there is no straightforward relationship between real-life behaviour and behaviour in simulations. This is a frequent finding of research studies in many areas. Judgment and behaviour in artificial laboratory tasks and simulated situations are often very different from that in real situations, where the individual has a personal investment or interest.

In the different testing situations, many variables could have influenced the subjects' responses and produced conflicting results. These include:

- the *viewpoint* of the observer
- the *understanding* of task requirements
- *interest*
- the *immediacy* of any *risk*

The types of cues available for processing would also have varied. It would seem likely that the real traffic situations, rather than simulations, would offer many more cues, but perhaps some of these would have been competing cues (e.g. noise). There would be many aspects of simulations that would be lacking in verisimilitude. In addition, only some of the various studies discussed above expected subjects to combine estimates of time to arrive with estimates of their own speed of crossing - this adds complexity but is necessary for judging safety margins. All of this makes it impossible to draw a clear picture from these studies of the nature of the factors influencing children's judgments, or of the progress associated with increasing age.

A study of children's and adults' traffic judgments by Vinjé (1982) is often referred to; this research makes even more apparent the diverse approaches and tasks in different studies. At the beginning of her report, Vinjé summarises the separate findings of a large number of the previous researchers in this area. All researchers were concerned with obtaining subjects' decisions about when it would be safe to cross, but methods varied in many ways. For example, studies involved slides, filmed or real events; responses required were verbal or mechanical (e.g. pressing buttons) or actual road crossing; estimates involved judgments of speed or distance or approach times, safety margins, minimum lags or accepted gaps; some studies used very small samples with fewer than 10 in a group, or required only one or two judgments, while others used large samples, and some required subjects to make large numbers of judgments, for example more than 30 road crossings.

It is difficult, again, to summarise such diverse research, but there does seem to be a fairly clear-cut trend towards increasing accuracy with age in children's judgment of time to arrive and of safety margins. The performance of 5- to 6-year-olds was generally found to be quite variable and frequently very inaccurate; by age 9 or 10 years judgments were more appropriate, and by 12–13 years children's estimations of safety margins were close to adult level. However, adult judgments were not always completely accurate, especially for higher speeds.

The various studies discussed by Vinjé are also not very helpful for drawing conclusions as to the basis on which judgments were made and the reasons for inaccuracy - this is essential if they are to be of value and provide implications for more appropriate guidance and training. There are conflicting suggestions, and the majority of studies make no attempt to relate their investigations to relevant child development theory and research.

Vinjé concludes that the single aspect that can lead to safe crossing decisions is the consideration of distance, in that if the distance of a car is great enough, speed will not need to be taken into account. In designing her own research studies she hypothesises that younger children, 5- and 6-year-olds, will base judgments on distance only, but older children and adults will make decisions that combine distance and speed in some way, due to greater cognitive competence. However, there is no further theoretical discussion.

A major finding of Vinjé's studies, using both filmed and real traffic situations, was that, in contrast to the findings of Hoffmann et al., the youngest children, 6- and 7-year-olds in Grades 1 and 2, made decisions about times for crossing that were too fast and 'absolutely unsafe' in the film situation (89% of their decisions were unsafe, compared to 57% for the 9- to 11-year-olds in Grades 4 and 5 and 22% for the adults). In the real traffic context, however, decisions of the youngest children were more appropriate, and similar to those of the older children. Vinjé concludes that the film situation was too difficult, although the reasons are not adequately explained.

At all age levels it was found that many of the decisions would have required the subjects to have crossed faster than their actual crossing pace. A factor that was not taken into account in the studies was children's estimates of their own speed.

Vinjé's further findings were that many of the younger children did appear to use only distance judgments, whereas 5th graders and adults tended to co-ordinate speed and distance judgments (although the design of the study does not make it possible to assess how these were co-ordinated). However, she also found that some of the younger children did appear to take some account of speed. It is difficult to know the significance of this, as there were only eight subjects in each age group. She states that older children's or adults' judgments of speeds appeared somewhat better co-ordinated, in terms of combining speed and distance judgments, but, at higher speeds, speed became the dominant factor in judgments.

In the study where films were used, an hypothesis was made, for younger children especially, that with a larger sized car there would be smaller minimum time lags allowed in the judgments of a safe time to cross, owing to overestimating distance; this, however, has a doubtful basis in theory. In effect it could not be tested, as the size of the cars was not adequately distinguishable.

None of the above studies were designed in such a way that they could test adequately whether there was any direct relationship between children's ability to make cognitive computations and the making of safe judgments about crossing.

Lee and his colleagues, taking the approach of ecological theory, have provided different directions for research that seem to offer some promise. The theoretical basis of their experiments is that even young children have the ability to process optical flow information to perceive time to contact of a vehicle, and this can be trained by experience. They have initiated several studies directly relating the hypothesis of direct perception to children's performance in traffic (Lee et al., 1984; Young & Lee, 1987; Demetre et al., 1992). In the first study, it was assumed that children could be trained to use their ability to perceive time to visual contact in a roadside simulation. They used a 'pretend' road 9 metres wide, laid out alongside a real road that was twice as wide and separated by a barrier. Children aged 5 to 10 years watched an adult demonstrate and instruct, and were then required to judge when to cross to a pretend traffic island (the barrier) after a car passed and before the next one arrived. On average, each child made 27 crossings, and their performance was compared with that of an adult group. The 5-year-olds were usually conservative and rejected 45% of gaps of adequate duration, but in 9% of the trials accepted gaps that were too short. Adults also accepted gaps that were too short in 7% of the trials, but missed only 10% of the opportunities that were adequate. Timing improved consistently with age, but in each age group some children performed as well as adults: 10% of 5-year-olds, and 25% of 7- and 9-year-olds. In the experimenters' view, these latter findings indicate that many young children could be trained to use optical flow information and perform as well as adults. Their findings contrast with those of Vinjé, where 89% of the judgments made by 6- to 7-year-olds were unsafe.

In Lee's second experiment, children aged from 4 years 7 months to 5 years 9 months were trained to perform the same task as in the first experiment over five or six sessions of 15 minutes each. The 5-year-olds performed very well, making crossings that were 'tight fits' less often than adults, and some children made no errors at all. The children were still more conservative than the adults and did not always use possible gaps. Lee and colleagues conclude that, in contrast to the views of previous research, 5-year-olds have the visual ability to cross safely, which can be developed by training. They did find, however, that some children apparently became bored by the training, and their performance fell away.

In order to clarify whether pretend road performance correlated with real road performance, a third set of experiments used only a real road. The subjects were 5-year-olds, and they stood 60 cm from the kerb and indicated a decision to cross by taking two steps towards the road. They were prevented from actually crossing by a barrier. The results were that they still missed many more opportunities than adults did, but they were only marginally more likely to attempt crossings that were 'tight fits'. Lee and his colleagues conclude that children do not have a developmental deficiency in assessing timing, as suggested by cognitive theorists; however, they consider the small but similar number of dangerous decisions made by adults and children alarming.

At this stage there is insufficient knowledge about how and when such a timing capacity could be relied upon to operate, and how it relates to development. Does it depend simply on sufficient experience and training, or are some developmental factors also involved? What happens when situations are complex, with varying movements and paths of cars, or cars potentially about to arrive but obscured around a bend in the road? These latter conditions would seem to make cognitive mediation necessary. There is also a need to investigate children's estimates of their own speed of crossing, and the bases for their judgments.

Processes of auditory perception

There is a paucity of relevant research on auditory perception in comparison to the research on visual perception. However, in terms of the traffic environment, hearing is highly important - it is required for ascertaining the direction and distance of approaching vehicles.

Auditory perception of direction

Research indicates that adults non-consciously process a variety of cues in determining the location of a sound source. Much of the information about location arises from the fact that the stimulus input to each ear varies according to where the sound is located. There are:

- *time differences* in the arrival of sound at the two ears
- *differences in intensity* at the two ears
- *changes in the composition of the sound* due to the effects of head shadowing of the sound
- effects of the *outer ear shape*

There are also changes produced by movements of the head and movements of the sound source. Laboratory experiments on sound localisation tend to focus on only one or two of these cues, but in real life many cues are available and usually help accuracy (Moore, 1977). In everyday contexts, unless there are many conflicting aural and visual cues, adults locate the general direction of sounds fairly accurately. This is not surprising, as the ability to locate sound is adaptive for survival in both animals and humans.

The research on children's sound location is very sparse. What there is has mainly been carried out with infants. This research shows that the type of stimulus affects responses, with infants being more responsive to high frequencies than low frequencies, for example (Aslin et al., 1987). (It is important to point out that, for adults also, sounds of higher frequencies are much more readily localised than those of low frequencies.) In the first months, under simple conditions, infants turn their heads fairly readily in the correct direction to locate sound on the lateral plane. However, head turning in the general direction of the sound heard is the only response required of infants in these studies, and this is a fairly gross measure (Clifton et al., 1981).

The only research on older children and sound location appears to be the studies in the 1960s by Sandels (1975), which are well known in traffic research. The 6-year-olds who made up the sample of children in this study made many more errors than adults in locating the sound of a car's approach, played through one of a circle of 12 loudspeakers. The adults' judgments showed a high degree of precision, whereas the 6-year-olds showed a smaller number of correct responses and a greater dispersion of incorrect choices (judgments were scattered).

Children also confused auditory sources to the right or left much more often than did adults. However, the most common incorrect judgments made by children were still fairly accurate, being only 30° to the right or left of the speaker from which the sound came (Sandels, 1975).

As Sandels herself has pointed out, other factors could have influenced the children's judgments. For example, their performance might have been influenced by the fact that apparatus prevented head movements and they were required to manipulate a pointer in the direction of the sound. In addition, they may not have been very motivated to perform effectively in such an artificial task, and may have found it very difficult to maintain attention for the required 96 tasks!

As support for her findings, Sandels quotes the opinion of Gibson (1966) that 'the perception of sounds is less effective in the child than in the adult: Children select different sounds from adults'. However, attentional differences in selection are not the same as differences in actual perceptual sensitivity.

This area requires considerably more research.

Auditory perception of distance

As pointed out by Moore (1977), there are a number of cues that we can use to judge the distance of a sound source. Many judgments depend on the familiarity of and experience with particular sounds at varying distances. Intensity of a familiar sound stimulus gives a crude indication of distance from the listener. The spectrum of sound frequencies also changes at a distance, owing to the absorbing properties of air, with high frequencies being attenuated more than low frequencies. When a sound source is nearby, the wavefront will be strongly curved, whereas a distant sound source produces a plane wavefront. Curvature affects inter-ear differences in intensity and time (phase), although it is not known how well we process these to gauge distance. If we are in a room where sound reflects off surfaces, we can also judge distance by registering the time delay between distant and reflected sound.

However, in spite of all these cues, research indicates that adult judgment of distance of sound sources is often inaccurate, especially for unfamiliar sounds (Moore, 1977). Although no research has been located on children's judgments, it could be expected that they would be much more inaccurate, especially as children would have had far less experience.

As judgments of distance to approaching vehicles by sound as well as sight are important for road safety, there is obviously need for well-conducted research on children's competence in this area.

DRAWING ON KNOWLEDGE AND PROCEDURES EXISTING IN MEMORY

When we engage in the process of trying to make sense of situations, there is constant movement back and forth as new information is related to existing knowledge in memory, and further new information is acquired and integrated as necessary. Identification, interpretation and comprehension of information are entirely dependent on the knowledge base stored in memory. Reflecting, reasoning and problem solving occur in 'working memory'. As children develop, their performance will be significantly influenced by the content, organisation and capacity of their memory.

Memory

In terms of road safety, this question should asked in relation to memory: 'What are children likely to have stored away in memory that will help them in identifying relevant perceptual aspects of the situations that they face in traffic, and in comprehending the meaning and significance of what they are perceiving?' Also relevant to ask is what instructions children have received in the past to help them deal with traffic situations, and whether they are likely to retrieve these from memory when appropriate.

Psychologists usually talk about different *memory stores*, or different *depths or levels of processing* occurring in memory. These are metaphors for what appear to be different types of memory that are not fully understood.

The sensory register

What might be called the first, or most superficial, level of memory is the 'sensory register' where incoming information from the senses is held for a few milliseconds. There appear to be different registers for the different sense modalities - hearing, vision, touch etc. As discussed in relation to attention, we attend only to some of the information that is in the sensory register, and this attended information is then held briefly in short-term memory. No developmental differences have yet been found in the capacity of the sensory registers.

Short-term memory

At the next 'level', what is often called 'short-term memory' has a very small capacity, but it lasts for a few seconds. Bjorklund (1989) calls the short-term memory store the place 'where we live mentally'. It is where we consciously deal with information while we are continuing to attend to it and process it. So short-term memory is often called 'working memory'. New information gets processed briefly in short-term memory before it either decays owing to lack of further attention or gets transferred to 'long-term memory'. We also retrieve information from long-term memory into short-term memory in order to help us process situations we are currently dealing with.

There appear to be developmental differences in short-term memory, although there is unresolved controversy over the reasons for the differences. In general, as children develop, the number of unrelated items that can be held in short-term memory appears to increase - from about two items at 2 years to four items by 4–5 years, six items at 8–9 years and seven items, plus or minus two, by adulthood.

The more that items can be grouped or linked together in some way, or occur in a meaningful relationship, the more information that can be held at any one time. For example, while only 2–6 nonsense syllables may be held in short-term memory, it is possible to hold a long sentence of many words if it is meaningful.

Many psychologists believe that the increase in capacity is due to maturation of the brain and nervous system. One factor could be the increased speed of processing due to *myelination* (insulation of the neurons).

Other psychologists emphasise experience as the main factor, as it leads to greater familiarity with the information to be dealt with and the production of more strategies for linking and relating incoming information. Younger children apparently take longer to encode unfamiliar information that would be familiar to older children and adults.

Short-term memory and road safety behaviour

In terms of road safety, the lesser efficiency of younger children's short-term memory, compared with that of older children, means they will not be able to deal with as much information at once as they attempt to identify and comprehend either information in the traffic environment or educational material and verbal instructions. They will be able to attend to less information, and they will be likely to be more limited in their comprehension, reasoning and problem solving, because they can relate only comparatively small amounts of information at one time. It is likely that their information processing will frequently be inadequate. This will, of course, have significant effects on their performance in traffic.

In addition, if an accompanying adult gives younger children instructions about safe behaviour, they may not be able to process these adequately. The instructions may be too long, and/or the components may not be well related to each other in terms of the child's understanding.

As mentioned, much of the information in short-term memory decays if it is not very salient or meaningful for the child and is no longer attended to. However, some information gets stored for long periods in long-term memory.

Long-term memory and road safety behaviour

The information that gets stored in long-term memory is information that is meaningful and significant to the individual, or else information that has been made distinctive in some way, such as by repetition, rehearsal or special memory strategies. Many psychologists believe that all information processed through to long-term memory remains in memory permanently, although it cannot always be retrieved. This, of course, is not directly testable. It is pointed out, however, that, while we may not always be able to *recall* much information from past experience, as in recall there are no cues to prompt memory, we may be able to *recognise* events from the past as being familiar if they occur again. Recognition (where there are many cues available) is much easier than recall, which makes it apparent that far more is stored in memory than we may have believed. In many instances young children's recognition memory does not show very many differences from that of older children and adults. There may, however, be significant differences if the experiences to be remembered are complex or contain many subtle details (Sophian & Stigler, 1981).

There is often a distinction made between different types of content that can be stored in long-term memory. Many psychologists differentiate *semantic* memory from *episodic* memory. The distinction is not discrete, however, and there is often overlap. The difference can perhaps best be described by saying that retrieval from episodic memory is retrieval of specific events and occurrences in our past experience that can be introduced by 'I remember ...'. Retrieval from semantic memory includes the retrieval of concepts etc. through the use of language and other symbol systems, and can be introduced by 'I know ...' (Tulving, 1974). When we have to remember a list of items or phrases or events that is not very meaningful, episodic memory is largely involved, although semantic memory is also involved to some extent in identifying the items - for example, in remembering a series of items on a grocery list. Episodic memory is also involved for young children when they are told to 'look to the right and look to the left and look to the right again'. This often becomes a learned sentence that is not very meaningful for younger children and does not fit in well with other knowledge in memory.

Commands such as 'look to the right ... etc.' for young children have to be learnt by rote, with considerable practice provided by adults. Much research has shown that, under 6 or 7 years of age, most children do not rehearse and memorise such material spontaneously, and adult assistance is required (Flavell, 1970; Siegler, 1991). Because the safety rules are not very meaningful to young children, they often need to be cued to use them in the appropriate circumstances - when crossing the road and in other traffic situations. However, when such sentences have become meaningful to older children, who understand, for example, why it is important to look in both directions for approaching traffic, what the distinction is between 'right' and 'left' and why it is important to look to the right twice, then they are more likely to remember them and to use them at the appropriate time. The sentence 'look to the right twice', and others like it, has become part of semantic memory associated with concepts and knowledge related to road safety.

It is not surprising that, when younger children have finally learnt the 'look to the right, look to the left and look to the right again' formula, they may use it as a sort of magic incantation to 'ensure' safety because they do not understand the purpose of the instruction.

The above example accords with the growing recognition in cognitive psychology that understanding or comprehension and semantic memory are strongly interrelated. If we understand something, we integrate it with our stored knowledge in semantic memory. This integrated stored knowledge can influence our understanding on future occasions, provided, however, that we actually recognise its relevance to the current context. Knowledge that is understood and can be readily assimilated with other knowledge in semantic memory is more likely to be retrievable on future occasions. Young children's memory will be less efficient, because not only do they have less stored knowledge, but the stored knowledge they *do* have is also less interrelated.

The limitations that appear to exist in young children's long-term memory processes relative to older children's ability will impede their ability to process information efficiently in traffic contexts. We need to take the limitations in semantic memory into account when devising road safety education programs for the very young, a matter that will be discussed further in the next section, which deals with comprehension.

INTERPRETING INFORMATION FOR COMPREHENSION, REASONING AND PREDICTION

Processes of comprehension

Comprehending a situation requires the interaction of many processes. We need to integrate perceptual information from many different sources in order to understand and make sense of the situation that currently exists, and to be able to form expectations and generate predictions about what is likely to occur next. To do this, as has been suggested above, it is necessary among other things that we have appropriate knowledge stored in memory.

Comprehension of what is happening is essential for safe behaviour in traffic. Information from traffic situations needs to be gathered, related and linked also with knowledge schemas in memory. Relevant knowledge schemas include *concepts* and *scripts*. Some of children's relevant knowledge will include past instruction and educational material provided by adults.

But a number of other factors also operate. It is not just a matter of perceptual identification of relevant aspects of the context; what is also involved is the integration of these to give an overall significance to the situation and allow interpretations to be made.

There are several processes involved. It is easier, for discussion purposes, to separate them and place them in an approximate serial order, but in practice we move back and forward between them. (We do this so swiftly that we are not aware of it.) Processes include:

- *Allocating attention and perceptual processes* to pick up relevant information requiring interpretation. This process may often be conceptually driven.
- *Relating incoming information* from perception to *appropriate existing knowledge* that can be activated in memory.
- *Reasoning and making inferences* to fill in gaps in information, attempt to understand causes and make predictions on the basis of past knowledge.
- *Linking all the relevant information* into relevant relationships, over both time and space where appropriate.
- *Monitoring the processing of information* to ascertain whether a valid understanding is being gained.

Research relevant to these processes of comprehension has important implications for children's ability to solve problems in traffic. It is also relevant for children's understanding of road safety educational material, both verbal and non-verbal.

The majority of the research on comprehension concentrates on the comprehension of verbal material, but of course the principles and relationships concerning verbal material can often be related to an understanding of other representational and symbol systems, including scenes, events, pictures, and filmed and videoed material. These principles and relationships can also be related to non-verbal communication that uses gesture, facial expression, direction of gaze, body movement etc.

In the process of comprehending traffic situations, it is important to understand the following:

- the *nature of the events* occurring
- the *significance of the movements* of vehicles and pedestrians, and factors influencing or likely to influence these
- the *intentions* of drivers and pedestrians
- the *meaning of signal systems* and signs
- *cause–effect relationships* and possible future events

For children, verbal messages or signs from an accompanying adult may also have to be taken into account.

Allocating attention and perception to pick up relevant information

All of the developmental differences in attention are relevant here, and will of course influence the efficiency of the information-gathering process and the degree of eventual understanding.

When the comprehension processes are working efficiently and appropriately there is a cyclical effect. There is a considerable amount of what has been referred to as conceptually driven or top-down processing. The knowledgeable individual, such as an older child or an adult, in interpreting a situation already has ideas of what to expect, and this guides the search for relevant information, which is then assimilated with knowledge stored in memory. For example, in traffic, when about to cross the road at a busy intersection, practised and efficient adults will know where to look for possible vehicle and pedestrian movements in all relevant directions as well as taking account of other aspects such as traffic lights and pedestrian crossings that they know are significant. In searching out this information, other cues, not previously anticipated, may also become apparent - for example, the distant sound of an unseen ambulance - and these in turn will be related to stored knowledge if they are to acquire meaning.

Young children will be much less efficient because of their comparative lack of experience and lesser knowledge, their tendency to centred thinking and their tendency to rely much more on data-driven or bottom-up processing. The result will be to limit their overall interpretation, which will tend to be:

- more effortful
- slower
- not always as appropriate, with significant cues possibly not being apprehended at all

As children develop they become capable of a more systematic approach, but usually it is not until late childhood or adolescence that these processes become efficient.

Relating information from perception to appropriate existing knowledge

One of the first questions to ask is whether children have acquired the knowledge necessary for relating to the situations they encounter in a way that will enable them to understand these situations and make soundly based predictions. A construct that is very useful here, and used widely by cognitive psychologists, is the *schema*. This concept has already been mentioned in earlier sections. Schemas, or schemata, are hypothesised to be organised mental representations of knowledge that are components in the vast network of knowledge in memory. They can be inferred to exist from behaviour, including verbal behaviour, and from the way individuals approach tasks. We may be able to verbalise some aspects of them if required, but they are not always easily accessible. Bartlett (1932), who was one of the first researchers to introduce the term 'schema' and use it in the above sense as part of his classic studies on memory, argues that all our knowledge is represented as an expanding set of schemas which over time develops more and more interrelationships.

Among the various types of schema currently being studied are concepts, scripts, story schemas, scene schemas and cognitive maps. These and many other schemas probably consist mainly of what is known as 'content knowledge'. Other schemas consist of *procedural* knowledge, that is, knowledge that children and adults have acquired and constructed about how to do things both physically and mentally. And some schemas will be a combination of content and procedural knowledge. For example, a driver might have not only detailed content knowledge about cars and their engines, but also procedural knowledge about how to drive them and how to troubleshoot and then repair them when things go wrong.

Children, of course, acquire many more schemas as they grow older, and content and procedures get added to with experience. But, also as the result of the interaction of maturation and experience, there are significant changes in organisation and in the type of content and procedure, including more logical relationships that may be established between schemas and components of schemas. Content may also become more abstract, and less dependent on what has been directly perceived. More mental procedures are also added to behavioural ones as children grow older. All of these changes mean that, while a young child may simply have a schema for a red traffic light that means she has to stop when she sees one, with development and experience she will relate it to: other schemas for red lights, and also for green and amber lights; concepts of danger; the whole concept of control by lights; the perspective of others at other positions in an intersection, etc.

These networks of schemas are part of the necessary foundations for comprehension, reasoning and prediction. Schemas such as concepts and scripts are the most relevant schemas for consideration in relation to traffic understanding and behaviour, and have been the subject of the most research by developmental psychologists studying schemas in general. There is a small amount of work on scene schemas, but insufficient at this stage for inclusion in this report.

Concepts

The concept is probably the most basic mental representation of knowledge. Most of the tens of thousands of words in a language stand for *concepts,* that is, categories of objects, events, attributes or relationships that have features in common. This does not mean, however, that concepts always have word labels; they may in some instances be non-verbal (Hospers, 1971). For example, an adult listening to various pieces falling into a certain category of music may feel that they all have something in common, but may be unable to name the concept. A child might have a concept of animals that fly without having any concept name for them, or even for 'flying'.

If a new stimulus can be related to an existing concept, a great deal about it can already be predicted or understood. Not all of the members of a concept have common sets of features, but they tend to share at least some of them. Examples of some of the very many concepts relevant to road safety include the categories of concrete, readily perceptible objects and people, such as 'policeman', 'pedestrian', 'driver', as well as 'traffic light', 'footpath', 'kerb', 'stop sign' and 'roundabout'.

Although the actual members of many categories or concepts such as those above may be directly observable, some of their attributes may be less concrete. For example, the uniform worn by a policeman is concrete, but other attributes are less tangible. Many concepts contain features that relate to function and/or to more abstract aspects of the environment. Functions in themselves may be directly observable, or more abstract. Compare, for example, 'puts up hand to stop traffic' or 'chases robbers' with 'controls and gives access to traffic from different directions' or 'helps to keep law and order'.

With experience, young children gradually identify and store in memory some, but usually not all, of the observable concrete features of the categories they encounter in their environment; but they may fail to detect or have difficulty in dealing with and representing the more abstract features. The concepts of preschool-aged children will generally be very concrete, and limited in the sets of actual attributes that they contain. As a result, children and adults may vary significantly in the meaning—that is, the conceptual attributes—they assign to the same word.

Another example, related again to traffic lights, can illustrate this further. Children under the age of 6 years or so are unlikely to have well developed concepts about traffic lights. They may come to regard green as having a simple function to say 'go' and red as indicating 'stop', without understanding either the significance of the amber light or the mechanical nature of traffic lights. So it is possible that a child may interpret a green light as always meaning she can cross safely without taking any account of actual traffic conditions. She may not take into account the possibility that an approaching car may not brake in time or that a car coming round a corner might not take account of pedestrians crossing with a pedestrian signal. The same type of problem may exist for children's early concepts of marked pedestrian crossings. Children's understanding of any traffic situation will only be appropriate if they have concepts that are appropriate.

Many of the concepts relevant to traffic, such as 'safety' and 'danger' (as indicated earlier), are relational, not absolute, concepts. They must be judged in relation to other factors, and often represent positions along a continuum. Examples of other relational concepts that may be used in respect to traffic include 'close', 'far', 'behind', 'soon', 'clear, 'left' and 'right'. The youngest children may not understand some of these concepts because they may treat them as absolutes, or may not understand the relationships involved. Older children, too, will have difficulty with higher order relational concepts such as 'priority' or 'right of way', the latter concept creating a further problem in that it is ambiguous - 'right' having a different meaning here to the spatial 'right'.

The concepts that feature prominently in the instructions given to children about how to deal with traffic and other situations often produce many opportunities for misinterpretation. Adults and children may use the same words, but their understanding of the concepts will often vary considerably without either adults or children being aware of this. For example, a child who was asked recently by a teacher to tell her what a 'policeman' is replied, 'Someone who has a gun and shoots you.' This is just one of very many possible examples that show it is important to be aware that communication with children may not result in the correct meaning being understood.

Children learn most concepts informally and mostly not consciously, by hypothesising what a word or symbol represents when they hear and see it in various contexts. They often have to correct these hypotheses as a result of experience. Young children may persist for quite a long time with incorrect hypotheses for more difficult concepts, if they do not modify the original meaning they have extracted as part of their own further experience and developing understanding. Children's incorrect comprehension of concepts such as 'old', 'tomorrow', 'husband' and 'birthday' illustrate this.

'Left' and 'right' are important concepts for road safety, and are also often misunderstood. Adults usually introduce the terms 'left' and 'right' to children in their preschool years. They are often concerned that children should become right-handed and will be able to perform activities related to left–right discrimination such as putting on shoes correctly or writing words and letters in the correct orientation.

Before the preschool years, children may use one hand consistently, but this is not a conscious choice and there is not usually a valid understanding of 'left' and 'right'. Before these concepts can be understood correctly, children must become aware of the 'sidedness' of their bodies and of the feeling that one side is different from the other, probably because one hand gets used consistently. The next steps are for children to distinguish objects and other aspects of their environment by relating them to their own right and left sides and noticing that objects and aspects of their environment have different sides also. This usually occurs by age 4–6 years. Many children also learn the correct verbal labels for the concepts of left and right at this time, and apply them appropriately. However, some children, and some adults also, continue to have difficulty discriminating right from left. They use the words without always applying them consistently. It is usually not until age 9 or 10 that most children who discriminate the two dimensions can understand how to apply concepts of right side and left side correctly to people and objects opposite their own person.

Children and adults who have difficulty understanding right and left often have difficulty navigating in an environment where they must read a map. More importantly for children, however, this difficulty can often create confusion when they must follow someone else's instructions.

Implications for traffic education

It is important that those with the task of designing road safety materials and training for children be aware of the many possibilities for young children's miscomprehension of the concepts involved. There needs to be careful analysis of the major features of the concepts used to ensure that children will comprehend them; if not, simpler explanations and alternatives will be necessary.

Scripts

Another type of mental schema important for children's comprehension of traffic is the *script.* A script is organised mental knowledge representing a familiar sequence of events together with some of the other components, such as the people, the roles and the objects, that go with the events in our everyday life. Because the general sequences are repeated so regularly we come to represent them mentally and make use of the order and predictability they confer on our everyday lives. Routine event sequences come to be run off fairly automatically.

For example, we have scripts for getting up and getting ready to leave in the morning, for going to the dentist, for eating in a restaurant, etc. Most children build up scripts for the sequence of events related to going to school in the morning. The sequence might include going out to the bus stop, meeting friends, getting on the bus, showing their passes to the driver, alighting at school, etc. As well as the sequence of events, children also represent objects and props that are part of it, such as school bag, bus pass, bus driver, and the roles played, such as that of the bus driver. Children who walk to school with friends or mothers would have scripts based on a different sequence of events, including the chain of events for crossing roads.

There has been a considerable amount of investigation of the development of scripts in children (e.g., Nelson & Gruendel, 1981; Mandler, 1986; Slackman et al., 1986). In this research the findings are that the youngest children, 3-year-olds, tend to have scripts of just a few events that occur in a temporal sequence. Usually they are aware of few or none of the cause–effect relationships that link the events. The older children, 4- to 5-year-olds, tend to have longer scripts containing more events, and understand some of the links between some of the events where there are simpler cause–effect relationships. They also have some understanding of the accompanying props and the roles played by participants.

By 5 to 6 years, children may be aware that scripts do not always follow the same steps, and there may be some variations. For example, they may sometimes go to a friend's house and walk to school with the friend. Seven- to 8-year-olds are much more aware again of the possibilities for variation, and have more insight into cause–effect relationships and the roles of participants.

A significant aspect of this is that younger children tend to be fairly rigid in their adherence to scripts, and may often perform activities as part of a sequence of events without a great deal of understanding. This gives them a sense of order and predictability. This situation has implications for traffic behaviour.

In traffic contexts, children will perform the same activities regularly each day, and perhaps give the impression to adults that they understand the reasons for their own behaviour. So, for example, they may always stop at a particular point on the road and look before crossing, without really understanding what they should be looking for. Adults could therefore be lulled into a false sense of security about children's understanding and behaviour.

In addition, if the routine is broken for some reason, younger children may become anxious and upset, may become unable to predict the next appropriate step and may behave inappropriately and unsafely - for example, they may cross the road impulsively or at the wrong place where there is insufficient visibility. They will no longer have their routine script to guide them, and if they have to make their own decisions these may be ill-judged owing to their lack of understanding.

By 7 or 8 years children are more adaptable and more aware of some but not all of the cause–effect relationships and reasons for behaviour. They do not need to adhere so strongly to scripts, but this does not mean that they will always make the right judgment.

Reasoning and making inferences and predictions to fill in gaps in information

The information in any situation, verbal or non-verbal, is never complete. We have to go beyond what is immediately apparent to infer what *could* be significant, but is implicit in that situation. Throughout our everyday activities, communication, reading etc. we make a great many inferences, usually without being conscious of doing so. It is also necessary in many contexts, including traffic situations, to reason further to make inferences or predictions about what is likely to happen.

Children in traffic need to make inferences about aspects that cannot be directly observed in actual situations in order to reason, make judgments and predict what future events might occur before the goal of acting safely can be reached. Some of the inferences relevant to the traffic situation will be:

- *causal* inferences
- inferences about others' *motives* and *intentions*
- inferences about the *visual perspectives* of drivers and pedestrians

We make inferences and predictions based on knowledge gained from past experience, or by means of logical deductions. For example, we reason on the basis of past experience that the driver who is moving slowly along a suburban street may be looking for an address or a house number, and may stop suddenly. Many other examples relating to traffic can be given. We may watch an elderly person or a child walking along a street and infer from their actions that they may step straight on to the road at the corner without looking. When we back out of a drive, we infer that there may be an unseen pedestrian who could be on a collision path with our car.

Categorising inferences

Psychologists have attempted to categorise the different types of inference and have come up with different systems (Small, 1990). However, for the sake of simplicity it is useful to divide them into just two categories:

- *logical* inferences
- practical, common-sense inferences, sometimes known as *pragmatic* inferences

Logical inferences are those inferences that abide by the very specific rules of logic. They enable us to combine given propositions or statements about relationships and come up with a valid conclusion that does not have to be tested against actual observation to see if it holds true.

If we abide by the rules of logic and if the original propositions to be combined are true, then the conclusion will necessarily be true. However, in everyday speech we often use the word 'logical' inappropriately when someone draws a conclusion that seems like common sense to us, although it has not been drawn by logical processes of thinking. These are usually pragmatic, or common-sense, inferences. Probably most of us do not actually engage in a great deal of strictly logical thinking.

The common-sense or pragmatic inferences are the inferences that we make most of the time and use for getting by in our everyday living. They are based on cues in the context, together with knowledge from experience about what generally seems to happen in such situations - on what seems probable or likely in our knowledge of similar repeated circumstances. If two or more things usually happen together in a specific context, it seems we can often reasonably expect the same sort of relationship or co-occurrence to obtain. It is possible, but not necessarily so, and at times an unwarranted assumption may lead to negative consequences, for example if we expect that a pedestrian will always look before stepping off the footpath. The range of possible inferences is vast, and we make them constantly to fill in gaps such as 'who?', 'what?', 'what next?', 'what before?', 'when?', 'where?', 'why?', 'how?'

Because Piaget's theory of cognitive development in childhood considers only logical inferences and the capacity for logical reasoning, children's ability to make pragmatic inferences was largely ignored by researchers until recently. Young children were believed to be incapable of making inferences, able to deal only with observable information, and unable to fill in gaps by deduction. What is apparent now, however, is that 3-, 4- and 5-year-old children do make many pragmatic inferences based on their knowledge from past experience. They do also make logical inferences (e.g., Donaldson, 1978), but these are cognitively more demanding, rather infrequent, and seem to occur mostly in situations that are very familiar to and significant for them.

Young children's pragmatic inferences, however, although more frequent, may be very limited in nature, often being based on too little knowledge and experience. These inferences involve mainly concrete objects and events that would be directly observable if the children were present. Many of their inferences will be either egocentrically based or inappropriate in another way because they have taken account of too few cues within the current context, failing to notice more significant cues. They may make inferences based on how they would react or how things happen within their own limited experience. They may overgeneralise on the basis of just one or two events that they have knowledge of.

Examples may make this clearer: a child and a mother are waiting for a train that is running very late. The child comments that this must be because the train driver is very tired. A car breaks down on a family outing. A child comments, 'Daddy will fix it.'

Even though young children make pragmatic inferences quite often in situations that directly concern them or interest them, as the above example shows, they frequently fail to make the spontaneous inferences that older children and adults make in contexts of less immediate relevance to themselves. Young children are often unlikely to reason about what lies behind some of the more complex events that they encounter, or to look much below the surface of many situations and events. For example, a child might come to a road crossing where several other people are standing and waiting, delaying crossing until it is safe, but will still fail to infer that the situation could be dangerous or that it is necessary to wait until a policeman beckons everyone across. Many children upon alighting from a bus fail to infer that a car may be coming, obscured from their vision as they cross behind the bus.

Research bears out this comparative lack of spontaneity in young children's inferences, even though studies have mostly been confined to children's comprehension of textual accounts and narratives and videoed and filmed events of interest to children (Flapan, 1968; Paris et al., 1977; Collins et al., 1978; Collins, 1983). The children who were the subjects of these studies concentrated on the surface events without, apparently, considering what might lie behind them.

This leads to a discussion of two very important categories of inference that receive significant treatment in the child development research literature and that are also very important for comprehending traffic situations:

- inferences about *cause–effect* relationships in the physical world
- *social-cognitive inferences* or attributions about other people, especially their inner experiences such as goals, motives, feelings and visual perspective. These inferences can lead to further inferences predicting how people might behave, and future events

There is some overlap in the types of reasoning required in inferring physical and social causes of events, but they do not always involve the same processes, and need some separate discussion.

Inferences about physical cause–effect relationships

Philosophers have long puzzled about whether we are justified in assigning cause–effect relationships to the events we encounter in our environment. However, in everyday life most adults are very confident in reasoning about cause–effect relationships that occur as part of familiar experiences.

As Bullock et al. (1982) and others such as Kassin (1981) have pointed out, adults generally reason about causality on the basis of three general principles:

- *determinism* - that is, that physical events do have causes
- *priority* or *unidirectionability,* which holds that a cause always precedes an effect - it cannot come afterwards
- *mechanism,* where this term is used to indicate that the 'causal impetus' between two events may be effected directly or through a chain of intermediate events that often may not be directly observable. This

does not involve specifying what the actual mechanism is. For example, we may infer that a push was the cause of a door closing, but a physicist would talk of more abstract intervening events

These principles are general ones that underlie the concept of causality, but they do not allow the specification of actual causal events where there is lack of knowledge about these. In trying to ascertain a cause where there is lack of knowledge, we tend to use specific rules such as *temporal contiguity, spatial contiguity, similarity* and *covariation* (Kelley, 1967). These are rules of thumb, pragmatic inferences, that do not guarantee a correct judgment. Covariation is explained below.

A key question is how children learn and reason about causality. Do they use principles and rules that are the same as those used by adults, and, if so, when do these occur, and do they change with development? This question has been difficult to answer because of various factors influencing research results. The original research by Piaget examining children's 'precausal' and causal thinking relied on questioning children about events usually fairly remote from their familiar experiences. They were required to give verbal explanations. Much of the follow-up research used similar methods, but these are methods that could easily lead to an underestimation of children's competence.

Investigators such as Bullock (1982) and Kassin (1981) have analysed carefully what is involved in children's causal reasoning. They suggest that there are three levels of causal comprehension:

1. *Tacit behavioural understanding*, where children's actions show an implicit understanding of simple causes without their being able to verbalise this understanding. This would be demonstrated in the ability of children to make a castle out of damp sand without being able to explain why they do not use dry sand.
2. A slightly more advanced level, where *children's comprehension* is *a little more articulated* and they *can make judgments and predictions.*
3. A level where children are *able to verbalise their understanding of causes.* Researchers have pointed out that verbal explanations also display different levels of understanding. Explanations may range from a simple restatement of the event, through identification of just a salient feature of the event, to discussion of a complex chain of mediating events.

Research by the various investigators indicates that, when preschool children are required to perform tasks related to the first level of causal thinking (involving simple familiar situations and not requiring verbal explanations), 4- to 5-year-olds clearly demonstrate an understanding of the principles of *determinism, priority* and *mechanism.* The behaviour of 3-year-olds is somewhat more doubtful, and shows many inconsistencies. Bullock (1985) found, for example, that 3-year-olds do not appear to assume that there must be a causal mechanism.

Investigations into children's understanding of specific rules for identifying causes such as temporal or spatial contiguity, similarity and covariation have shown that the performance of younger children is variable (Mendelsohn & Shultz, 1976; Shultz, 1982). This variation is not surprising, because these rules are rules of thumb and cannot always be relied upon. As adults we learn that, while temporal and spatial contiguity and similarity might indicate causality, this is not always so. For example, a power failure may be due to a lightning strike that is not close, but several miles away; a large button on a machine does not necessarily make a louder sound when pushed than a smaller button would.

Covariation may be more misleading, and adults may often be confused by this rule of thumb. It is the rule we tend to derive from observations over a number of occasions that lead us to believe that, when one event occurs, often another event will also occur. Our observations may suggest that there may be a causal relationship, but this is not necessarily so. For example, accident statistics may show that more red cars are involved in accidents than cars of any other colour. However, it is not the colour of the car that is likely to be the cause - this could be some other factor, such as the personality characteristics of drivers who choose red cars.

As children and adults acquire knowledge and experience, they learn to be more cautious when making judgments about causality based on these rules. Also, adolescents and adults are better able than young children to integrate different aspects of information and relationships in more complex, less familiar contexts in order to make causal attributions. Of course, adolescents and adults also tend to acquire a greater understanding of specific mechanisms that underlie causal events, especially the more abstract and complex mechanisms, such as what it is that happens under the bonnet of a car when we start the engine and drive it. It can be expected, therefore, that younger children will have many difficulties with the understanding of causes and with the making of appropriate causal inferences and predictions. Research and informal observation both bear this out.

Preschoolers, children of 4 or 5 years, may often select a prior event that is not actually a cause. They are less likely to pick a spatially distant event as a cause (Koslowski, 1976; Lesser, 1977). They are also less likely on some occasions to choose a temporally prior event that occurred earlier than an event closer in time. On many occasions they may simply not pay enough attention to previous events. For example, a preschooler may place too much reliance on *contiguity,* and explain to his friend: 'You have to turn the wheel to make the car go.'

If they lack the necessary experience or understanding, preschoolers will often confidently link two unrelated events that may have some association in the child's mind, although this association is not a genuinely causal one. Piaget (1962) calls this 'transductive reasoning'. An example would be a preschooler saying to his friend: 'You have to put your seat belt on or the car will crash.'

Frequently, younger children, those of preschool age, will make no spontaneous inferences at all about causes. As noted earlier, they seem to accept many events without looking for explanations. The more abstract and complex the series of mediating causal events, the less likely are children to understand these or to look for explanations; indeed, many adults have problems with this too.

Much of the current research on causality is designed to reveal children's basic competence by making it as simple as possible for them to behave appropriately or make judgments. But of course real-life events are often not simple, and children's understanding in real life will, therefore, often be very limited.

Understanding causality and performance in traffic

An understanding of causality is essential in order to act with understanding and safety in traffic; however, there does not appear to be any research on children's understanding of causality as it relates to their performance in traffic. There are many questions that could be explored:

- Do some children perhaps think that *pressing the button at a pedestrian crossing* will stop the traffic?
- Do children think that *looking to the right, then to the left, and then to the right again* will cause a safe passage?
- What effects do children think *putting on a seat belt* will have?
- Do they understand *how the seat belt could*

prevent injury?

- Similarly, what do they understand about *cause–effect relationships in terms of wearing safety helmets?*
- At what stage do they understand about the *relationships between accidents and wet slippery roads or riding a bike on gravel?*
- At what stage do they understand that *speed can cause lack of control?* Research is clearly needed in this area.

Inferences about the social world

In everyday life, our ability to infer others' motivation and inner experiences and predict their behaviour can have a significant effect on the appropriateness of our own behaviour. Research on the cognitive skills required categorises these abilities under the heading of 'social cognition', a very broad concept that covers, among other things:

> *understanding of people and of the self; the social relations between people in dyads or social groups; roles and rules; and the relations of such understanding to social behaviour (Shantz, 1983).*

There are several different theoretical approaches to social cognition, although the bulk of the research can be traced back to two major sources. It is difficult to draw a coherent picture of the development of social cognition in the child because of differences in the research in conceptualisation, the types of tasks presented to children and methods of assessment. However, there are some compatibilities in findings that have significant implications for children's performance in traffic.

One major strand of research arose from criticism of Piaget's concept of egocentrism. Researchers considered that Piaget had underestimated children's competence in relation to social understanding and perspective taking, and they set out to demonstrate how under the right conditions children could make inferences about others' inner experience and psychological characteristics. Psychologists using this approach who are interested in cognitive development have undertaken a number of different lines of investigation, which no longer bear much resemblance to the original concern with egocentrism. One of the current areas attracting a great deal of research is Children's Theory of Mind (e.g., Astington et al., 1988; Frye & Moore, 1991). As mentioned earlier in this report, 'Theory of Mind' is concerned with children's awareness of and beliefs about their own cognitive processes as well as those of others.

The social attribution theory approach

The other major approach, termed 'social attribution theory', has been developed by social psychologists rather than developmental psychologists interested in cognition. Its fairly narrow focus of concern has been to investigate how individuals attribute causes for a person's actions. It asks the question: Do people attribute causes to personal disposition and characteristics such as beliefs and values, or do they assign causes to external factors in the individual's situation?

Attribution theorists hypothesise that when a behaviour is high in *distinctiveness* (i.e., if it occurs only in a specific situation), high in *consensus* (i.e., if others behave similarly in the same situation) and high in *consistency* (i.e., if it always occurs in the same situation), then the cause has been *external* to the individual, and is a factor within the situation (e.g., Kelly, 1967). However, if a behaviour is low in distinctiveness and consensus, although high in consistency, the cause is considered to be within the *person.* It seems, though, that adults in societies that are more individualistic, for example Western societies, tend to attribute causes to personal factors more often than might be expected from the use of the above principles (Kassin & Pryor, 1985).

Most social attribution research has concentrated on adults, but there has also been some research investigating the development of social attributions in children. The general findings with children are that, in making attributions, younger children usually consider external events as the cause and do not infer personal factors. For example, Ruble et al. (1979) found that 5- to 6-year-olds made predominantly external attributions, 7- to 10-year-olds showed no specific tendency, and adults made predominantly personal attributions. In a further study (Rholes & Ruble, 1984), the investigators found that 5- to 8-year-olds sometimes described behaviour with terms for personality traits such as 'braveness' or 'generosity', but they did not expect people to behave in ways consistent with these traits. In contrast, 9- to 10-year-olds and adults did see traits as predictive of future behaviour - that is, as causal.

While adults are able to judge whether causes appear to be internal or external on the bases of distinctiveness, consensus and consistency, young children are unable to use these in any logically consistent way. They tend to rely on only one or two observations of behaviour, do not take consistency into account and have difficulty co-ordinating the three different types of information. Their judgments show a pronounced tendency simply to attribute behaviour to the most salient prior event, even when this conflicts with what is logically more appropriate.

The cognitive development approach

Research on social cognition from within the other main strand, the cognitive development approach, proceeds from quite a different basis. It has directed most attention to how and when individuals, especially children, infer a variety of specific psychological characteristics and inner experiences in others such as emotions, intentions, thoughts, strategies and personality traits. This process of making inferences is often referred to as 'role-taking', in the sense that it involves trying to put oneself inside the person of another individual.

In line with the general trends in cognitive development and research on inferences discussed in preceding sections, a finding that is evident in much of the cognitive developmental research on social cognition over the last 25 years is that young children up to 7 or 8 years of age often fail to make spontaneous inferences about personal psychological characteristics and do not actively try to find causes of behaviour or predict future actions. The researchers, like the social attribution theorists, have found that children tend to concentrate on surface events and characteristics, without seeking deeper attributes and processes within the individual. In terms of Flavell's three main steps in social cognition, young children often appear to be unaware of one of these steps - the *need* to make inferences about people.

However, both the need step and the inference step may occur on some occasions, depending on the circumstances (these steps may be separate - it often occurs that the need is recognised but the inference required is too difficult). In simple interpersonal contexts that are very familiar to children and/or have been a significant part of their experience, they may make some spontaneous inferences about feelings and motives and other characteristics. For example, they might infer that another child is upset because he is lost, or that an old man walks slowly because he has a sore leg.

By 8 or 9 years, children are starting to make many more inferences about other people that are relevant and show increased understanding of the internal motivators of behaviour. They have become more aware of significant cues in the person they are observing as well as those within the person's situation, and they can relate these cues to each other.

By adolescence there is an awareness of the uniqueness of individuals. There is also an understanding that others may interpret behaviour differently to oneself.

Social cognition and performance in traffic

The findings of both social attribution theorists and social cognitive theorists have significant general implications for children's traffic behaviour, but more needs to be known about the specific knowledge and reasoning involved. It would seem, for example, that safe traffic behaviour depends on inferences and predictions based on an understanding that some individual drivers and pedestrians will have characteristics, thoughts, feelings or motives that might lead them to behave in ways that interfere with the actions of others or threaten their safety, often through a disregard of traffic rules and measures specifically designed for safety reasons.

This type of inferential reasoning is essential for taking defensive action and foreseeing safety problems in traffic. For example, young children, unlike many adults, are unlikely to infer some of the possible reasons that might lead some car drivers to fail to stop at a red light or a pedestrian crossing. It would not be expected that they could infer that some drivers might not be paying attention, might act impulsively, might enjoy risk taking and/or might be indifferent to the welfare of others.

This defensive reasoning requires a high degree of second-order cognitive processing. We need to be aware of our own attention, impulsivity or self-control and our anticipatory and inferential processes before we can take account of these in others. Researchers interested in metacognition and children's theory of mind are just beginning to investigate some of these aspects, for example in the studies of children's cognition about selective attention that was discussed in an earlier section (Miller, 1985).

There is a great need for more research, including applied research relevant to traffic behaviour. As Wellman (1985) states:

> *Conceptions of persons' intelligence, competences and deficiencies, behaviour over time, trustworthiness, mistakes, goals and aspirations, motivations and beliefs, and more all come to rest on some understanding of the mental processes and potentials underlying social–behavioural acts and characteristics.*

Defensive reasoning about traffic behaviours of others also involves notions of chance and the probability of events occurring. Adults are much more likely than children to be aware that, while observed drivers are behaving safely, there is a chance factor that, for example, an 'unsafe' driver could enter the situation and pose a threat to safety, or a cyclist could behave erratically.

Inferences about visual perspective

So far, in this discussion of social cognitive inferences, there has been no consideration of the inferences about the *visual perspective* that others apart from oneself may have of a particular situation. This is somewhat different to other forms of inference, because while the thoughts and feelings of others are unique to the individual experiencing them, the visual perspective of any person who occupies a different position in space from oneself is not unique to the *individual,* but to his or her *spatial* position.

Inferring the visual perspective of another requires a different type of cognitive processing to inferring the person's personal feelings and experience. It is a very important process for traffic safety, because both pedestrians and drivers need to know whether they can be seen by another person, who might otherwise come into collision with them or cause other threats to safety. Most adults have the ability to take account of spatial relationships and work out whether they are in another's line of sight, how well they are likely to be seen or whether they are obscured for some reason, but we need to ask: When does this develop in children? When, also, does a child realise that factors such as poor light, rain or distance may make him or her difficult to see?

Flavell is the researcher who has probably investigated visual perspective taking most thoroughly (Flavell et al., 1974; 1978; 1981; 1991). In his later research he has identified two developmental levels in this form of perspective taking. At each of the levels each of his three main steps, discussed earlier - existence, need and inference - is required, but what distinguishes Level 2 from Level 1 is the higher level of difficulty of the steps. His findings are that before around 2 years of age children are very egocentric on most occasions and are unaware that others have a different perspective. They are not capable of the first level of perspective taking. At Level 1 they are capable at times of inferring what objects another person in a different spatial position sees or does not see. At Level 2 they are capable of understanding that an object viewed by oneself and another from different positions will give rise to different visual impressions or experiences.

By 3 years of age most children are capable of Level 1 perspective, which involves making a very simple inference as to which objects (or people) can be seen from another person's viewpoint. They know that observers can see whatever could be connected by a direct line of gaze to their eyes, although at this level they do not realise that the line must be straight and not curved. Most 3- and 4-year-olds and occasionally some 2-year-olds show this Level 1 awareness in simple tasks. This was demonstrated, for example, in experiments in a small-scale environment where children were required to place a small doll behind a cardboard wall so two policeman dolls in different positions would not be able to see it (Hughes & Donaldson, 1979). Both 3- and 4-year-olds were successful in this task. (But we should ask: Would they be successful in a large-scale environment?)

The tasks described in the research do *not* appear to have been carried out in everyday large-scale environments, and have not involved the child as the object of another person's perspective. It could be speculated that children might be more egocentric when they themselves are within the range of another's perspective. They might assume that they see the other person, and therefore the other person sees them. Even older children and adults tend to believe on some occasions that they are the object of another person's visual perspective when this may not be so.

A traffic situation would make it much more complex and difficult to assess a driver's perspective in relation to oneself. It would require looking into a car to try to assess the line of gaze of the driver. Even then, the child who could actually do this if the car were close enough may not realise that, to the driver, he or she is perhaps just one of many objects and people in the driver's field of vision. The child may also not realise that the driver's awareness of his or her presence will depend on the driver's attention and visual scanning of the field of view (Flavell et al., 1978; 1981; 1991).

Flavell et al. (1991) have hypothesised that, whereas Level 1 knowledge involves knowing which objects can be seen by the other person, Level 2 knowledge probably involves, among other things, the realisation that perceptual processes are not always straightforward. Flavell also suggests that research is needed to find out when children become aware that another person's vision of objects, although in direct field of view, could be obscured by lack of light, rain or blurring with distance, or could be indistinct because detected only in peripheral vision. Even some adults show a lack of awareness of this problem when they cross roads in the evening or at night in front of a car. They can see the car clearly because of its headlights, but do not always take into account that the driver may not be able to discriminate them.

Level 2 of perspective taking, which begins around the age of 4 or 5 years, also involves the understanding that people (and this would include drivers) in different spatial positions have different viewpoints, wherein the spatial relationships among objects that can be perceived vary according to the viewpoint, and the objects themselves may look different from different perspectives. However, the ability to actually infer *correctly* a specific perspective that takes into account various spatial relationships between objects and people that will be transformed in different perspectives will not be within the ability of 4- or 5-year-olds. Much will depend on the difficulty of the task. It may involve co-ordinating relations such as right–left, near–far and front–back, which is unlikely before 9 or 10 years. When the array is complex, with many relationships involved, even adults may have difficulties in performing the required mental manipulations that may be necessary in some complex traffic contexts where drivers and pedestrians approach from and move in different directions. The cognitive processing required would be quite outside the competence of young children.

A concern that arises from considering the research on perspective taking is that the investigations are designed to tap children's basic competence by reducing any task demands that would confound an accurate assessment of this. However, in real-life situations children may not perform at the level of their basic competence because of other demands made by the situation. Even such simple factors as competing demands for attention from other cars, other people and other sights could affect children's actual ability to infer viewpoints. In addition, in the tasks in the research, children have usually been specifically asked what the other person could see. This makes them aware of the *need* to take this into account, but in everyday situations they may fail to do so.

LINKING ALL RELEVANT INFORMATION TO MAXIMISE COMPREHENSION

Any situation requiring comprehension requires the linking together of all of the relevant information, including inferences that have been made from the cues available. The situations themselves will be quite various. They will include:

- *actual events* in our everyday lives
- *social interactions* involving non-verbal behaviour
- *communication and conversation*
- experiencing many *different types of text* and written material
- experiencing *films and television, illustrations, paintings* and other pictorial material
- encounters with other *symbol and sign systems*

Young children's understanding of all of these will frequently be limited, owing to the difficulty of having to link large amounts of information with appropriate inferences. Most of the general trends in cognitive development discussed are relevant.

For example, children's slower speed of processing than adults means they will not encode some information at all, and will not be able to link up and relate information quickly from many sources. They will be likely to attend to less of the relevant material, and to scan less efficiently, centring on what to them are some of the most salient and readily observable aspects. They will be able to hold less information in short-term memory, and work there with fewer items of information. For events extending over a longer time, or for longer passages of verbal material, this means that they may not be able to relate earlier information obtained to current information, and so the overall meaning or message may be lost. Unless situations are simple, familiar and/or of intrinsic interest to them, children will make very few inferences about aspects that cannot be directly observed, such as causes, motives and possible events. Even then, the inferences may be incorrect.

Research on children's comprehension of stories and text (Stein & Glenn, 1979; Mandler, 1984), of complex pictures and illustrations (Pettit, 1981), of film (Flapan, 1968), and of television (Collins, 1983; Collins et al., 1978) highlights many of these difficulties. Young children tend to respond only to parts of complex situations and not the whole, and the more subtle messages and meanings are frequently not comprehended. The young child's processing is very much at a surface level, concentrating on concrete objects and overt action and events. In lengthy or complex contexts, such as some narratives with complex causal sequences or pictorial material such as book illustrations with much detail and many inferences needing to be made, children's understanding might in some aspects be quite contradictory, or it may quite miss the mark. This is relevant not only to children's behaviour in traffic, but also to their comprehension of road safety education materials such as written material, posters, pictures, videos and storybooks containing road safety messages.

The traffic situation

In traffic, it could be predicted that younger children will often have difficulty comprehending the whole, complex situation, in that it involves many traffic and pedestrian movements at varying distances, and there will be many other details competing for attention. When it comes to written, pictorial or filmed safety material, children may understand only some of the information, and miss either the whole point or the more subtle aspects of the message. Preschool-aged children are likely to be particularly limited in their understanding, but even 5- and 6-year-olds will often have difficulty. Nine- and 10-year-olds are likely to show quite reasonable skills of comprehension, but it is usually not until 13 or 14 years that comprehension approaches the adult level.

The limitations in young children's comprehension of text and illustrations make it imperative that there should be well-conducted research investigating children's comprehension of road safety material and resources. There is the potential for a great deal of misinterpretation of this material by young children.

Comprehension of road signs

An aspect of comprehension that appears to have been largely overlooked in child development research is the comprehension of *symbolic* material. Children must master many different symbol systems, numbers and letters being the most important, but there are many others, such as gesture, musical notation, diagrams and graphs, scale models, maps, musical notation and the partly pictorial types of symbols used in road signs and other public signs. All of these rely on more abstract symbols than pictures.

Because road signs bear some resemblance to reality, it is often assumed that children, and adults too, will readily interpret their correct meaning. But this is not necessarily so. The very nature of such symbols requires that cues be very much reduced, lacking in many distinctive features and only partly isomorphic with the situations they represent. To interpret them, the viewer must try to relate the distinctive features present in the symbol to the context in which they appear, and infer their meaning. For children, confusion is often the result.

Studies in the 1960s by Sandels with 4- to 7-year-olds seem to be some of the few investigations involving road signs, and her findings about signs that are directed at drivers, pedestrians and cyclists are significant. She notes (Sandels, 1975) that many of the signs used in Sweden at that time for crossings, warnings, prohibitions, indications of sites such as playgrounds and schools and vehicle directions etc. relied mainly on silhouettes of objects, or of figures carrying out actions. As she comments, children at all ages in the study showed 'an astonishing lack of knowledge of traffic signs' (Sandels, 1975, p. 100). They were frequently unable to understand the signs, and some of their misinterpretations would have led them into danger.

Research is therefore required that will analyse the nature of the task of understanding presented by many of the signs and symbols in use in this country. The research needs to analyse what messages children take from the signs and the developmental differences shown in their interpretations.

MONITORING THE PROCESSING OF INFORMATION

When items of information are separated in time and space, we need to monitor our ongoing comprehension in order to:

- *check how current information relates* to what has been understood up to that point, or if there has been a change in circumstances or events
- *interpret changes* in circumstances or events and use them to re-evaluate the current situation

For example, when we read longer texts or listen to detailed instructions, the current information has to be monitored in relation to what has gone before; when we cross the road, the judgments made before crossing may often need to be reassessed by the time the middle of the road has been reached. These are metacognitive tasks.

The research on this topic has concentrated on comprehension of passages of text. Young children have been shown to carry out very little monitoring of their own verbal understanding, and even older children, those of 10 or 11 years, show limitations if information is complex and not very familiar. They do not seem to be aware that their understanding may be faulty and that they often do not integrate later information with earlier information. Metacognition of this type, which is often rather complex, seems to be relatively late in developing (Markman, 1985).

It would be expected that there would be similar limitations in children's monitoring of their own comprehension of real-life continuing events. These limitations would have a direct effect on young children's competence in traffic.

PLANNING AND DEVISING STRATEGIES

When a goal cannot be attained directly, but requires means–end analysis, as in planning a longer route, choosing alternatives, or planning in a complex situation that may also involve time delay, effortful and controlled mental processing is required. Metacognition is a key factor.

Most psychologists consider that some metacognitive awareness of the self as a problem solver is necessary, as strategies require control over thinking (Rogoff et al., 1987; Harnishfeger & Bjorklund, 1990; Small, 1990). In order to be safe in traffic contexts as well as other situations, both adults and children need to be aware of their own mental processes, and of how these may be controlled to devise strategies and subgoals in relation to an overall plan. In terms of the problem-solving process, after all relevant information items have been gathered and then linked, if immediate action cannot be taken to achieve the goal, then the final stages of problem solving may involve the active mental processes of planning and devising strategies.

Planning in the traffic situation

In many traffic situations there is no time for planning; decisions have to be made very quickly. What usually happens, once the situation has been comprehended, is that past strategies and procedures that have become a habit get brought into play. For example, a driver backing a vehicle out of a small lane onto a main roadway adopts previously acquired strategies of moving out slowly, looking behind and to left and right, stopping at the kerb, etc. - in other words, habitual actions come into play. Very little forethought and planning is involved.

However, on some occasions, when actions are extended over time, there may be more need for strategies. For example:

- a person crossing a road with several lanes may include in his or her plan the subgoal of stopping in the middle of the road and reassessing
- a cyclist seeing a parked car up ahead in his or her lane and noting heavy traffic in adjacent lanes may plan an avoidance strategy
- an individual may plan a driving or walking route to avoid busy roads and dangerous intersections

In such situations, unless behaviour is just trial and error or the running off of habitual actions, some degree of planning is involved. There is some means–end analysis, a working out of a sequence of actions designed to meet the goal, or perhaps some subgoals related to the goal. An example is the subgoal mentioned above of crossing safely to the middle of the road onto a traffic island before taking the next steps necessary for crossing to the other side.

In small-scale research studies designed specifically to allow children to demonstrate maximum competence in planning, it has been found that 3-year-olds will not use strategies. Four-year-olds, however, will occasionally plan and use strategies if the strategies are simple, goals are concrete and the alternatives are made clear to them. But at this age the skill is fragile, and children will frequently resort to trial and error (Small, 1990).

In the middle years, children become much more skilled at using varied strategies suitable for specific situations. How efficient and effective they are will depend very much on the context and nature of the task (Rogoff, 1982). However, in general they are frequently able to work out more steps mentally, and to co-ordinate these in relation to a goal or subgoal, provided the task involves fairly concrete goals and related actions.

Individual differences

Some of the individual differences in style and temperament discussed in preceding sections will influence planning behaviour. Those children who are more impulsive in temperament, as well as younger children who have not yet developed very far with self-control of their behaviour, will be more likely to omit planning and act without much forethought and reflection. They will be likely to act to achieve their goal without the delay necessary for planning. For example, if a 4-year-old or an older child who characteristically behaves impulsively sees a friend waiting across the road, he or she may not wait to consider an important subgoal, that of finding a safer place to cross further along the road.

TAKING ACTION TO REACH THE GOAL

There are two aspects to consider in this final component of the problem-solving process:

- whether children will *deliberately take risky actions*
- children's *competence in the appropriate motor skills*

Risk taking

When children understand that an action may expose them to potential hazard, but they still take that action, then risk taking is involved. Because many more boys than girls are involved in traffic accidents, the point has been made that this may be due to the increased risk-taking behaviour that is associated with stereotypes of the male. It has also been suggested that the greater number of accidents to younger children may be partially related to what had been labelled as their greater 'risk-taking' behaviour, but is perhaps a result of their inability to assess the degree of risk adequately.

The research on risk taking in children is sparse and does not contribute an adequate account of developmental, individual or gender differences in risk taking. It has been pointed out by Suchman and Schertzer (1960, p. 15):

> *We need to know much more about the relationship of intellect, including cognition, judgment, and decision-making to risk-taking among children and the way in which these mental processes develop in the growing child.*

This lack of knowledge still exists, and in fact it has been recognised that issues related to risk taking are wider than those listed by Suchman and Schertzer. For example, Fischoff (1992) suggests that factors requiring investigation in relation to risk taking in children include:

- *cognitive development*
- *knowledge* and *experience*
- *emotional* control
- social norms and *socialisation*

It would seem appropriate to add to these factors other qualities of temperament such as being uninhibited/inhibited (Kagan et al., 1988) or approach/withdrawal (Thomas et al., 1963).

The point was made earlier, in the discussion of perception of time to arrive, that results from laboratory tasks used for research on risk taking may bear little relationship to performance in real situations, especially where genuine risk of injury is involved. For example, Ebbesen et al. (1977), in a study with adults, found little relationship between results for a simulated task of driving a car and crossing in front of another and results for actual performances observed at a road intersection.

The few studies of risk taking in children carried out in the last thirty years have mostly involved fairly innocuous situations bearing little relationship to traffic contexts. For example, Slovic (1966) investigated the male stereotype of greater risk taking in tasks similar to a type of quiz contest popular on television. Children had to pull switches to release rewards of sweets. After receiving a reward they had to decide whether to pull further switches, where the outcome would be either that they would win more rewards or that they would lose everything. At all age levels from 6 to 16 years, girls stopped earlier than boys and took fewer risks.

In a naturalistic observational study by Ginsburg and Miller (1982), children from 3 to 11 years were observed on a visit to the zoo to see whether boys would be more likely than girls to risk actual injury to their person, although the potential injury could be expected to be minor. Children were observed, for example, climbing up and walking along the top of a very narrow embankment or feeding a burro where the sign warned that it might bite. For all activities, a significantly greater number of boys than girls took risks. Younger children also took more risks. The authors did not attempt to explore causes of this behaviour. It could be suggested, in relation to Fischoff's factors, that boys are socialised to show more bravado and that younger children may not have the cognitive skills or the experience to assess risk adequately.

In relation to individual differences in temperament thought to be relevant, no clear-cut relationships have been found. For example, Kopfstein (1973) found no relationship between risk-taking behaviour and performance on the reflection–impulsivity dimension as measured by Kagan's 'Matching Familiar Figures' test (Kagan & Kogan, 1970). However, the relationship between impulsive behaviour in this paper-and-pencil test and behaviour in traffic seems rather tenuous, and the concept of impulsivity, as mentioned in an earlier section, has come under much critical review (e.g. Kogan, 1983; Bjorklund, 1989).

Correlational studies indicate some relationship between various types of childhood accidents and injuries and qualities such as:

- *extroversion*
- *fearlessness*
- *sensation seeking*
- *hyperactivity*
- *aggressiveness*

These studies suggest that there may perhaps be some causal factors due to temperament, but the relationships are as yet obscure. Correlations do not of themselves indicate causes, and, in addition, actual risk-taking behaviour as the cause of the accidents cannot just be assumed, but must be demonstrated (Finlayson, 1972; Kafry, 1982; Christoffel et al., 1986; Matheny, 1987; Nyman, 1988). There are further problems in that there is often a great deal of overlap between categories of temperament, and the behaviours associated with a category are often not consistent in all situations. For example, a child might be challenged and act fearlessly in one situation, such as bike-riding or climbing, but not in another, such as at the beach or pool.

The concept of risk taking, the factors involved and the relationship to traffic behaviour all require further investigation.

Perceptual–motor skills

When children are actually negotiating traffic, the efficiency, flexibility and speed of their perceptual–motor skills are very significant for their safety. Perceptual–motor skills are all of those sequences of body movements, whether large or small, that must be performed in co-ordination with perceptual information, both from the environment and from the performer's own body.

In effect, perceptual–motor skills have two major components that must be co-ordinated:

- a *motor* program
- *cognitive /perceptual* processing of spatial–temporal cues and internal body cues relevant to performance

A motor program consists of the memory traces of a series of actions involved in a particular skill such as walking, using a spoon, catching a ball, drawing, or any other learnt motor skill. It is run off unconsciously unless it has to be adapted to meet changing circumstances.

Cognitive/perceptual processing is required to co-ordinate motor performance with the demands of the particular context, not only for the initiation of actions, but also in response to feedback during performance. It involves both conscious use of visual information about the external spatial and timing requirements of the task, and non-conscious internal information about our own movements via the kinaesthetic sense.

Kinaesthesia provides information about body and limb position, the direction, extent and velocity of movements, and the level of tension in the muscles (Laszlo & Bairstow, 1985, p. 14). It is the kinaesthetic sense, for example, that provides individuals with information that is then stored in memory about past experiences such as the speed of their movements in crossing a road.

It is assumed by Laszlo and Bairstow that when a task requires close co-operation between both vision and kinaesthesia, as in intercepting a ball or crossing in front of a moving car, young children will make inaccurate judgments because each of those modalities is relatively undeveloped (although this would not necessarily be accepted by ecological theorists such as Lee, who considers relevant experience the main factor (Lee & Lishman, 1975)). In addition, complex cross-modal relationships have not yet been learned. When such perceptual capabilities have developed, their maintenance depends on continuous exposure to correlated sensory events (Riesen, 1982; Welch & Warren, 1980).

It would be expected, therefore, that young children would require both considerable experience and adult guidance in order to perform safely the task of crossing a road before the approach of moving vehicles. The difficulty would be greatly increased when the estimated safety margin between the child's own arrival on the other side and the vehicle's arrival is not large. Children must combine estimates of their own speed across a specific distance with estimates of one or more vehicles' speed and arrival time. As they cross a wide road it is also necessary to continue to monitor the vehicle's approach to see if their estimates are correct and they are moving fast enough.

There are a number of other factors, both cognitive and physical, some discussed earlier in other sections, that could limit children's performance and ability to cross safely. They include the following:

- Not only are young children's cognitive processes comparatively slow, but their *reaction times are* also *slow,* and they have difficulty in starting and stopping quickly (Cratty, 1979).
- Young children *move relatively slowly* (Sudgen, 1980). In fact it has been estimated that an average 5-year-old, running, not walking, covers a distance of only 11.5 ft (3.5m) per second (reported in Cratty, 1979).

Much of the research discussed in this report in relation to the other problem-solving processes is just as relevant for taking action. Even though the prior judgments and decisions have been made, it is necessary to anticipate changes and be flexible in adapting to them. Young children, unfortunately, do not have many of the skills and understandings required.

Young children are less likely to anticipate new factors entering a situation. Therefore they will not be so flexible in adapting to changing situations.

However, as research by Young and Lee (1987) has indicated, specific training can bring about significant improvement in young children's road-crossing performance. As stated by these researchers:

> *notions of 'safe time to cross', 'safe place to cross' and 'adequate view of the road' have meaning only in a behavioural context, and so that is where they must be learned (Young & Lee, 1987, p. 340).*

CONCLUSION

Throughout this review it has become apparent that there are many developmental aspects of children's understanding, personality characteristics, behaviour and skills that would be relevant to their behaviour in traffic. There are also individual differences, and possibly gender differences, that could be significant. However, in the literature surveyed there are very many inadequacies and gaps in understanding; further analysis and research are required in order to:

- provide further insight into factors likely to influence children's traffic behaviour
- act as an aid in increasing the effectiveness of road safety education for children and providing more effective protective measures

The type of general research needed can be characterised under four headings, but the list below, with some examples of topics, provides suggestions only and is not intended to be exhaustive.

Research required on relevant general aspects of child development and also on gender and individual differences

Topics that require further research include:

- the ability to locate sound auditorily
- dynamic visual acuity
- the nature of the development of self-control
- the basis of risk taking
- comprehension of posters and illustrated material
- accuracy of judgment of one's own speed of movement
- perception of time to arrive

Developmental research required on specific aspects of children's knowledge, understanding and behaviour

Research is required on tasks directly relevant to traffic behaviour and road use. Such research would be designed to clarify the developmental bases and individual or gender differences influencing children's performance in many different traffic contexts, and allow predictions to be made about their behaviour. Where possible, such research would need to be related closely to real situations rather than to small-scale laboratory tasks, simulated models, responses to black-and-white drawings and other more artificial tasks.

Examples of topics for this research would include:

- a more refined analysis of children's concepts of danger in actual traffic situations
- the efficiency of children's perception in traffic contexts
- attentional processes in traffic
- visual perspective and role taking in traffic
- anticipation and prediction in traffic
- comprehension of traffic signs, signals and symbols
- analysis of factors involved in 'dart-out' behaviour

Research required for finding ways to educate children to behave safely and with greater understanding in traffic

There appear to be many possibilities for parents and teachers to take, in co-operation, a very active guiding and mediating role, rather than relying largely on classroom experiences with resource materials that are often ineffective. Research indicates that the transfer of learning from the classroom to real contexts may often be non-existent (e.g., Rogoff &

Gardner, 1984; Rothengatter, 1981a, 1981b, 1984; Antaki et al, 1986). New research could focus, for example, on the role of adults in:

- helping children to control impulsivity
- walking children through an environment to guide their understanding of hazards to safety, with the aim of developing safe behaviour
- helping children to become more aware of their own attentional processes and develop more effective strategies
- training children to anticipate and predict traffic movements and other relevant events

Research evaluating existing road safety training material and programs

Although there have been a variety of material and programs developed to foster road safety behaviour in children within Australia, there seems to be little or no attempt to evaluate the effectiveness of this material in increasing children's safe behaviour. Overseas research indicates that increases in traffic knowledge alone rarely correlate significantly with increases in safe behaviour. It is not appropriate, therefore, to concentrate only on outcomes for children's knowledge. Suggestions for research include the following (such research must take into account children's development):

- the evaluation of instruction programs, with analysis of the concepts involved
- the evaluation of published material and other media such as books, posters, kits and videoed and televised material
- the evaluation of games and toys with road safety messages produced by various toy manufacturers, such as puzzles, miniature town and street settings with vehicles, figures of people and traffic signs and also some toys such as strollers with safety harnesses
- investigations of children's actual understanding of learned road rules
- following road safety training, studies of children's actual behaviour at significant sites such as pedestrian crossings, traffic lights, school entrances, bus stops and sites where there is restricted vision

GLOSSARY

affect
emotion; affective: relating to the emotions

alertness or arousal
the quality of being awake, aware, attentive, and ready to act or react; a prior state of receptivity to stimuli, a precursor to attention in most situations. When stimuli become very familiar, alertness may decrease

apparent or projective reality
the image that is projected on the retina of the eye, in contrast to external or **objective reality**. For example, an object that is coming closer to an observer is projecting an image that is becoming larger, but is not actually increasing in size; see also **visual angle**

attention span
the ability to maintain attention to a task over an extended period of time; also called 'vigilance', or, in everyday terms, 'concentration'

automatic processing
the practice of analysing a situation without much conscious awareness or effortful attention, as a result of practice and experience

binocular convergence
the muscular movements involved in turning the eyes to focus on objects at varying distances from the observer. When the objects are close there is a marked convergence of the eyes that provides useful cues to distance

binocular disparity
a reference to the fact that the two eyes receive from the same visual field slightly different images that, when put together, produce an experience of three dimensions. When both eyes focus on an object, the different position of the eyes produces a disparity of visual angle, and a slightly different image is recorded by each retina. The two images are automatically compared and fused

binocular parallax
the differences in the two retinal images due to the separation of the eyes

bottom-up processing
also known as data-driven processing; processing in which incoming sensory information is analysed into separate elements and transformed at successively higher levels; initial processing prior knowledge or conceptual understanding; see also **top-down processing**

children's 'theory of mind'
children begin to have a 'theory of mind when they recognise mental states in themselves and others and develop concepts about these states. For example, they realise that people, including themselves, can have memories, feelings, beliefs, desires etc.

cognition
the act of knowing; the mental processes concerned with the acquisition, organisation and manipulation of knowledge

cognitive development
the qualitative changes in the acquisition, organisation and manipulation of knowledge as children develop; there are changes in processes such as attention, perception, memory, comprehension and problem solving

cognitive development theory
usually refers to the theory put forward by psychologists who, like Piaget, view cognition as undergoing qualitative structural changes as children development; maturation is seen as of key importance in this development, as is experience

cognitive map
the mental representation of a spatial layout

concepts
mental categories of objects, events, attributes or relationships organised on the basis of features they have in common; often viewed as the basic units of knowledge

conceptual space
the capacity to act in conceptual space is the ability to imagine, think about and visualise spatial relationships; contrast **practical space**

conceptually driven or top-down processing
in this form of the processing of information received from the senses, previously acquired knowledge or information influences how and what we perceive and comprehend what information we seek

connectionist framework
a model of cognition of information processing where the brain is conceived of as capable of parallel processing through neural networks, that is, through the interconnections between neurons. Information consists of patterns of interconnections. Learning depends on changes in the strengths of the connections between the nodes

constancy
refers to the fact that certain aspects of the environment have invariant physical properties, such as size or shape, which are usually perceived as constant despite changes in conditions under which they are observed; for example, a person walking away from an observer is not seen as getting smaller in size, although the retinal image is becoming smaller; see also **perceptual constancy, underconstancy**

contiguity, law of
a law of association to the effect that objects or events occurring to the mind close together in time or space tend to become associated

covariation
the rule we tend to derive from observations over a number of occasions that lead us to believe that, when one event occurs, often another event will also; those lacking the necessary experience or understanding may confidently link two unrelated events that may have some association in their mind, although this association is not a genuinely causal one

covert orienting
locating items in the peripheral area of vision with only unconscious registering of the stimulus, so that no physical eye movements are involved

determinism
the philosophical doctrine that every event has a cause, and hence that all future states of the universe are determined by previous ones

direct perception theory or ecological theory of perception
the theory that perception does not involve cognitive operations, inferences or the construction of representations; both animals and humans register all the information necessary (that is, patterns of light) directly on the retina, and this can directly trigger action without cognitive mediation

distinctive behaviour
behaviour that occurs only in a specific situation

ecological theory of perception
see **direct perception theory**

egocentrism
Piaget's expression for a phenomenon he thought he had observed: that, until about 7 years of age, children talk and think entirely in terms of their own needs and viewpoints without being aware that others can have different viewpoints and mental states; he also considered that young children attempt to understand events in the physical environment in terms of their personal experiences

episodic memory
the hypothetical part of the memory that stores autobiographical events—personal experiences, events and episodes that have occurred in a person's life; contrast **semantic memory**

extraocular muscles
the muscles lying outside the eyeball that change the direction of gaze

field dependence, field independence a style of temperament; initially it referred only to an individual style of perception, but later was extended to include aspects of cognition and personality. In the area of perception, for example, an individual with a field dependent style is considered to have difficulty in separating the parts of a visual field from the whole, while a field independent individual has little difficulty in disembedding the parts from the whole context to detect what is relevant

filtering
the selection of some stimuli over others for conscious attention; used when the individual must ignore irrelevant information in order to select and process efficiently only the relevant information; there is controversy over the structures or processes involved

fovea
a circular depression in the centre of the retina, the area of maximal visual acuity; this is the centre of focus of the eye, and here colour and shape are discriminated most accurately; see **retinal eccentricity**

inferences
conclusions that go beyond the available information that is explicit in any situation; they are drawn from empirical evidence, from past experience or from premises using a set of logical rules

information-processing framework
this view draws analogies between the processing by the human brain and the serial or step-by-step processing carried out by computers, and examines the progressive steps, actions and operations that take place when people receive, perceive, remember, think about and use information

interactionist framework
this theory of child development holds the view that development occurs as a result of the interaction between inherited or biological factors and environmental factors; a person's genetic characteristics influence his or her environment and responses to it, while and the environment also influences his or her learning and development

isomorphic
having a similar form

kinaesthesia
also called the proprioceptive sense; it is the sense that monitors the movements and position of parts of the body through receptors in the muscles, joints and tendons, and includes the sense of balance

lability of emotions
the changeability of an individual's emotions

luminance
the objective intensity of the light emitted or reflected by a surface, as opposed to brightness, which is the perceived intensity of light

maturationists
theorists who, taking a biological base, have put nearly all development down to biological factors, and see changes in development as a process of unfolding due to a biological clock; they hold the belief that many innate behaviour patterns appear only when the organism has reached the right stage of physical and neurological maturity

metacognition
a person's knowledge about his or her own thinking processes - for example, knowing one's own memory for an experience will decay with time, or knowing that one is bad at maths. Also refers both to the ability to exert some control over one's thinking processes

motion parallax
parallax is an apparent change in the position of an object because of a change in the position of the observer; in the case of motion parallax, for example if an observer fixates on the horizon, with fixation on the horizon, a lateral movement of the head will sweep all objects in the opposite direction in the visual field—where objects are at varying distances from the

observer, nearer objects will appear to move further and faster

motor learning process
in this process, several input channels of perception - e.g. what is heard and seen - are integrated with each other and correlated with motor activity. This in turn provides feedback to correct perception-for example, an infant who has reached out to grasp a swinging object will try again with more success once the first attempt at grasping it has given more information about the position and size of the object

motor program
onsists of the memory traces of a series of actions involved in a particular skill such as walking, using a spoon, catching a ball, drawing, or any other learnt motor skill. It is run off unconsciously unless it has to be adapted to meet new circumstances

motor system
refers to the system involved in co-ordinating movement, and the ability to exert separate control over individual muscles

myelination
process by which neurons become coated with an insulating, fatty substance called myelin, which leads to the speeding up of neural transmissions and so, probably, to increased speed of cognitive processing

neuroanatomical system
the nerve cells, and also the system of connections between neurons. As children develop, both maturational and environmental factors bring about important changes in this system; neurons enlarge and form many connections to other neurons in ever-enlarging networks; neurons that are unstimulated die out

objective reality
the external world of physical objects, events and forces that can be observed, measured and tested

perception
the discrimination, identification and interpretation of what is sensed - that is, the information from sensory receptors. Perceptual information is a refinement of sensory information; perception imposes order and meaning on sensations

perceptual constancy
the ability to perceive the stable or invariant properties of objects such as size, shape and colour, regardless of the variability of the impression these make on the observer when visual perspective or other viewing conditions change; see **constancy**

perceptual field
all of the perceptions a person has at an instant in time

perceptual-motor
a combination of the input of perception and output of motor activity. Reflects what is happening in the child's central nervous system

perceptual-motor skills
all of those sequences of body movements, whether large or small, that must be performed in co-ordination with perceptual information, both from the environment and from the performer's own body

peripheral vision
vision for those parts of the visual field which are not falling on the central portion of the retina (the **fovea**), but on the periphery (edge)

personal causality
attributing success and failure to one's own strengths, weaknesses and effort

practical space
the capacity to act in practical space is the capacity to act in real, external, three-dimensional space; contrast **conceptual space**

pre-attention
level features of stimuli are analysed, and there is no recognition of complex symbols or objects; a state or process preceding the

attentional processes which affects the amount and the quality of the attention paid to the environment

procedural knowledge
knowledge acquired and constructed about how to do things both physically and mentally; children will have less procedural knowledge than adults

projective reality
see **apparent reality**

proprioceptive sense, the
see **kinaesthesia**

recall
remembering when the object, event etc. is not present; bringing material in memory to mind from past experience when all or most cues are missing

recognition
remembering in the presence of objects, events etc. that these are familiar and have been experienced previously; much easier process than **recall**

retina
light-sensitive membrane in the eye, composed largely of a form of the optic nerve. Images focused here by the lens of the eye are transmitted to the brain as nerve impulses

retinal eccentricity
the degree to which the centre of an image is displaced from the centre (fovea) of the eye

schema
an hypothesised organisation of information in memory - an organised mental model of something, especially a class of objects or a class of linked events, which makes it possible to interpret new data in terms of existing knowledge, to make inferences and to plan. Schemas include not only 'knowledge that', but also 'knowledge how', which includes procedures, rules and strategies

script
a schema that is a stored representation of familiar sequences of events, the relationships between them and associated objects, roles of people involved, etc.

selective attention
concentration on one stimulus or type of stimulus, to the relative exclusion of others

semantic memory
that hypothetical part of memory 'containing' all organised knowledge about the world and self; contrast episodic **memory**, which contains specific, personal, time-dated events

sensory
relating to the visual, auditory, tactile, gustatory (relating to taste), kinaesthetic (relating to sensations in muscles, tendons and joints) and olfactory senses

sensory-motor development
learning to respond through motor activity to the various stimuli that are presented to the senses; generally refers to infant development

sensory register
the first, or most superficial, level of memory, where incoming information from the senses is held for a few milliseconds, without all or most of it coming to our conscious attention

social cognition
the capacity to understand social relationships, and to infer other people's inner characteristics and experiences such as goals, motives, feelings and visual perspective; sometimes also called **'social perception'** in everyday terms

social interaction theory
This theory emphasises as the major influence on children's development the guidance of more knowledgeable and capable others.

social learning theory
emphasises external social experience, such as the observation of others' behaviour and reinforcement received from others, as the main influence on development; may be used

more widely to refer to any theory of social behaviour that emphasises the role of social interaction with others as the basis for learning behaviour

social perception
see **social cognition**

social perspective taking
the ability to put oneself in another person's place, or see from another's perspective - including the visual perspective

static or non-transformational thinking
thinking that focuses on the surface of events and does not attempt to transform existing relationships in order to reason about what cannot currently be received directly

textural gradient
the fact that textures and surface grains of objects appear progressively finer as the viewer moves away from them

theory of mind
see **children's theory of mind**

top-down processing
see **conceptually driven processing**

underconstancy
the fact that observers apparently perceive a distant object as smaller than it is, and more in accordance with the projected retinal image. For example, we may see an object as tiny if it is a very long way off; see also **constancy**

visual angle
the angle between a line drawn from one edge of an object through the centre of the pupil of the eye, and the line drawn from the opposite edge of the object through the pupil to the eye. As an object approaches the eye, this angle will increase, and the image cast on the retina will become larger

working memory
the current contents of consciousness, a temporary store in which items from long-term memory or from perception may be placed, and in which they may be manipulated. Reflecting, reasoning and problem solving occur here; may be identified as the same as short-term memory, or as part of it

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SUBMISSIONS RECEIVED BY THE STAYSAFE COMMITTEE

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PED 2	Beverley Hills North Public School - Mr B. Robson
PED 3	Mr/s J. Erskine
PED 4	Mr R.C. Knowles
PED 5	Mrs A. Taylor
PED 6	Mr K. Wilson
PED 7	Vehicle Design and Research - Mr M. Paine
PED 8	Mrs S. Doherty
PED 9	Anonymous
PED 10	Mrs M. Emms
PED 11	Mr/s G. Gaudron
PED 12	Grenfell Public School P & C Association - Ms J. Hetherington
PED 13	Mrs S. Cannings
PED 14	Mr/s C. Green
PED 15	Mr J. Holder
PED 16	Dr A.W. Gaudron
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PED 42	Mr K.D. Hoy
PED 43	Ourimbah Public School - Mr B. Lofts
PED 44	Mr/s J. Hansen
PED 45	Mr/s H.J. Williams
PED 46	Anonymous
PED 47	Mr S.O. Stokes
PED 48	Community Service Committee, Rotary Club of Sutherland Civic Inc. - Mr G. Weidenhofer
PED 49	Ms M. Burnett
PED 50	Mrs D.F Merrett
PED 51	Mr T. Gamble
PED 52	Greater Taree City Council - Mr C.E Chatwood
PED 53	Mr M. Smith
PED 54	Mr B. Dean
PED 55	Travelsafe Committee, Parliament of Queensland - Mr Rob Downey
PED 56	Mr D. Green
PED 57	Ms M. Domhan
PED 58	Mr J. Andrews
PED 59	Mr I. Lane
PED 60	Mr John Mills M.P., Member for Wallsend
PED 61	Richard Ridout and Associates - Mr Richard Ridout
PED 62	State Transit Authority, Brookvale Bus Depot - Mr D. Mullineaux
PED 63	Mr B.J. Fuller
PED 64	The Hon. Chris Hartcher M.P., Minister for the Environment and Member for Gosford
PED 65	Kurri Branch of the Australian Labor Party - Mr J. Brown
PED 66	Mr/s V. Skoblin
PED 67	Roads and Traffic Authority
PED 68	Mr P. Gregory
PED 69	Mr T.J. Mills
PED 70	Mr I. Snow
PED 71	Mr R. Walker
PED 72	Mr M. Baird
PED 73	Mrs A. Poulter
PED 74	Mr G. McKenty
PED 75	Mr/s C. Buresch
PED 76	Bellingen Branch Combined Pensioners' and Superannuants' Association Inc. - Mrs Olwyn Mackenzie
PED 77	Mrs S. Hearn
PED 78	Mrs F. Abbott

PED 79	Mrs P. Smith
PED 80	Garden Suburb Primary School - Mr E. Roach
PED 81	Lake Cargellico Central School P & C Association - Mrs J. Aubrey
PED 82	Mr A. Hurwitz
PED 83	Mr F.C Jarrett
PED 84	Mr W. Houlahan
PED 85	Mr I. Harrison
PED 86	Mr/s H Hanes
PED 87	Ms M. Zerafa
PED 88	Wollongong City Council - Mr R.J. Oxley
PED 89	National Council of Women of NSW Inc. - Mrs J. Elliston
PED 90	Mr Wayne Merton M.P., Parliamentary Secretary for Transport and Member for Baulkham Hills
PED 91	Lake Macquarie Volunteer Drivers - Mrs R. Jurd J.P.
PED 92	Mr A. Waterson
PED 93	Awaba Public School - Mr/s R Lambert
PED 94	Mr/s W Paye
PED 95	Mrs K. Wellard
PED 96	Mr/s N Collins
PED 97	New South Wales Department of Transport - Ms P. Sayers
PED 98	Harris Park Transport Company - Mr K. Wagner
PED 99	Mr R. Barry
PED 100	Andrew Bridge Committee for Child Safety - Mr B Van der Mast
PED 101	Pelaw Main P & C Association - Mrs S. Bartlett
PED 102	Mr G. Killeen
PED 103	Mr Adrian Cruickshank M.P., Member for Murrumbidgee
PED 104	Mr Michael Richardson M.P., Member for the Hills
PED 105	Mr R.S. Clayton
PED 106	Mr/s K.W. Banbury
PED 107	Mrs F.A. Currell
PED 108	Avondale Schools Home and School Association - Mrs B.A. Duncan
PED 109	Mr/s B. Taylor
PED 110	Mr N. Tallack
PED 111	Range Rover Club of Australia - Mr G. Williams
PED 112	Mr H. Scruby
PED 113	Helping Our Pedestrians Everywhere - Mrs V. Moorhouse
PED 114	Mr R. Considine
PED 115	Mr D.C. Walker
PED 116	Waratah Technology High School - Ms V. Whitehead
PED 117	Dr J.O. Oluweye
PED 118	Dr J.O. Oluweye
PED 119	Mr K. Bendall
PED 120	The Pedestrians Association - Mr K. Vaughan

PED 121	Ms B. Cassidy
PED 122	The Advertising Engine Room - Mr G. Ross
PED 123	The Australian Quadriplegic Association
PED 124	Brian Bruce and Associates - Mr B.C. Bruce
PED 125	Biddabah Public School P & C Association - Mr/s J. Betts
PED 126	Mr P. McCloud
PED 127	Mr R.P. Lawlor
PED 128	Combined Pensioners' and Superannuants' Association Inc. - Mrs M. Kates
PED 129	Australian Automotive Aftermarket Association Ltd. - Mr D. Wright
PED 130	National Roads and Motorists Association - Ms M. Booth
PED 131	Mr K. Digges
PED 132	Mr S. Snow
PED 133	Friends of the Earth - Mr T. Floyd
PED 134	Wooli Progress Association - Mr J. Knox
PED 135	Miss K. Connell
PED 136	Bellingen Shire Access Committee - Mr B. Casey
PED 137	Ms C. Pillar
PED 138	Mr D. Heywood
PED 139	Mr/s A.V. Payne
PED 140	Mr/s H.W. Castle
PED 141	Mr W.D. Mayor
PED 142	New South Wales Police Service
PED 143	Dr I. Brajtman
PED 144	Mr/s N. Hazeldine
PED 145	The Australian Optometrical Association (NSW) - Mr B. Layland
PED 146	Mr N. Loughman
PED 147	Mr K. Eadie
PED 148	Burwood Access Committee - Mr/s B.A. Chapman
PED 149	Ms K. Foy
PED 150	Consultative Committee on Ageing - Mr D. Chesterman
PED 151	The National Council of Jewish Women of Australia - Ms J. Shedlezki
PED 152	Mr/s R. Herd
PED 153	Mr M. & Mrs C. MacLaurin
PED 154	Mr A. Miles
PED 155	Mr J.J. O'Brien
PED 156	Mr J. Gomez
PED 157	Mr V. Kejriwal
PED 158	Bus and Coach Association - Mr B. Macdonald
PED 159	Mrs C. Napthali
PED 160	National Federation of Blind Citizens of Australia Ltd. - Mr P. Downie
PED 161	Manly Health Promotions Unit - Ms J. Horton
PED 162	Mr/s R. Carey
PED 163	Mr J. Telford

PED 164	Mr E. Black
PED 165	Mr R. Pascoe
PED 166	Mr J.S.W. Donovan
PED 167	Mrs P. Gorman
PED 168	Mr/s J. Pearse
PED 169	Fairfield Family Resource Centre - Mr A. Lao
PED 170	Croydon Park Public School P & C Association - Mrs W. Reid
PED 171	Federation of Parents and Citizens Associations of New South Wales - Mr W. Johnson
PED 172	Dora Creek Ratepayers and Progress Association - Ms S. Day
PED 173	3M Australia - Mr F. Dunne
PED 174	Mr P. Prigent
PED 175	Mr/s J.M. McEachern
PED 176	Australasian College for Emergency Medicine - Mr P. Cunningham
PED 177	Mr/s J. Diamond
PED 178	The Disability Council of NSW - Ms T. Avadia
PED 179	Council on the Ageing - Mr L. Kaplan
PED 180	Mr K. Thurlow
PED 181	Mrs A. Manne
PED 182	Randwick Community Consultative Committee - Mr R. Baker
PED 183	Athelstane Public School Council - Ms K. Kirkpatrick
PED 184	Mr/s D.W. Treble
PED 185	Waratah Public School P & C Association - Mr M. Clarke
PED 186	Highway Safety Action Group of NSW Inc. - Ms M. Bollinger
PED 187	The Council of the City of Armidale - Ms R. Foskey
PED 188	NSW Police Service Technical Support Group - Mr J. Mennie
PED 189	Elden Communications - Mr D. Cobley
PED 190	Guide Dog Association of NSW and ACT - Mr R. Cappie
PED 191	Mr P. Tickle
PED 192	Michael Henderson Research - Dr J.M. Henderson
PED 193	Terrigal High School P & C Association - Mrs W. Tomlinson
PED 194	Mrs S. Brophy
PED 195	Mount Annan Public School - Mr D. O'Meara
PED 196	Mr A. O'Connell
PED 197	Royal Randwick Shopping Centre - Mr T. Brown
PED 198	Mr M. Mattatall
PED 199	School Bus Safety Committee - Mrs K. Clothier
PED 200	Maitland Teachers Association - Mr W. Harvey
PED 201	Castle Hill Public School Residents' Committee
PED 202	Mr A. Cliff
PED 203	Jiggi Public School P & C Association - Mr/s P. Martyn
PED 204	Truck Rear Vision Systems - Mr R. Fredericks
PED 205	Mr J. Mooney

PED 206	Mr G. Anthony
PED 207	Institute of Municipal Engineering Australia - Mr D. Sheffield
PED 208	Mr D.J. Ryan
PED 209	Engadine Counselling and Psychological Services - Mr J. Tierney
PED 210	Mrs D.L. Nolan
PED 211	Dr R.F.S. Job
PED 212	Mr R. & Mrs A. Milne
PED 213	ACROD Limited NSW Division - Ms A. Burns
PED 214	Ms C. Vella
PED 215	Traffic Police Department Republic of Singapore Police - T. Raja Kumar
PED 216	Mr R.A. Moncrieff
PED 217	Ministry of Transportation, Ontario, Canada - Mr Kim Devooght
PED 218	Community Development Division, Municipality of North Sydney - Ms J. Napier
PED 219	Funnell's Electrical Contracting Pty Ltd - Mr D.D. Funnell
PED 220	Mr R.J. Farrer
PED 221	Mrs H. Honigstock
PED 222	Mrs M.J. Lerch
PED 223	Mr W.E. Robb
PED 224	Mrs L.Lawrence
PED 225	Airdraulic Birco Group Pty Ltd - Mr R. Bradley
PED 226	Dr L. Earp
PED 227	St John Bosco Primary School - Mr M.J. Lennon
PED 228	Ms K. O'Callaghan
PED 229	Mrs J. Hosford
PED 230	Les McDonnell and Co. - Mr O.L. McDonnell
PED 231	Mr I. Anderson
PED 232	Ms C. York
PED 233	Mr C. & Mrs S. Bowring
PED 234	Mr B. Lynch
PED 235	Wadeco (Australia) - Mr J. Hartnett
PED 236	Catholic Education Commission - Mr E. Murphy
PED 237	District Council of P & C Associations of Dee Why Education Resource Centre Based Schools - Mr A. O'Connell
PED 238	Warringah Council - Ms L. Johnston
PED 239	Stratford Traffic Pty Ltd - Ms S. Penfold
PED 240	Mr P. Haldeman
PED 241	Mr G. Vinten
PED 242	Mr G. Harper
PED 243	Company Loss Prevention - Mr C. Norris
PED 244	Electro-Fluid Power Automation - Mr L. Townsend
PED 245	Mr D.C. Macdonald
PED 246	Mr A. Simon

PED 247	Belmont Public School P & C Association - Ms A. Quail
PED 248	Mr A. Townsend
PED 249	Mr F. Browne
PED 250	Mr B. Lawson
PED 251	Mr M. Taylor
PED 252	Mr T.J. Matt
PED 253	Mr P.G. Hitchon
PED 254	Mrs H.R. Evans
PED 255	Mr D.P. De Santis
PED 256	Miss A. Kamaralli
PED 257	Mrs J.M. Brady
PED 258	The Hon V. Chadwick MLC, Minister for Education, Training and Youth Affairs
PED 259	Mrs J. Treharne
PED 260	Mr G. Thomas
PED 261	Elvex (Safety) Sales - Mr T. O'Sullivan
PED 262	Mrs J. Haldeman
PED 263	North Wollongong Primary Principals' Council - Ms G. Doyle
PED 264	Campbelltown City Council - Mr C. Harvey
PED 265	Mrs E.R. Hyde
PED 266	Bowral High School P & C Association - Ms V. Rowney
PED 267	Stoplight Communications Systems P/L - Mr D. Critcher
PED 268	Mr K. Blake
PED 269	Mr D.G. Bradley
PED 270	Mr W. Gibson
PED 271	Mr J. Williamson
PED 272	Image Applications Pty Limited - Mr B. Leggatt
PED 273	Mr P. Amos
PED 274	Mr G. Rendall
PED 275	Mr R.J. Burden
PED 276	Mr Andrew Humpherson MP, Member for Davidson,
PED 277	Mr J. Bainbridge
PED 278	Mr W. Wales
PED 279	Riverian Regional Council of P & C Associations - Ms A. Henwood
PED 280	Erina High School P & C - Mrs B. Ward
PED 281	Numericon Pty Ltd - Mr G. Sale
PED 282	Mr R.S. Munro
PED 283	Mr J. Watts
PED 284	Mr L. Hansson
PED 285	Mr J.D. Ramsay
PED 286	Mrs N. Fletcher
PED 287	Mr B. Morley
PED 288	ALP Gosford Branch - Mr J. Gifford

PED 289	The Hon. E.T. Page MP, Minister for Local Government and Member for Coogee
PED 290	Mr P. Cheeseman
PED 291	Mr A. Hogan
PED 292	Mr S. La Vin
PED 293	Mr A.H. Thomson
PED 294	Mr M. Peebles JP
PED 295	Mr R. Henry
PED 296	Mrs M. Kilborn
PED 297	The Rt. Hon. The Lord Mayor of Sydney, Cr Frank Sartor
PED 298	Mr P. Hope
PED 299	Mr P. Zahra
PED 300	Mr D. Loveridge
PED 301	Mr H. Aram
PED 302	Mr M.J. Wood
PED 303	GPM (Aust) Pty Limited - Mr P. Dumycz
PED 304	Goulburn Access Committee - Ms J. Dodd
PED 305	Mrs P. Hall
PED 306	O'Connor Bellamy - Mr G.V. Bellamy
PED 307	Mr D Commins
PED 308	Mrs I.D.G. Dobie
PED 309	Mr Kevin Moss MP, Parliamentary Secretary for Transport, on behalf of Mr L. Loker
PED 310	T.H. & M.A. Cameron
PED 311	Ms Christine Fitzsimmons
PED 312	Mr J.C. Blount
PED 313	Motor Accidents Authority of NSW - Mr M. McCurrich
PED 314	Garden Suburb Parents & Citizens' Association Inc. - Ms J. Brownsmith
PED 315	Blue Mountains-Great Western Highway Safety Action Committee - Mr P. Trevaskis
PED 316	Mr A. Hurwitz
PED 317	Mr H. Castle
PED 318	Mr A.G. Hodge
PED 319	Mr D. Alexander
PED 320	Mr J. Durbin
PED 321	D.H. & D.C. Sykes
PED 322	Mr C. Roberts
PED 323	Mr P. Gloag
PED 324	Ms C. Batterham
PED 325	Mr G. Hellier
PED 326	Mr Ken Butson
PED 327	Pedestrian Council of Australia - Mr H. Scruby
PED 328	Yagoona Public School - Mr F. Hickey

PED 329	Ms G. Fordham
PED 330	Ms H. Oakey
PED 331	Mr B. Spaul
PED 332	I. Worthington and R. Minogue
PED 333	Mr B. Lehner
PED 334	Mr F. Mingare
PED 335	Municipality of Kiama - Mr N. Edgell
PED 336	Richard Ridout & Associates - Mr R. Ridout
PED 337	Mrs M. Jones
PED 338	Mr R.F. Norrington JP
PED 339	Visualtech - Mr M. Tait
PED 340	Combined Pensioners & Superannuants Assoc of NSW Inc. - Mr L. Jenkins
PED 341	Richmond Public School School Transport Committee - Ms M. Gough
PED 342	Allan Gibson
PED 343	Mr F. Bates
PED 344	Mr M. MacLaurin
PED 345	Mr B. Jepsen
PED 346	Mr W. Norris
PED 347	Mr I. Carnash
PED 348	Yagoona Public School Parents' and Friends' Association - Ms Joanne Ivanisevic
PED 349	Mr G. Testaz
PED 350	Parliament of Victoria, Road Safety Committee
PED 351	Sutherland Shire Carers and Consumers Forum - Ms M. Bills
PED 352	Public Safety Pty Ltd Australia - Mr G.E. La Delle

WITNESSES APPEARING BEFORE THE STAYSAFE COMMITTEE

Monday 20 December 1993

Pamela Gaye Sayers, Director, Vehicle Transport Policy Development, Department of Transport

David Gilbert Saffron, General Manager, Road User Safety, Roads and Traffic Authority

Bruce Lawrence Dowdell, Manager, Vehicle Standards, Roads and Traffic Authority

Christine Bowes Gowdie, Executive Officer, Child Accident Prevention Foundation, New South Wales Division

Wallace Gladstone Grigor, Consultant Paediatrician, Chairman, Child Accident Prevention Foundation of Australia, New South Wales Division

Barrie Grahame Macdonald, Executive Director, Bus and Coach Association (NSW)

Roby Tidswell, retired

Jennifer Helen Barker, Metropolitan Vice-president, Federation of Parents and Citizens Associations of New South Wales

Beverly May Baker, Publicity Officer, Federation of Parents and Citizens Associations of New South Wales

Christina Barbara Floyde Smith, Councillor, Federation of Parents and Citizens Associations of New South Wales

Warren Alistair Finnan, Operations Controller, Brookvale Bus Depot, State Transit Authority

Aundry Winsor Beck, Bus Inspector, Manly Bus Interchange, State Transit Authority

David Anthony Nimmo, Bus Operator, State Transit Authority

David Phillip Mullineaux, Bus Operator, State Transit Authority

Jim Stemitsiotis, Bus Operator, State Transit Authority

Richard Harding Finch, Bus Operator, State Transit Authority

Raymond Arthur Woods, Bus Operator, Peninsula Bus Lines

Neil Espie Smith, Managing Director, Peninsula Bus Lines

Nadine Elizabeth Ann Thorburn, Managing Director of Harris Park Transport Company Pty Limited

Keith Mervyn Wagner, Road Safety Officer for Harris Park Transport Company Pty Limited

Monday 21 February 1994

Pamela Gaye Sayers, Director, Vehicle Transport Policy Development, Department of Transport

Gail Julie Bruton, Senior Curriculum Adviser, Road Safety Education, Curriculum Directorate, Department of School Education

Kimbel John Fillingham, Assistant Director General of School Education, Riverina Region

John Joseph Bruton, Road Safety Investigation Officer, Roads and Traffic Authority

Rosemary Anne Rouse, Manager of School Education, Roads and Traffic Authority

Raymond David Taylor, General Manager, Road Safety Development, Road Safety Bureau, Roads and Traffic Authority

Barbara Phyllis Black, Manager, Road User Standards, Roads and Traffic Authority

Dr Raymond Franklin Soames Job, Senior Lecturer, Department of Psychology, University of Sydney

John Reginald Bliss, General Manager, Traffic Technology, Roads and Traffic Authority

Ashok Mehta, Manager, Road Environment Safety Guidelines, Road Safety Bureau, Roads and Traffic Authority

Monday 21 March 1994

Gavin Mowat Rendall, School Charter Bus Operator

Robert Allan Baker, School Bus Operator

Ronald Allan Moncrieff, Auto Electrician and Light Manufacturer

Monday 22 August 1994

Simon Ralph Edgar-Jones, Teacher, Sydney Japanese School Ltd

Pamela Annette Acott, Head Teacher, International Department, Sydney Japanese School Ltd

Susan Margaret Brophy, Parent, Sydney Japanese School Ltd

John Francis Delohery, Traffic and Forward Planning Manager, Canterbury City Council

Paul Yannoulatos, Chief Engineer, Botany Council

Melissa Jane King, Road Safety Officer, Sutherland Shire Council

Slavko James Joseph Bosnjak, President, Bus and Coach Association (New South Wales)

Ivan Ronald Ferris, Technical Officer, Bus and Coach Association (New South Wales)

Barrie Grahame Macdonald, Executive Director, Bus and Coach Association (New South Wales)

Pamela Gaye Sayers, Director, Vehicle Transport Policy Development, Department of Transport

John Douglas Stott, Executive Director, Vehicle Transport, Department of Transport

Dr John Michael Henderson, Medical Practitioner and Road Safety Consultant

John Edward Tierney, Psychologist, Engadine Psychological Services

Desmond William O'Brien, Associate, Engadine Psychological Services

Frank Richard Howarth, General Manager, Vehicle Registration, Roads and Traffic Authority

Geoffrey James Deacon, Director, Registration and Licensing, Roads and Traffic Authority

Monday 19 September 1994

Mervyn Lyle Lane, Superintendent of Police, employed by the New South Wales Police Service

Monday 19 June 1995

Ms Stacey Ann Williams, Team Leader, Early Childhood Road Safety Education Program, Institute of Early Childhood, Macquarie University

Associate Professor John Eaton Taplin, School of Psychology, University of New South Wales

Ms Michelle Louise Maxwell, Manager, Child Safety Centre, Royal Alexander Hospital for Children

Ms Christine Bowes Gowdie, Executive Officer, Kidsafe—Child Accident Prevention Foundation

Ms Kathleen Florence Hayes, Rehabilitation Adviser, Motor Accidents Authority

Mr Christopher Patrick Ford, Director, Road Safety and Traffic Management, Roads and Traffic Authority

Mr Raymond David Taylor, General Manager, Road Safety, Roads and Traffic Authority

Ms Rosemary Anne Rouse, Manager, Education Programs, Roads and Traffic Authority

Mr Ashok Mehta, Leader, Road Environment Safety, Roads and Traffic Authority

Ms Barbara Phyllis Black, Leader, Road User Standards, Roads and Traffic Authority

Mr Keith Rigby, Senior Region Road Safety Manager, Roads and Traffic Authority

Mr Gary Leonard Stapleton, Suburban Amenity Manager, Roads and Traffic Authority

Mr Terence Patrick Keating, Road Safety and Traffic Manager, Roads and Traffic Authority

Mr David Michael Riches, Road Safety Education Leader, Roads and Traffic Authority

Mr Christopher Philip Harvey, former Road Safety Officer, Campbelltown City Council

Ms Christine Anne Pollachini, Road Safety Officer, Bankstown City Council

Ms Leanne Paula Johnston, Community Road Safety Officer, Warringah Council

Ms Catherine Barlow, Road Safety Officer, Rockdale Council

Mrs Valerie Moorhouse, President, HOPE—Helping Our Pedestrians Everywhere

Monday 17 July 1995

Dr Kay Bussey, Senior Lecturer in Child Psychology, Macquarie University

Dr John Michael Henderson, Medical Practitioner and Road Safety Consultant

Mr John Ross Watts

Senior Constable Glenn Andrew Sherlock, New South Wales Police Service

Superintendent Mervyn Lyle Lane, Commander, Traffic Services Branch, New South Wales Police Service

Inspector Terrence Raymond Tamplin, Traffic Coordinator, Northern Region, New South Wales Police Service

Inspector Terence Earle Lester, Traffic Services Branch, New South Wales Police Service

Sergeant Neville Herbert Flegg, Crash Investigation Unit, Hunter Police District, New South Wales Police Service

Ms Michelle Viola Booth, Manager, Road Safety, NRMA

Mr Andrew Richard Macky, Manager, Traffic Engineering, NRMA

Mr Thomas Duff Higgins, Behavioural Scientist, NRMA

Mr Harold Charles Wolfe Scruby, Chairman and Chief Executive, Pedestrian Council of Australia

Mr Timothy Charles O'Sullivan, Managing Director, Elvex Safety (Sales), Jindabah Proprietary Limited

Mr Brian William Layland, Chairman, Motorists Vision Committee, Australian Optometrical Association, New South Wales Division

Mr Francis Joseph Dunne, Government Markets Manager, 3M Australian Proprietary Limited

Mr David Andrew Duguid, National Product Manager, 3M Australia Proprietary Limited

Mr Paul Yannoulatos, Chief Engineer, Botany Council

Ms Jacqueline Anne Anderson, Road Safety Officer, Fairfield City Council

Mr Stephen Mark Anderson, Manager, Design and Traffic Services, Fairfield City Council

STAYSAFE Committee Reports, 1982-1998 (con't)

STAYSAFE 42 (1998)	Review of the road safety situation in New South Wales in 1996.
STAYSAFE 43 (1998)	Electronic drivers licences.
STAYSAFE 44 (1998)	Developing safer motor vehicles for Australia.
STAYSAFE 45 (1998)	Injury prevention and infection control in the taking of blood samples from drivers suspected of alcohol or other drug impairment.
STAYSAFE 46 (1998)	Falling asleep at the wheel— Legal and licensing implications of driver fatigue.
STAYSAFE 47 (1998)	Review of the road safety situation in New South Wales in 1997.
STAYSAFE 48 (1998)	Pedestrian safety. IV. Child pedestrian safety in New South Wales.

STAYSAFE Committee Reports, 1982-1998

STAYSAFE 1 (1982)	Alcohol, drugs and road safety.
STAYSAFE 2 (1984)	Car driver licensing and road safety.
STAYSAFE 3 (1984)	Motorcycling safety.
STAYSAFE 4 (1985)	Is there a police quota system?
STAYSAFE 5 (1985)	Traffic law enforcement.
STAYSAFE 6 (1985)	The administration of random breath testing.
STAYSAFE 7 (1986)	Police hot pursuits.
STAYSAFE 8 (1986)	Speed control.
STAYSAFE 9 (1986)	Safe speed and overtaking on 100 km/h roads.
STAYSAFE 10 (1986)	Radar detectors and jammers.
STAYSAFE 11 (1987)	Safety of 2-lane country roads.
STAYSAFE 12 (1988)	Bicycle safety.
STAYSAFE 13 (1989)	Immediate and certain loss of licence for extreme drink-driving.
STAYSAFE 14 (1989)	Malpractice in driver licence testing.
STAYSAFE 15 (1989)	Alert drivers, and safe speeds for heavy vehicles.
STAYSAFE 16 (1990)	B-Doubles.
STAYSAFE 17 (1990)	Novice drivers: the student's view.
STAYSAFE 18 (1990)	Steering novice drivers towards safety.
STAYSAFE 19 (1992)	Alcohol and other drugs on New South Wales roads. I. The problem and countermeasures.
STAYSAFE 20 (1993)	Alcohol and other drugs on New South Wales roads. II. Offences, penalties, and the management of convicted drivers.
STAYSAFE 21 (1992)	Culpable driving.
STAYSAFE 22 (1992)	Towing caravans and trailers safely.
STAYSAFE 23 (1992)	A decade of the STAYSAFE Committee 1982-1992.
STAYSAFE 24 (1992)	Livestock warning signs: Road safety implications of the draft Rural Lands Protection (Amendment) Bill 1992.
STAYSAFE 25 (1994)	Death and serious injury on New South Wales roads: An examination of the provisions of the Crimes Act 1900 (NSW) regarding dangerous driving.
STAYSAFE 26 (1994)	Pedestrian safety. I. School children around buses.
STAYSAFE 27 (1994)	Traffic stops, police chases and police pursuits of motor vehicles.
STAYSAFE 28 (1995)	Sleep disorders, driver fatigue and safe driving.
STAYSAFE 29 (1995)	Pedestrian safety. II. Cleaning windscreens and other itinerant commercial activities on or alongside the roadway.
STAYSAFE 30 (1996)	Pedestrian safety. III. Bicycle courier activities in the Sydney central business district.
STAYSAFE 31 (1996)	Review of the road safety situation in New South Wales in 1994.
STAYSAFE 32 (1996)	Aspects of road safety administration in New South Wales.
STAYSAFE 33 (1996)	Responses to recommendations in STAYSAFE reports of the 50th Parliament.
STAYSAFE 34 (1996)	A 50 km/h general urban speed limit for New South Wales.
STAYSAFE 35 (1997)	The Traffic Amendment (Street and Illegal Drag Racing) Act 1996 - A report into the sunset provision.
STAYSAFE 36 (1997)	Drivers as workers, vehicles as workplaces: Issues in fleet management.
STAYSAFE 37 (1997)	Driver licensing in New South Wales: First entry into the driver licensing system.
STAYSAFE 38 (1997)	Report of the 2nd meeting of Australasian Parliamnentary road safety committees and Ministerial nominees, Parliament House, Sydney, Wednesday 2 April 1997 and Thursday 3 April 1997.
STAYSAFE 39 (1997)	Young drivers - Proceedings of a seminar at Parliament House, Sydney, 30 April 1997.
STAYSAFE 40 (1997)	A 50 km/h general urban speed limit for New South Wales: Progress report and edited minutes of evidence.
STAYSAFE 41 (1998)	Review of the road safety situation in New South Wales in 1995.

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