THE BEHAVIOUR OF CHILD PEDESTRIANS TRAVELLING TO AND FROM DARWIN PRIMARY SCHOOLS

by

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ABSTRACT

This thesis addresses children’s pedestrian behaviour, in particular road crossing behaviour. The Child Pedestrian Safety Model, developed using the epidemiological triad, that is agent, environmental and host factors, provided the framework for the research. Subjects were Darwin primary school children who in 1994 were or were not exposed to the road safety education program Out and About. The study involved observing child pedestrians over three observation sessions. A total of 3174 subjects were observed of whom 1827 crossed a road. Children’s pedestrian behaviour was obtained unobtrusively utilising videotaping. In addition to frequencies, percentages, and Crosstabs, Pearson’s Chi-Square and Fisher’s Exact Tests were undertaken to obtain significance levels for nominal data. Logistic regression analysis was undertaken to measure the level of association between variables. Of the nine road crossing behavioural elements, subjects’ level of compliance was 98-99% to three elements, 80-90% to another three and less than 55% to the remaining three. The elements to which a higher proportion of subjects attained a low compliance score were: subject stopped at kerbside prior to crossing the road, appeared to observe for approaching traffic prior to crossing the road, and appeared to monitor traffic whilst crossing road. At the first observation session, it was identified that being female, and crossing the road during the Wet season, in the morning and on Monday to Thursday were associated with high compliance to crossing behaviours. A higher proportion of unaccompanied children was associated with high compliance to monitoring behaviours. It was found that the Out and About road safety program as an agent factor variable had a statistically significant effect on experimental subjects’ overall crossing behaviours compared to that of control subjects. The education program had no statistically significant effect on experimental subjects’ host factor variables, that is, age group and gender. In the format in which it was delivered, overall the Out and About program had virtually no demonstrable effect on children’s road crossing behaviour. Furthermore, the findings suggest that Darwin primary school children do not understand the relevance of the specific elements associated with safe pedestrian road crossing behaviour. Nineteen recommendations emanate from the research findings.
DECLARATION

I hereby declare that the work herein, now submitted as a thesis for the degree of Doctor of Philosophy by research, is the result of my own investigations, and all references to ideas and work of other researchers have been specifically acknowledged. I hereby certify that the work embodied in this thesis has not already been accepted in substance for any degree, and is not being currently submitted in candidature for any other degree.

Signed

Date: December 2001
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Without the support of specific people, this thesis would not be at its current stage. The primary support person and inspiration for the completion of this thesis is my late husband John Batterham (Jack Batt). Therefore, this thesis is dedicated to him and his untiring support.

I have read many acknowledgements where the researcher appears to routinely extend thanks to the supervisor. However, by just acknowledging the professionalism, academic guidance, mentorship, direction and support that my supervisor, Kathryn (Kay) Roberts has afforded me during my candidature would be underselling her true worth. I would imagine that in many ways I was not unlike other post-graduate students. However, I was, specifically that my husband died during my candidature. In addition to her academic role, throughout my grieving period, Kay gently but purposefully guided me back to my research. Irrespective of whether I was living in Darwin or Perth, it was uncanny how often Kay made contact with me, either by telephone, E-mail or in person, especially when I was most in need of academic and/or personal support. For this I say thank you from Jack Batt and myself. On many occasions, especially at short notice, Kay’s husband, Dr Ron Roberts, came to the rescue by providing computer and statistical guidance. For this I am very grateful and also extend my thanks to Ron. Thanks are also extended to my co-supervisor, Dr John Condon, for his objective and valuable advice, especially with regard to methodology and statistical analysis.

To everyone else who has assisted me in the completion of this thesis, especially: the primary school children of Darwin who provided the focus of the research; the Road Safety Council of the Northern Territory; the Northern Territory Department of Education; my relatives and friends who supported me during my candidature; and Mrs Vivian Topham who formatted the thesis, I say thank you.
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CHAPTER 1
INTRODUCTION

The major objective of this study was to research and analyse the behaviour of child pedestrians as they travelled to primary schools in the greater Darwin area within the Northern Territory (NT) of Australia. Another aspect of the study was to investigate the effect a prevention strategy, namely a road safety education program, had on child pedestrian behaviour.

Issues relevant to the research are outlined in this chapter. The concept of health promotion and the consequent refocussing of health priorities and strategies designed to promote the health and well-being of Australians is introduced. Information on the magnitude of childhood unintentional injury, in particular pedestrian injury as a health problem is presented. An overview of Piaget’s theory of cognitive development is given. The relationship between children and learning is discussed. The pedestrian safety education program offered by the Road Safety Council of the Northern Territory (RSCNT) in Darwin primary schools is examined. The epidemiological framework used in the research is outlined. The chapter concludes by defining the context of the problem, purpose, and significance of the study.

Background to the Research

Preventive strategies have long been recognised as effective mechanisms for promoting and maintaining the health of individuals and communities. Examples of how these strategies have worked can be traced back to the nineteenth century. In the 1850s John Snow successfully linked cholera outbreaks to contaminated drinking water and took action by removing the handle from a water pump, thus preventing people from accessing the water (Harkness 1995; Beaglehole, Bonita & Kjellstrom 1993; and Valanis 1986). In the event of exposure, the use of immunisations to reduce the likelihood of individuals contracting a communicable has been a very successful health promotion strategy (Weller 1991). Worksafe
Australia was established in 1986 with the principal functions of '... policy and standards development by consultation, the collection and dissemination of data on occupational health and safety, research and training ...' (Sax 1989:227). These examples illustrate the range of health strategies designed to improve the health status of individuals and communities. Once the cause of a health problem becomes known, interested groups in the health sector seek strategies to eliminate the problem and/or advance concepts designed to promote a healthy lifestyle.

A range of approaches aimed at prevention rather than cure can be employed in health promotion including methods designed to change living conditions, lifestyles and social environments. Support for this view can be seen in Bates and Winder (1984) who defined health promotion as:

any combination of health education and related organisational, political and economic interventions designed to facilitate behavioural and environmental adaptations that will improve or protect health (Bates & Winder (1984) cited in Egger, Spark & Lawson 1990:5).

Since the late 1970s, the notion of health promotion has been advanced by international groups and various governments as a positive means of improving health whilst at the same time being cost-effective.

**Purpose of the Study**

The purpose of the research was to describe children's pedestrian road safety behaviour and to examine the effect road safety education has had on the behaviour of children as pedestrians travelling to and from Darwin primary schools. This was achieved by using a descriptive and quasi-experimental design that involved monitoring the extent to which children changed their pedestrian behaviour in an effort to reduce their risk of unintentional injury. An additional aspect of the research was the monitoring of the children to find if the change in the child's pedestrian behaviour was maintained for a given period of time. In addition, the research was designed to examine the effect of other variables such as accompaniment, day of week and supervision of road crossings, on the behaviour of children as pedestrians.
Significance of the Study

An aspect of primary health care is the use of health promotion strategies to prevent diseases, control communicable diseases, influence the quality of one's lifestyle and promote safety. In addition to promoting a healthy environment, health education addresses behavioural changes that should be adopted if the health status of a community is to improve. In 1988, the Federal Office of Road Safety (FORS) developed the educational package *Out and About*. The package is aimed at teaching children a broad range of safe road safety techniques, including pedestrian, vehicular and bicycle safety knowledge, skills and behaviour. Safe pedestrian behaviour includes: taking care when walking along a footpath or crossing a road, entering and exiting a vehicle, not playing in areas close to pedestrians or vehicular traffic, and obeying traffic signs. Manuals, audiovisual aids, posters and activity work books formed the basis of the *Out and About* educational package. This education program was made available free of charge to interested educational bodies throughout Australia. The RSCNT was one of the groups who utilised this program.

At the time of undertaking this research, no major evaluation of the program had been undertaken by the RSCNT. In light of the lack of research on the effectiveness of the education program, this study was considered to be timely and appropriate.

Unintentional Injury

In this section, the usage of the terms *unintentional injury* and *accident* is addressed. An overview of unintentional injury from an international and national perspective is then presented. The sub-section concludes with general reference to road transport related injuries and specifically the incidence of mortality and morbidity patterns associated with child pedestrian-traffic events.
Unintentional injury is:

Physical or psychological harm and/or death that a person incurs as a result of an unexpected event (Batterham 2001).

This definition is based on the Better Health Commission (1986) definition of injury, namely:

... a disruption to the structure or functioning of the human organism, resulting from acute exposure to physical or chemical energy (cited by National Health Goals and Targets Implementation Working Group on Injury Prevention (1994:8).

Contemporary public health experts prefer the term *unintentional injury* instead of the word *accident* (Green & Anderson 1986:519). This change in terminology from *accident*, which '... implies an unavoidable event ...' (National Health Goals and Targets Implementation Working Group on Injury Prevention and Control 1994:8), to *unintentional injury*, highlights the difference between causes of injuries. Events in which there is a definite intention to cause violence to another or deliberate self-harm, such as suicide, homicide and sexual abuse are referred to as *intentional injuries* (University of Otago 2000; College of Saint Benedict and Saint John's University 2000; and Virginia Department of Health undated). Other events which are unexpected, unintentional and occur suddenly, such as falls, burns, poisoning, transport accidents and drowning, are referred to as *unintentional injuries*. Discussing the debate on usage of both terms, Wong and Perry (1998:786) state that:

The term *accident* suggests a chaotic, random event that is “luck” or “chance”; the term *injury* is preferred because it connotes a sense of responsibility and control.

However, both terms, accident and unintentional injury, are used extensively and interchangeably throughout the health literature. Irrespective whether the term accident or unintentional injury is used, the aim of contemporary public health is, where possible, to prevent injury occurrence or if this is not possible to minimise adverse effects of personal-environmental injury.
Unintentional injury is an international problem affecting all age groups. The National Academy of Sciences in 1966 referred to injuries as: '... the neglected disease of modern society' (Rivara & Mueller 1987:13). Health Canada revealed that for children and youth under 20 years of age:

The leading cause of injury-related hospitalizations was falls (25.9%) followed by traffic injuries (17.9%), suicide (6.3%) and unintentional poisonings (4.8%) (Health Canada 1998).

Evidence shows that because there has been little change in western countries in the incidence of child mortality and morbidity due to injury, there is a need to identify strategies to prevent and/or minimise unintentional injuries. Wong and Perry (1998); Agran, Winn and Anderson (1995); Avery and Jackson (1993); Bouchard (1992); and Wilson, Baker, Teret, Shock and Garbarino (1991) support this view about the high incidence of unintentional injury. In the USA, 10,000 children die as a result of injury each year (Wilson et al. 1991:3). A decade earlier the Massachusetts Statewide Child Injury Prevention Program (SCIPP) found that for every unintentional childhood death, approximately 1300 children required emergency treatment and 45 were hospitalised (Wheatley & Cass 1989:72). In Canada it was reported that between the years 1990-1992, for the 0-20 year age group, that:

.. the mean number of annual deaths related to injury in this age group was 1,542 and the mean number of hospitalizations approximately 81,000. There were about 53 hospitalizations for every death (Health Canada 1998:1).

Over a five-hour time-frame these figures translated to: one child dying, 40 children being hospitalised and 2500 requiring treatment in a Canadian Accident and Emergency Department (Bouchard 1992:1).

Wong and Perry (1998:786) stated: 'Injuries have not shown the dramatic declines seen in other areas of childhood mortality.' However, Sweden has become a world leader in reducing the incidence of childhood injuries. The child injury death rate in Sweden was reduced from 450 in 1954 to 88 in 1988 (Bergman & Rivara 1991:69). Over this period, a range of social, political and educational strategies was
implemented to reduce the child injury death rate. Initiatives included: compilation of detailed statistical data, establishment of a community based Children's Accident Committee, recruitment of existing organisations and groups that had an interest and expertise in the area of safety, community planning and development actions which focused on producing a safer environment, passage of legislation and regulations designed to protect children, and broad based safety education campaigns. Education campaigns were structured so that members of the public and specific groups were provided with information about the injuries which were likely to occur at different levels of a child's development and the environment in which they were exposed. Another aspect of the education program was to make the people aware of how such injuries could be prevented through knowledge acquisition and behavioural changes (Bergman & Rivara 1991). The Swedish experience supports the health promotion initiatives outlined in the Ottawa Charter for Health Promotion.

In 1996, the Commonwealth Department of Health and Family Services (CDHFS) in conjunction with the World Health Organization (WHO) hosted the Third International Conference on Injury Prevention and Control in Melbourne. This conference produced the Melbourne Declaration on Injury Prevention and Control. It was acknowledged that to achieve a reduction in the incidence of all forms of injury, there must be worldwide cooperation and responsibility in promoting safety (CDHFS and WHO 1996).

In the report on National Health Priority Areas (NHPA), injury prevention and control was targeted as one of the five major health issues confronting Australia (Australian Institute of Health and Welfare (AIHW) & CDHFS 1997). Statistics indicate that injury is the major cause of death for children and young adults. Data showed that in 1994, although injury caused less than ten percent of all Australian deaths, it '... accounted for 62% of deaths at ages 1-24 years (males 72%; females 48%)' (Australian Bureau of Statistics (ABS) 1995 cited in AIH & CDHFS 1997:87).

In its policy paper on injury, the Australian Association of Health Promotion Professionals (AAHPP) stated that: 'The total cost of injury in Australia has been estimated as 7% of GNP' (AAHPP 1994:1).
International health organisations and governments have expressed concern regarding the direct and indirect costs of unintentional injury. There were two major categories associated with unintentional injury: direct and indirect costs. Direct costs were those associated with: '... resources used to prevent, detect, treat, and rehabilitate the health problem ...' (Rivara & Mueller 1987:15). Indirect costs include suffering, disability and/or loss of potential life years for the injured child, as well as the impact such an injury has on the child's family and the community. Costs associated with unintentional deaths and injuries were also of concern to Roberts and Brooks (1987), who made reference to the indirect costs of unintentional injury, in particular lost productivity and the resultant social and economic outcomes.

In summary, unintentional injury is an ongoing challenge currently confronting professions from a number of disciplines and the broader community. To reduce the incidence of unintentional injury demographic, economic, social, behavioural and environmental factors need to be addressed. Currently, unintentional injury results in a range of direct and indirect costs, which impinge on all members of society.

Child Pedestrians and Traffic Related Injury: An International Perspective

This sub-section initially outlines the incidence of traffic related events and then specifically addresses the incidences and factors associated with child mortality and morbidity related to pedestrian-traffic injury. In addition, this section incorporates what is meant by the term pedestrian.
In contemporary society, transport related trauma has been found to be a major source of unintentional injury and death. Wolf (1996) stated that:

> Since the car was invented, about 25 million people have been killed by traffic. Every year, says the World Health Organisation, about 250,000 people die on the world's roads - roughly the same number as those killed by the Hiroshima and Nagasaki bombs (p A10).

Sensational media headlines appear following the crash of an airliner with multiple loss of life. Road transport injuries, which result in a higher level of pedestrian mortality, do not attract similar media coverage or public concern. The lack of media attention and public concern possibly occurs because motor vehicle crashes are an everyday event with small numbers of casualties per incident. Plane crashes are more infrequent than motor vehicle crashes but have a higher number of casualties per incident. In an attempt to put the incidence of these road deaths into perspective, Wolf (1996:A10) commented that:

> These road deaths are taken for granted in the daily life of the car society. But they would be unacceptable were they to occur in any other form of transport.

Internationally, Western industrialised countries have a poor record in relation to mortality and morbidity patterns pertaining to road transport trauma (Wolf 1996).

The term *pedestrian* is defined by Pitt, Guyer, Hsieh and Malek (1990:558) as:

> a person standing, walking, running, crouching, bending, sitting, roller skating or using a skateboard in a highway, street or other traffic way ...

Avery and Jackson (1993) stated that traffic trauma was the leading cause of childhood deaths in England and Wales. Analysis of child pedestrian injury data in the United Kingdom found that the commonest sites where these injuries happened were main roads (Sabey 1988). One quarter of the pedestrian injuries involving school aged children occurred as they travelled to or from school with more occurring on the way home. No numerical data was presented to support this statement. It was reported that prior to the injury happening, four-fifths of the
children injured were running and three-fifths had not stopped at the kerbside prior to crossing the road (Sabey 1988:3). Furthermore, within one United Kingdom county, there were 103 child pedestrian fatalities in 1996 (Warwickshire County Council undated: 8).

An earlier United Kingdom study of child pedestrian injuries revealed that just over one-quarter of the injuries occurred when children were travelling to or from school (Grayson 1975 in Russam 1976:100). The study found that there was a comparable number of children who were injured going to school (13%) and after leaving school (14%). It was revealed that four out of five children injured were running when the pedestrian injury occurred. It was also noted that ‘... three out of five children started to cross the road without looking at all ... ’ (Grayson 1975 in Russam 1976:100). These findings are comparable to those of Sabey (1988).

In relation to the relative risk of children being involved in pedestrian-traffic collisions, it was reported that in the United Kingdom:

Boys age 5 are 5 times as much at risk as boys age 10. For girls between the same ages, the risk falls by a factor of 3 (Routledge, Repetto-Wright & Howarth 1974:467).

The disparity in gender based pedestrian injury rates for United Kingdom primary school children was suggested to be due to boys being higher risk takers and more impulsive than girls (Whitebread & Neilson 1999). This finding is akin to that identified by Swedish researchers Laflamme and Diderichsen (2000).

In Northern Ireland road trauma was perceived to be a major health and social problem. It was reported that in 1994 almost 12,000 people were injured and 157 killed due to road traffic injuries. The mortality and morbidity rate due to road traffic trauma was greater than the number of people injured and killed due to terrorist violence (Department of the Environment for Northern Ireland 1995:7). Terrorism in Northern Ireland tends to attract more media attention than motor vehicle crashes involving pedestrians. The lack of media attention to the incidences of motor vehicle crashes and pedestrian injuries is possibly due to them being
everyday events, thus creating a degree of insensitivity amongst members of the public.

In the United States of America (USA), one-sixth of traffic fatalities resulted from injury to pedestrians (Malek, Guyer & Lescohier 1990:301). Child pedestrian injuries occurring in the United States of America were analysed by Snyder and Knoblauch (1971) and cited by Malek et al. (1990). The commonest types of child pedestrian injuries were associated with children's impetuous and impulsive behaviours. This was evidenced in children suddenly crossing the road by what they referred to as either mid-block darting or intersection dash (Malek et al. 1990:304). Mid-block darting accounted for approximately half of the injuries and just over one-tenth of the injuries were children who dashed out onto the road at an intersection. Other common causes of child pedestrian unintentional injury were found to be associated with children walking along the road and those hit by a reversing vehicle (Malek et al. 1990).

Socioeconomic differences were suggested to be risk exposure factors associated with child mortality and morbidity due to pedestrian-traffic incidences (Laflamme & Diderichsen 2000). It was revealed that there is a higher incidence of injury amongst children from lower socioeconomic areas. Although the reasons were not fully understood for this difference, it was suggested a possible reason being that there are fewer children pedestrians from higher than lower socioeconomic areas, thus being less at risk (Laflamme & Diderichsen 2000).

Child pedestrian injury is not limited to Western countries. It was reported that in developing countries, between 20-25% of all road accident deaths involved child pedestrians (TRL Report 227, 1996 in www.trl.co.uk/educ.htm undated: 1).

Discussing the need to protect children who are car passengers and prevent injuries to child pedestrians, Rivara (1999:883) stated that ‘... prevention of child pedestrian injuries are [sic] still problematic’. According to Roberts (1995:413) ‘Injuries to child pedestrians have held the rank of “captain of the kings of death” for the past 20 years, ...’. Consequently, it is important to examine fatalities that result from injury
to pedestrians given their significant occurrence. However, from an international perspective, this must be undertaken cautiously as terminology and classification systems used in the collection of pedestrian injury statistics are not universally standardised (Foot, Chapman & Wade 1982). Non-standardised use of pedestrian injury terminology and classification systems can lead to inappropriate comparison of data. For countries that have adopted the use of an international system for classifying diseases, which also includes the coding of injury and poisoning, comparison of data can be made with a high degree of reliability. Until such terminology and classification systems are standardised and recognised internationally, comparison of data must be undertaken with caution.

In summary, child pedestrian-traffic injuries are an ongoing challenge currently confronting professionals from a number of disciplines and the broader community. Such injuries need to be addressed from demographic, economic, social, behavioural and environmental perspectives. Statistics indicate that boys are twice as likely as girls to be involved in a pedestrian injury. Children’s impulsiveness and impetuosity, resulting in them suddenly darting or dashing out onto the road in front of oncoming vehicles, has been reported as a common cause of child pedestrian-traffic injuries.

Child Pedestrians and Traffic Related Injury: An Australian Perspective

In this subsection reference will be made to the incidence of mortality and morbidity patterns associated with Australian child pedestrians. Initially notation is made that childhood unintentional injury is a national health issue.

The significance of injury as a major cause of mortality and morbidity in Australia was supported by a number of individuals and agencies including: The Child Accident Prevention Foundation of Australia (Kidsafe) (1997); Australian Institute of Health Welfare (AIHW) and CDHFS (1997); Moller and Kreisfeld (1997); FORS (1996a; 1996b; 1996c); Dolinis, O'Connor and Trembath for National Injury Surveillance Unit (NISU) (1995); National Health and Medical Research Council (NHMRC) (1995); Nutbeam, Wise, Bauman, Harris and Leeder (1993); Australian
Institute of Health (AIH) (1990); AIH (1989); and Health Targets and Implementation Committee (1988). The importance of prevention of unintentional injuries to infants, children and young people was perceived to be a priority by Jolly and Wigg (1994).

By 1993, unintentional injury as a leading cause of death had become a national issue in Australia. Bordeaux and Harrison (1996) stated that during 1994, less than one-third of injury related deaths were transport related. The characteristics and circumstances of unintentional injury differ by age group:

Injury is a leading cause of death in Australia accounting for 7489 deaths in 1992 or 6.1% of all deaths. ... Injury is the principal cause of death of both males and females between the ages of 1-44 years (National Health Goals and Targets Implementation Working Group on Injury Prevention and Control 1994:2).

Dolinis, O'Connor and Trembath (1995) and The National Health Goals and Targets Implementation Working Group on Injury Prevention and Control (1994) indicated that transport-related injury was a major cause of injury and death for the 0-14 years age group. Pedestrian injuries were reported to be the leading cause of unintentional injury resulting in the death of people in the 0-24 year age group (Jolly & Wigg 1994). In 1997 it was reported that:

Each week 1 or 2 Australian children die and 15 or 20 are admitted to hospital as the result of pedestrian injury. For each child killed 30 require medical treatment (The Child Accident Prevention Foundation of Australia 1997:1).

It was found that in the 5-14 year age group, almost one-tenth of injuries occurred on the path, road or highway (Australian Bureau of Statistics (ABS) 1992:4). In 1994, within the 5-17 year age group, it was reported that 20 children died and 400 were admitted to hospital after being involved in a pedestrian-traffic collision which occurred either on their way to or from school (FORS 1999). Of these deaths and hospital admissions, about one-quarter were primary school children (FORS 1999:1).
The incidence of child pedestrian mortality and morbidity patterns decreased in Australia between 1989 and 1994. Statistics compiled by FORS for this timeframe show that:

... 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 received minor injuries as a result of a pedestrian crash (FORS 1996b:1).

However, for the 12-month period ending March 2001, 46 child pedestrians, aged 0-16 years, died on Australian roads. This was an increase of 10 on the preceding 12-month period (Australian Transport Safety Bureau (ATSB) June 2001:5). These statistics reinforce the view that in Australia, child pedestrian fatality is a contemporary social and health problem that is in urgent need of address, ideally through intersectoral collaboration and integrated preventive strategies.

Analysis of child pedestrian deaths between 1989 and 1994 revealed that the majority happened during the daytime when the weather was clear (FORS 1996b). A high proportion of the injuries occurred on straight roads and about two-thirds were at mid-block sites (FORS 1996b). The ratio of male to female pedestrian deaths was approximately 2 to 1 (FORS 1996b). The majority of child pedestrian deaths occurred in the afternoon when the children were on the way home from school or using the road for other purposes, such as recreation (FORS 1996b:2). It was suggested that one possible reason for the time of day when the injury occurred is that adults may drive or accompany children to school in the mornings but leave them to travel home by themselves. It was stated that children were primarily responsible for the pedestrian injuries in which they were involved, for example, a child running onto the road between parked vehicles resulting in a motorist often being unable to avoid the collision. The 1992 road-trauma statistics revealed that in country areas eleven child pedestrians died as they travelled home from school. Children who had just alighted from a school bus accounted for nearly half of these (FORS 1996b:3). Child pedestrian morbidity data was unavailable for the 12-month period ending March 2001 (Roberts, T. 12 July 2001, Email comm.)

1 Thomas.Roberts@dots.gov.au (Transport Safety Statistics Unit, Australian Transport Safety Bureau)
It was recognised by Moller and Kreisfeld (1997:7) that child data injury statistics should be presented in ‘... narrow ranges...' thus reflecting each stage of development. Unfortunately, FORS no longer compiles pedestrian-vehicular related injuries and fatalities, rather this role has been taken over by ATSB. It was predicted that there would be: ‘... about 25 to 30 deaths and 600 to 700 serious injuries amongst Australian pedestrians aged 5 to 12’ (FORS 1996b:4). Instead of narrowing age groupings to present data, ATSB has broadened it to 0-16 years of age. Therefore, it is difficult to confirm if this prediction came to fruition.

The costs of unintentional injuries incurred as a result of traffic trauma have an impact on individuals, society and governments (Rivara & Mueller 1987; and Roberts & Brooks 1987). It has been estimated that road trauma costs the Australian community approximately $6 billion per annum of which $1 billion is attributed to pedestrian injuries (FORS 1996a:1).

In summary, in Australia, a leading cause of childhood mortality and morbidity is traffic-related trauma. For the 12 months ending in March 2001, the number of 0-16 year old children who died in Australia due to pedestrian-traffic collision increased from 36 to 46 (ATSB 2001:5). At a national level there is increasing concern about the incidence of transport related unintentional injury being a significant cause of childhood morbidity and mortality. Unless relevant authorities and the public are proactive, the magnitude of child pedestrian injury will continue. Furthermore, it is important that members of the Australian public do not become complacent with the current child pedestrian-traffic related mortality and morbidity trends. Childhood mortality and morbidity due to unintentional injury results in personal, social, cultural and/or economic costs to Australia and Australians.

**Child Pedestrian-Traffic Related Unintentional Morbidity and Mortality: A Northern Territory Perspective**

This sub-section addresses the incidence of this health problem in the Northern Territory, the research site for this study.
Devanesen, Furber, Hampton, Honari, Kinmonth and Peach (1986) reported Northern Territory mortality and morbidity patterns for the period 1979-1983. For children in the 0-14 year age group a leading cause of mortality and death was unintentional injury. The commonest cause of external injury was traffic-pedestrian collisions.

Motor vehicle traffic injuries were shown to be the most frequent cause of death in Northern Territory children in the period 1978-1985 (Vimpani, Doudle & Harris 1988). It was found that these deaths were predominantly due to a collision between two or more motor vehicles, pedestrian-motor vehicle collisions and motor vehicle collisions that did not involve another vehicle.

In July 1993, Child Accident Prevention Foundation of Australia (Kidsafe), Northern Territory Division, commenced an Injury Surveillance System at Royal Darwin Hospital (RDH). Over a period of ten months, it was found that pedestrian injuries were one of the main causes of childhood unintentional injury (Northern Territory Division, Child Accident Prevention Foundation of Australia 1994).

In the Northern Territory, a number of government departments and other organisations are actively addressing the issue of child pedestrian safety. Included amongst these bodies are: Department of Education, Department of Transport and Works, Northern Territory Police, Darwin City Council, Palmerston Town Council, RSCNT, and Child Accident Prevention Foundation of Australia (NT). In an attempt to reduce the incidence of child pedestrian injury, individually or collectively these bodies aim to provide a safe environment and change people's driving and pedestrian behaviour through public and school education programs.

**Health Promotion: International Perspective**

This study has investigated the effectiveness of a program that sought to prevent child pedestrian injury, which is related to health promotion. Therefore, this section addresses the relationship of health promotion and unintentional injury, specifically child pedestrian-traffic related situations. An international and Australian overview
of health promotion strategies directed at child pedestrians is presented.

In recent years, finite financial resources and increasing costs associated with health care have contributed to the need for international and national organisations, governments and professional health organisations to focus on the importance of illness prevention instead of disease treatment (WHO 1986; 1978). These organisations have highlighted the significance of identifying patterns of health and disease and the importance of individuals and groups adopting behaviours, which reflect a healthy lifestyle, thus minimising health problems. In recent years, three catalysts for refocussing health care have been the WHO's *Health For All By The Year 2000*, the *Ottawa Charter for Health Promotion* and the concept of *Healthy Cities*.

The WHO's 1978 Alma Ata Declaration, *Health For All By The Year 2000* (shortened to *Health For All*) (Vuori 1984; WHO 1978) codified the concepts of primary health care. This strategy included identification of current health problems, methods of preventing, controlling and treating such problems, health education and disease prevention.

Primary health care is perceived as a multi-focal concept that has a number of characteristics including a: philosophy, set of activities, level of care and strategy for organising health care (Vuori 1984). Components of primary health care include: intersectoral cooperation, community action, self-determination, social justice and equity, appropriate funding and legislative frameworks, and programs which facilitate changes that will improve the health status of individuals and communities (Vuori 1984). For primary health care to be successful, the various characteristics outlined need to be adopted by governments, communities, all providers of health care, and community members. The ultimate aim of primary health care is to influence community members to adopt a health promoting lifestyle.

The second catalyst for refocussing health care was the *Ottawa Charter for Health Promotion* (WHO 1986). The Ottawa Charter provided a framework for individuals, groups, organisations, communities and governments to take responsibility for identifying and addressing issues impinging on the health and well-being of the
Identified broad health promotion strategies included: the need for governments to enact legislation as well as initiating monetary, organisational, educational and environmental changes designed to encourage communities; and encouraging individuals to have control over and improve their health. It was noted in the Ottawa Charter that for health promotion to be effective a diverse range of activities was necessary. The activities required were stated as: initiating healthy public policy; reorienting health services; creating supportive environments; strengthening community action; and developing personal skills (WHO 1986).

Foci of subsequent health promotion conferences were ‘health public policy’, ‘supportive environments for health’ and ‘collaboration between government and non-government organisations (Wass 2000; and 1994) was the focus of the 1991 conference (Wass 1994). At each conference it was reinforced that the most effective way of promoting health and well being was to focus on the need for intersectorial collaboration in identifying, developing, promoting and initiating health promotion strategies (Wass 2000).

The government of Northern Ireland was one of many countries that embraced the concepts endorsed by the health promotion movement for distinguishing and addressing health issues. As a result, various Northern Ireland government departments set about developing and formalising health priorities, objectives and targets for a five year period (Mercer, R. 1996, pers. comm.)². For the period 1992-1997, seven key areas were targeted for improving the health and social wellbeing of citizens. Family, child health and welfare were the key areas addressed, with specific focus on physical, sensory and learning disabilities, mental health, circulatory diseases, cancers and communicable diseases (Department of Health and Social Services undated, 70). Traffic collisions, trauma and violence traversed a number of these key areas (Mercer, R. 1996, pers. comm.). Using the principles and activities outlined in the Ottawa Charter, the Department of the Environment for Northern Ireland, the Royal Ulster Constabulary and Health and Personal Social Services undertook a concerted approach to address this major health and social issue. The target ‘... was to reduce road casualties by one-third by the year 2000 ...

² Churchill Fellow of 1996, Child Safety Development Officer, Department of Epidemiology, Belfast, Northern Ireland
Numerous strategies were initiated including public and school road safety education programs, relevant traffic legislation and allocation of sufficient monetary and human resources to support the various initiatives designed to reduce the number of road casualties.

Another health promotion catalyst developed by the WHO was the concept of Healthy Cities. Initially, Healthy Cities was implemented in European countries but in more recent years it has been adapted and introduced into other countries including Australia (Wass 1994). The principles of community health, namely planning and promoting healthy environments, form the basis of Healthy Cities (Ashton, Grey & Barnard (1986) cited by Owen & Lennie in Baum, Fry & Lennie 1992).

Attributes of Healthy Cities have been described as being: ‘... cost-effective, people friendly, oriented to change, socially responsible, democratically run, and flexible in the extreme’ (McCarthy 1992:15). Healthy Cities is characterised by the concepts of: community participation, community empowerment, and intersectoral cooperation, thus resulting in the broad approach to health promotion through strengthening community action. Targets for Healthy Cities are achieved by community members naming, owning and controlling their own endeavours (Kaplan in Baum, Fry & Lennie 1992). Once a community group adopts a local public issue, a common strategy utilised is that of lobbying, especially politicians, local councillors, and representatives of business and professional groups in the area, so that they can make informed decisions on the health related issue.

In summary, the need to change the major focus of health from having a high emphasis on treatment to prevention, involving all community sectors, has been advocated by international organisations and countries. To date, three major health promotion strategies have been formulated and adopted by a number of countries: Health for All, the Ottawa Charter for Health Promotion, and Healthy Cities.
Health Promotion: Australian Perspective

For some years now the Australian Government has recognised the need to change its focus on health and disease. The Australian Government has become concerned about national mortality and morbidity patterns, available health related services and their cost, and the need to improve and maintain the health status of Australians. Evidence of this can be found in the commissioning of a number of major projects designed to: investigate the national health status; report on the outcomes of medical care; and make recommendations designed to improve the health status of the community through setting goals and targets designed to promote health and prevent illness. Projects which address these issues include those undertaken by: Australian Institute of Health and Welfare (AIHW) and Commonwealth Department of Health and Family Services (CDHFS) (1997); National Health and Medical Research Council (NHMRC) (1995); Jolly and Wigg (1994); Nutbeam, Wise, Bauman, Harris and Leeder (1993); AIHW (1992); Jolly (1992); Australian Institute of Health (AIH) (1990); Health Targets and Implementation Committee (1988); and Better Health Commission (1986).

The Better Health Commission (1986) investigated and reported on the health status and associated concerns of Australians. This Commission identified cardiovascular disease, nutrition and injury as three of the major health issues. In 1988, the Health Targets and Implementation Committee was commissioned to develop national health goals and targets for these three major health problems plus a number of other key areas. The Health Targets and Implementation Committee (1988) proposed a number of national health priority areas important to this research, which included injury prevention. As a result of the 1988 publication of the national health goals and targets, the National Better Health Program was established. This resulted in a range of activities being formulated and organisations established for the purpose of promoting better health in Australia (Nutbeam et al. 1993).

In 1987, the Australian federal government made funds available to support selected Healthy Cities projects. By early 1990, the federal government decided not to renew funding of these projects after 1992. Rather, the monies were to be reallocated to activities associated with specifically targeted health goals. According to Wass
(2000; and 1994), many local councils, which had embraced the Healthy Cities concepts, chose to maintain this health initiative.

A product of the National Better Health Program was the establishment of the National Injury Surveillance Unit (NISU), under the auspices of the AIH (Vimpani & Hartley 1991). At a national level, this organisation has the responsibility of monitoring the incidence of injury and providing support and assistance to groups interested in preventing injury.

In 1992, the government through the establishment of a project committee, under the guidance of Dr Diana Jolly addressed children’s and youth health. The team was commissioned to outline the health issues of significance to children and youth, and to develop broad goals, targets, indicators, policies and strategies to address the stated health issues (Jolly 1992). One of the specified goals was to: ‘... reduce the frequency of preventable premature mortality.’ (Jolly 1992:11). It was reported by Jolly (1992:12) that, after one year of age, injury was the leading cause of childhood and youth mortality and morbidity. Furthermore, it was ascertained that injuries were frequently caused by traffic trauma.

The NHMRC (1995) Discussion Paper entitled *Health Australia: Promoting Health in Australia* identified four main principles that characterised population health. These principles were: ‘... a focus on prevention; an understanding of the causes and determinants of illness; evidence-based practice; and community participation in decisions which affect health’ (NHMRC 1995:7). These principles indicate that there are many aspects of health promotion to consider, all of which are important when developing strategies aimed at achieving the goal of *Health for All*.

Cooperation and collaboration between the advocates of intervention strategies and those who support the concept of creating a high level of awareness amongst community members is crucial so that behaviours are changed resulting in improved health and well being. These views are in accordance with those espoused in the *Ottawa Charter for Health Promotion* (WHO 1986), especially the need for collaboration between government, non-government and community organisations, and members of the public in identifying, developing, promoting and initiating
health promotion strategies (Wass 2000).

In the first National Health Priority Areas (NHPA) report, injury prevention and control was among the five major health issues impacting on Australian society (AIHW & CDHFS 1997). The National Health Priority Committee reinforced the need to apply the population health principles advocated by the NHMRC (1995). In particular, it was recommended that an evidence-based approach be used to identify: future priority health areas, acceptable levels of practice, and appropriate intervention strategies. The need to foster and gain intersectoral cooperation was seen to be necessary if health promotion intervention strategies were to achieve successful outcomes (AIHW & CDHFS 1997). School based education programs have been identified as one of many appropriate health promotion intervention strategies (Wass 2000; McMurray 1999; and Baum 1998). Moreover, these authors argue that health education programs need to interface with other intervention strategies. Furthermore, it is recommended that health education programs are appropriate for and address the needs of the target group.

In summary, since the mid 1980s, a number of agencies have been commissioned by the Australian Government to investigate and report on the health status of Australians. Each of the aforementioned agencies either stated or alluded to injury as one of the commonest health problems currently occurring in Australia. Education has been identified as an important component of health promotion intervention strategies.

Children and Learning

Children’s pedestrian behaviour is linked to their stage of development. Therefore, this section addresses the topic of how children develop and learn. An insight is presented into how children’s biophysical, social, motor and cognitive development contribute to the way they react to their environment. Piaget’s theory of cognitive development is used as a framework for many road safety education programs; therefore, an overview of the theory is presented in this section.
Children: Development Aspects and Learning

Biophysical development is reflected in a child's increase in growth, height, muscular and skeletal development throughout childhood, although at a slower rate than during infancy (Schuster & Ashburn 1986). Motor development pertains to a combination of gross and fine motor skills (Schuster & Ashburn 1986). Gross motor skills are described as consisting of balancing, walking, running, jumping, kicking and similar activities. Fine motor skills address a range of activities including throwing, catching, picking-up, grasping and manipulating items. As children progressively learn to combine gross and fine motor skills, their actions tend to become more diverse and coordinated.

Two processes associated with learning are cognition and activation (Biggs & Telfer 1987). The cognitive process is concerned with paying attention to an activity, for example reading, listening and rote learning. Rote learning involves repeating the information until there is a high degree of accuracy, but often without understanding (Lefrancois 2000). Meaningful learning occurs when the information is coded, learned with understanding and recalled when required (Lefrancois 2000; Biggs & Telfer 1987; and Jarvis 1987). Memorising comprises scanning and coding the material. The information is initially transferred to working or short term memory. Information is retained in short-term memory for a limited period of time unless it is transferred to long-term memory. It is in long-term memory that information, which has been memorised, can be recalled for later use. Long term memory holds an immense amount of information including words, objects, events, actions, rules et cetera. Effective learning is dependent on a person's ability to activate all components of the cognitive process (Lefrancois 2000; Biggs & Telfer 1987; and Jarvis 1987). The way a person reacts to a situation affects the manner in which information is retrieved from short and long term memory. For example, anxiety may impede the retrieval activity or if a task is performed regularly and skillfully, then retrieval is likely to be fast. This response to stimulation or arousal of cognitive functioning is referred to as the activation process of learning (Biggs & Telfer 1987:60-67). Irrespective of the focus of an education program or the cognitive and activation processes used to acquire and utilise knowledge, it cannot be assumed that the acquisition of knowledge will alter a person's behaviour. Consequently, it is
extremely difficult to predict how a child will behave at any one time.

Cognitive development involves children being able to: '... make sense out of their environment rather than react unthinkingly to it ...' (Biggs & Telfer 1987:19). Such development is demonstrated by a child's maturation and level of understanding which includes the ability to differentiate and classify objects and events, determine differences based on temporal and spatial relationships, identify causal relationships, make judgements, predict outcomes and solve problems in relation to knowledge base and memory (Schuster & Ashburn 1986). School-age years are when the interaction of motor, cognitive and social skills is increased. This is especially so during middle and late childhood. It is during these periods of development that children undertake primary school education. This is of critical importance to this study since this age group was the focus of the research.

Social development involves behaviour patterns, which are in accordance with social and moral standards. Imitation and reinforcement enhance this process. Social development is cumulative, interactive and a lifelong process (Wong & Perry 1998). Three groups, which have a major influence on a child's socialisation process, are family, schools and peers (Wong & Perry 1998; Wong 1997; and Whaley & Wong 1991). The influence that sociocultural factors, including activities and environmental settings, have on children's cognitive development is endorsed by Flavell (1992).

Learning does not occur in isolation from other developmental processes. The learning process may be intentional such as information provided to children by parents, teachers, peers or specific organisations and groups, for example Boy Scouts, St. John Ambulance Association and sporting groups. Learning may also be unintentional. Unintentional learning may be the result of children observing and/or imitating how different people react to a given situation or event (Lefrancois 2000). Children often imitate and/or mimic the actions and sounds of other people or animated characters as learning strategies, for example, a child sees the animated character Hector the Cat preparing to go to bed and saying 'goodnight' and the child imitates these actions. In this way a child develops and learns simultaneously. As a
result of this form of learning, known as social learning, the child is socialised into appropriate societal skills, behaviours and values.

In childhood, learning also tends to be an active process, and during this period the child is more at risk of harm due to unintentional injury. This is because children tend to be unaware of pending danger or dangerous behaviours, such as darting out onto the road in front of oncoming traffic. Such inappropriate behaviour is often due to a number of factors including: level of biophysical, psychological and social development; childhood curiosity; risk taking; and spontaneous actions.

**Children: Piaget’s Theory of Cognitive Development and Road Safety**

The development of children’s road safety education programs should not be undertaken in isolation (Briem & Bengtsson 2000; Organization for Economic Co-operation and Development (OECD) 1986; Elliott 1985; Molen 1983; Molen 1981; and Sandels 1975). One of the major factors influencing the development of such programs is an understanding of child development. This is considered to be essential if each aspect of the program is to be relevant to the target group. In addition to a general understanding of children's level of development, Briem and Bengtsson (2000) identified social, biological and cognitive development as the other major factors associated with children’s learning ability.

Piaget’s theory of cognitive development is one of the theoretical frameworks commonly used to underpin road safety education programs (Elliott 1985; Molen 1983; and Sandels 1975). Although Piaget’s theory is not part of the theoretical framework for this study, it is summarised here because it influenced the development of the child pedestrian road safety program used in the Northern Territory at the time this research was undertaken. Consequently, Piaget’s theory also has a minor influence on the way that the results of this study are interpreted.

To aid understanding, Piaget’s theory is presented as separate components whereas in reality the transition between stages is gradual, continuous and interrelated. It is also recognised that children have individual developmental differences, so the ages
specified are presented as guidelines. In Piaget's theory, development is divided into four periods of knowledge acquisition. Each stage is affected by the child's overall physical development, experience and social interaction.

The following summation of Piaget's theory and stages of child development is based on information presented by Smart and Smart (1977).

The sensori-motor period is from birth to two years of age. This period is characterised by: reflex activities present from birth in children; development of habits, for example grasping objects and putting them in the mouth; searching for vanishing objects; imitation; and selecting and grouping objects, for example, building a tower using coloured blocks. During this period the child is unable to distinguish between itself and the outside world.

The pre-operational period addresses the ages from two to seven years. In this period the child starts to develop the ability to integrate actions, situations and symbols within the immediate environment to solve problems. The child tends to think in terms of the present, but can reflect on missing objects and people, for example, 'Daddy at work'. Features of this developmental period are that children tend to focus on one thing at a time, have difficulty generalising, are impulsive and have a short concentration span. The inability to process information on more than one thing at a time Piaget refers to as concentration (Schuster & Ashburn 1986:219).

Road safety education programs for children under seven years of age tend to be structured so that one simple task is presented at a time, for example the footpath is the safest place to walk and the road is for vehicles.

The concrete operational period occurs when the child is aged between seven and eleven years. During this period, the child is starting to develop logical reasoning and causal thinking patterns. The child is now able to understand, classify, order and apply relationship between events, actions and/or symbols associated with a specific situation or problem, for example, fruit can be classified according to size, shape, taste, texture and colour. During the latter stages of the concrete operational
period the child is showing a beginning understanding of the interrelationships between duration, velocity and distance. In this period, memory is better organised and more efficient. The child is developing an ability to anticipate what will happen in the future. Frequently children in this age group confuse hypotheses with facts. Egocentric behaviour is a feature of this period of development. Children in this age group can memorise information without comprehending its meaning (Lovett & Flavell 1990).

The formal operations period addresses the ages eleven to fifteen years. In this age group, children acquire the ability to organise information and reflect on all aspects of a situation. Logic can be used in complex ways so that problem solving skills and abstract thought processes are refined. Children in this age group are able to grasp and apply the principles of logical and causal thinking. For example, they should be able to: differentiate between the right and left side of the body, conceptualise and solve visual-spatial problems including assessing the distance and speed of an approaching vehicle and determine if they have adequate time to cross the road without risking being hit by the vehicle. It is during this period of development that children should be able to systematically solve problems including those that they may confront as pedestrians. Thus, children from the age of 11 years should be able to understand and apply the complex principles associated with safe pedestrian behaviour.

Critics of Piaget's theory of development argue that children may move into the different periods of development earlier than that stated by Piaget (Solso 1991). It would appear that these critics do not challenge the concepts outlined by Piaget; rather, there has been some modification of the concepts he postulated. Therefore, Piaget's theory is considered to provide a reasonable framework for children's road safety education programs.

**Children: Road Safety Education Programs**

In Germany, Great Britain, the Netherlands, Sweden, the United States of America and Australia, considerable attention has been given to what and how road safety should be taught to children (Briem & Bengtsson 2000; Penna 1994; Ampofo-

The education of children must provide them with the necessary motor and behavioural skills and intellectual ability to use the skills wisely, thus fostering a sense of social responsibility throughout the processes of growth. Part of social responsibility is learning to discriminate right from wrong. Teaching children that there is a right and wrong way of undertaking a task can be incorporated into teaching children general road safety concepts.

The ultimate aim of any road safety education program is for children to learn how to behave safely, competently and independently in traffic situations (Briem & Bengtsson 2000; and Pettit 1996). It is advocated that children: ‘... should be given a thorough training in real, but risk-free, traffic situations (Briem & Bengtsson 2000:503). To achieve this aim, road safety education programs need to be: comprehensive, feasible, relevant to students’ level of development, language specific, repetitive, and should proceed from simple to more difficult concepts (Briem & Bengtsson 2000; Pettit 1996; and Sheppard 1975 in Sheppard 1980). The need to ensure that road safety education programs are developed for and taught to specific age groups was perceived to be of paramount importance in reducing child pedestrian injuries (Rothengatter 1984b; Limbourg & Gerber 1981; Molen 1981; Vinje 1981; Sandels 1975; and Sheppard 1975 in Sheppard 1980).

Educational objectives involve helping students learn basic pedestrian rules when walking, crossing the road at intersections, and the meaning of simple traffic signs and signals (Fortenberry & Brown 1982). The concept that road safety educational objectives should address a number of aspects is also recommended by Rothengatter (1984b). He proposed that:

The selection of educational objectives for traffic-safety education
programs should focus on the behaviour that is both critical in terms of accidents and feasible for the age group involved (Rothengatter 1984b:148).

The way children behave in traffic is dependent on a number of factors including: their level of cognitive and physical development; if they are distracted; accompanied or alone; and the presence of regulatory mechanisms or devices designed to calm or control the flow of traffic, such as road crossing supervisors, traffic signals or road humps (Penna 1994; Limbourg & Gerber 1981; Vinje 1981; and Molen 1981).

Tasks associated with child pedestrian behaviour have been described by many researchers and organisations interested in child safety (Malek et al. 1990; Rivara & Mueller 1987; Gardner et al. 1986; OECD 1986; Molen 1984; Preusser & Blomberg 1984; Molen 1983; Molen et al. 1983; OECD 1983; Fortenberry & Brown 1982; Molen 1981; Molen et al. 1981; and Sandels 1975). There was general agreement amongst these authors regarding the curriculum framework for teaching road crossing tasks to children. When formulating the curriculum it is necessary to address the skills associated with road crossing and the needs of different groups of children. Therefore, the curriculum should include road crossing behavioural skills taking cognisance of each child’s age and physical and intellectual capability. The curriculum should address situations such as child pedestrians being alone or accompanied; traffic density; and relevant social environmental and legal factors (Penna 1994; Marsh & Hyde 1990; Elliott 1985; Molen 1984; Limbourg & Gerber 1981; Vinje 1981; and Molen 1981).

A synopsis of the salient behaviours associated with road crossing include:

- walking at a normal tempo;
- selecting an appropriate place to cross the road;
- stopping at the kerb or the outside edge of a parked vehicle;
- searching for approaching traffic, for example look right-left-right;
- waiting until approaching traffic has passed;
- repeating the searching task until it is considered safe to cross the road, for example no approaching traffic or traffic is a safe distance away from the crossing site;
- crossing the road at right angles to the kerbside; and
monitoring for approaching traffic whilst crossing.

In the past, a major educational focus has been on children learning kerbside drill by rote without giving them any rationale for performing the specific actions. As a result, it has been revealed that children tend to chant the words of the kerbside drill as if they were ‘... a kind of magic incantation’ (Pease & Preston 1967 in Sheppard 1980:397). Similar findings were reported by Schreiber and Lukin (1978:35) who reported that the children ‘... performed the kerb drill as a magic rite ...’ without any understanding of road safety. It was strongly recommended that rote learning should be replaced by educational strategies which are designed to help children understand the concepts associated with safe pedestrian behaviours (Howard in Osborne & Levis 1980; Preston in Osborne & Levis 1980; Schreiber & Lukin 1978; and Pease & Preston 1967 in Sheppard 1980).

It is advocated that young children should not be allowed to act independently in traffic. Children between three and six years of age were found to be incapable of independently dealing with traffic situations (Briem & Bengtsson 2000). Rather, a competent older person who can prompt them to stop at the kerb side before crossing and ask why it is important to stop before crossing a road should accompany such children. Such actions would help to ensure that children comprehend safe road crossing tasks.

Various instructional media have been used in children’s road safety programs including: films, videos, posters, story books which are suitable for use both at school and home, cartoons, comic books, use of male and female role models, animated fantasy characters, road safety themes which are suitable for group discussion, and use of photographs of local roads with which children are familiar. The use of photographs as an educational tool has been promoted by Preston (1980:393), who states that it is very appropriate to use photographs that focus on local areas where children have been injured. Instructional media have also been developed for use by television stations as community notices or advertisements. Although acknowledging the role television advertisements or community notices play in road safety education, Herbert (1979:6) indicates that to be successful two
versions of the road safety message need to be developed, one suitable for children and the other for adults.

The duration and format of road safety education programs has been advanced by a number of researchers and educationalists. Studies have shown that single road safety education lessons are ineffective (Fisk & Cliffe 1975; Lewis 1970 cited by Preston in Osborne & Levis 1980). It was found that in Great Britain, a single lesson on the Green Cross Code road crossing procedure taught to children aged between 5 and 8 years did not significantly improve their road crossing behaviour (Fisk & Cliffe 1975). For any change to be manifested in children’s pedestrian behaviour it was recommended that: ‘Either more lessons, at this age, or a different approach is required to achieve significant improvement’ (Fisk & Cliffe 1975:10). Based on her research, Preston (1980:391) stated that not enough time was allocated to teaching road safety. Lewis (1970 in Preston 1980:389) questioned the efficacy of involving children in a one-off road safety education program. It was found that 24 hours after a teaching session, less than 10% of the children could recall the contents of a poster used in a teaching session or to answer questions relating to the topic. Molen, Herik and Klaauw (1983) recommended that children receive a minimum of four training sessions per road crossing task, with each training session lasting between 10 and 15 minutes. A similar educational format was suggested and initiated by Rothengatter (1984b) with the children in his study having three training sessions.

Instructional methods and strategies used in road safety education have focused on one or more forms of learning, namely: cognitive instruction involving pictorial as well as written information, demonstrations, and practical skills. Demonstrations and practical skills have been taught in classrooms, playgrounds, road safety training centres and in real traffic environments. The use of real traffic situations as the venue for teaching children safe road crossing behaviour has been advanced by Briem and Bengtsson (2000); Ampofo-Boateng, Thomson, Grieve, Pitcairn, Lee and Demetre (1993); Rothengatter (1984b); Molen, Herik and Klaauw (1983); Fortenberry and Brown (1982); and Limbourg and Gerber (1981). Molen, Herik and Klaauw (1983:155-156) argued that to teach children safe road crossing behaviours, teaching sessions should be undertaken in three real traffic settings, namely a quiet
It is through the use of a variety of instructional strategies including general instruction, role modelling, memorisation and reinforcement of traffic and pedestrian rules that children can relate to a given situation and choose appropriate action(s) resulting in positive pedestrian behaviours (Ampofo-Boateng et al. 1993; Anthony, Cavallo & Crowle 1992; Ampofo-Boateng & Thomson 1991; Rothengatter 1984; Molen et al. 1981; Deschamps 1981; and Fisk & Cliffe 1975). It has been recommended that a range of road safety learning instructional methods, strategies and formats be utilised and incorporated into the school curriculum. Furthermore, these authors indicate that road safety should be included in each year of the primary school curriculum so that children gain pedestrian knowledge and skills cumulatively. It has been advocated that where classroom teachers are responsible for the delivery of road safety education programs, in-service programs should be provided for these staff members (Harrison, Penman & Pennella 1997; Antill 1990; Marsh & Hyde 1990; Rivara & Mueller 1987; and Gardner et al. 1986).

Evaluation is a critical component of any education program and road safety should not be an exception (Cross, Stevenson, Hall, Burns, Laughlin, Officer & Howat 2000; Penna 1994; Marsh & Hyde 1990; OECD 1986; Bowen 1985; Elliott 1985; Molen 1983; Molen et al. 1983; Molen et al. 1981; Molen 1981; Fisk & Cliffe 1975; and Sandels 1975). Evaluation strategies appropriate to road safety education programs include written and oral testing of children's knowledge, observation of their pedestrian behaviour and a review of child pedestrian injury rates.

In summary, two particularly important areas for the safety of children are awareness of potential traffic related dangers and learning positive pedestrian behaviours. Although adults may consider that road crossing is a relatively simple task, it is not necessarily so for young children, especially if traffic is present and they have to make a decision as to when it is safe to cross. It is important that educationalists take cognisance of children’s learning processes, especially memory, and provide programs suitable for their level of understanding and learning ability. The acquisition of such knowledge and skills should result in a reduction of pedestrian related injuries in children.
A more detailed analysis of some road safety education programs will be presented in the literature review section of this thesis.

Road Safety Council of the Northern Territory (RSCNT) Primary School Education Program

In the Northern Territory, the RSCNT conducts the primary school road safety education program. The *Out and About* program is preferred by RSCNT because it addresses the various stages of a child’s development. Although not stated, the *Out and About* education program takes cognisance of Piaget’s theory of development. The *Out and About* program is divided into two levels. In level one simple tasks are presented one at a time, thus addressing the developmental ability of children under seven years of age, for example, a child in this age group is taught that the footpath is where they should walk. Within the second level of the program information is progressively presented, thus recognising the different developmental skills and ability of children aged seven to eleven years and those eleven to fifteen years of age. The teaching and reinforcement of the meaning of traffic lights and road signs demonstrate that in the *Out and About* program takes cognisance of the development of seven to eleven year old children’s causal thinking patterns and use of symbols. The ability of older children to logically organise information and solve complex problems is acknowledged when a child is required to assess the distance and speed of an approaching vehicle and then determine if there is adequate time to safely cross the road. A more comprehensive overview of the *Out and About* program is presented in Chapter 2: Literature Review

The following description of the Darwin road safety education program was outlined by the Darwin Field Officer (Solien, A. 1994, pers. comm.). The description given shows how active learning was encouraged. In 1994, the Field Officer, responsible for Darwin primary school students' road safety education, predominantly utilised the FORS *Out and About* program. The format of the program consisted of lessons conducted at primary schools and in a simulated environment at the RSCNT Parap Education Centre. This Centre consists of an indoor classroom that contains a

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3 Darwin Field Officer, Road Safety Council of the Northern Territory
model road system and an outdoor scaled down street environment. The Field Officer tended to utilise a *modelling* teaching technique for classroom and outdoor education sessions. In the classroom environment the Field Officer verbalised the correct pedestrian behaviour and then reinforced the instruction by writing the information on a white board. Through a variety of questioning techniques and where necessary prompting, children were encouraged to explain the various safety aspects which should be considered when walking along a path and subsequently crossing a road. Responses were reinforced by the Field Officer acknowledging that they were correct through the use of praise and smiles. Videos that featured either a well-known personality or animated symbolic animal characters such as *Hairy Nosed Wombat, Koala, Marsupial Mouse, Yellow-Bellied Glider Possum, Platypus* and *Bilby* were used in the education program to teach children correct pedestrian behaviours. Where appropriate, other teaching resources were utilised and/or adapted to meet the learning needs of specific age groups. Children viewed photographs and/or current newspaper items and were asked to think about the subject and respond to specific question on road safety behaviours. As a further strategy to reinforce correct safety messages, children were given road safety pictures designed to be coloured in, stickers and posters. From time to time, the animated animal character *Hector the Cat* made a visit to various primary schools. The purpose of such visits was for *Hector* to reinforce the importance and use of appropriate road safety behaviours. Classes conducted outdoors at the Parap Education Centre or in the school yard involved children practising road crossing, general pedestrian and bicycle behaviours. For children in the 5-7 year age groups, the duration of the classroom sessions tended to be approximately 30 minutes. The combined classroom and outdoor sessions varied in duration: 45-60 minutes and upwards for children in the age groups 8-10 years and 11-13 years.

The Field Officer perceived the ultimate goal of the program to be a reduction in the incidence of child pedestrian injury. Short term program goals were for children to increase their knowledge of road safety, and to develop safe pedestrian behaviours.
Theoretical Framework: Epidemiology

In this section, a description is given as to how epidemiology has been adopted as a framework for this research. The first aspect of health promotion is to ascertain who is affected as a result of a health problem and to determine what factors are associated with its occurrence (Rivara & Mueller 1987:13-14). This stage of the investigation is commonly referred to as epidemiology. Epidemiology has been defined by Valanis (1986:7) as:

... the study of the distribution of states of health and the determinants of deviations from health in human populations.

An epidemiological framework used in research consists of three factors that collectively are referred to as the epidemiological triad (Valanis 2000; Harkness 1995; Valanis 1992; Sleet, Egger & Albany 1991; McMurray 1990; Wilson & Baker 1987; and Haddon 1980). This triad refers to the interaction of the host, the causative agent and the environment. The host was perceived to be the person with the disease, the agent was the factor, object, organism or structure which caused the disease and the environment was primarily the internal and external surroundings or conditions which contributed to the effect the agent had on the host. The epidemiological triad is illustrated in Figure 1.1.
In epidemiology, methods by which agents are transmitted are referred to as vehicles and/or vectors. A vehicle is an inanimate object and a vector is a living thing. To illustrate these concepts Haddon (1980:413) stated:

... electric lines are vehicles of electricity, hot rivets are vehicles of thermal energy, poison containers are vehicles of their contents, and moving objects are vehicles of mechanical energy. Similarly, poisonous plants and animals are vectors of their toxins, and animals that injure by tearing and crushing are vectors of mechanical energy. This concept is a useful one, since many preventive measures must be directed against the vehicles and vectors rather than against the physical and chemical agents they transmit.
Epidemiology has three purposes, namely to determine causes of health deviations, provide data upon which intervention strategies can be developed to prevent or control the health problem, and provide data which maximises the timing and effectiveness of interventions (Valanis 1992). This process is achieved by studying population groups, especially those perceived to be at risk, and identifying who and how many are at risk, when, where, why, and in what circumstances.

Recent changes in health milieu orientation from disease to wellness have seen a broadening of epidemiological concepts so that they can be applied to a range of health issues. Broadening the scope of epidemiology to a wider range of conditions has resulted in the identification of multiple social and/or behavioural interactions, which have the potential to contribute to a health problem (Baum 1998; Harkness 1995; and Hawe, Degeling & Hall 1990).

The use of an epidemiological framework is in keeping with the philosophy of primary health care and health promotion strategies. Based on hazard identification, risk estimation, and/or triggers associated with a health issue, appropriate health promotion strategies can be developed, initiated and evaluated. In the United States of America, the application of epidemiological concepts has been used in the development of health promotion activities (Green & Anderson 1986). Activities used in achieving health targets include: education, behaviour modification, media and advertising, engineering, regulation, legislation, and socio-cultural influences (Green & Anderson 1986). In summary, the adoption of epidemiological concepts in health promotion has resulted in the development, implementation, and evaluation of preventive strategies designed to eradicate or limit the occurrence of specific health issues or events. Furthermore, the use of epidemiological techniques has expanded from focusing on the cause and outcome of disease to evaluating intervention strategies designed to prevent disease, injury and disability. The extension of the original definition of epidemiology to include health promotion activities designed to promote healthier lifestyles and prevent unnecessary injuries, disabilities and/or deaths is in keeping with the philosophy of primary health care.
Epidemiology: Application to Child Pedestrian Safety

Use of the epidemiological triad has been identified as an appropriate framework for research into childhood unintentional injuries and associated preventive strategies (Wong, Hockenberry-Eaton, Wilson, Winkelstein, Ahmann & DiVito-Thomas 1999; and Harborview Injury Prevention and Research Center 1997). Applying the epidemiological triad to child pedestrian-traffic research, the child pedestrian is the host and addresses variables such as age and gender, road safety education is an example of an agent variable, and environment variables may include day of week, time of day, traffic calming devices and speed restrictions. In addition, motor vehicles were identified as being a major environmental agent associated with unintentional deaths (MacKenzie 2000:113). For example, a vector might be an inattentive driver while the agent's vehicle might be the speed at which an approaching motor car is travelling. It is reported that motorists generally modify the driving speed in relation to known hazards and ‘... may be caught out by atypical pedestrian behaviour’ (Brown 1980 in Osborne & Levis 1980:373). It has been predicted that at lower speeds the driver may be concentrating on issues other than driving, and at high speed the driver has a narrow field of attention and is less likely to see a pedestrian unexpectedly crossing the road until it is too late to prevent a collision (Brown 1980 in Osborne & Levis 1980). Therefore, health promotion education programs should target drivers in such a way that they modify their driving habits to anticipate the unexpected especially if they are driving in an area frequented by children.

An example of how the epidemiological triad can be applied to child pedestrian road crossing behaviour is illustrated in Figure 1.2. The model used does not address all agent, host and environmental factors pertaining to child pedestrian safety, rather it is limited to the main variables associated with study.
Host Factors

* Age
* Gender
* Attentiveness to Environment

Agent Factors

* Road Safety Education Program
* Accompaniment
* Supervised Crossing Site

Environmental Factors

* Day of Week
* Time of Day
* Climatic Conditions
* Season of Year
* Traffic Density
* Speed Devices

Figure 1.2 Child Pedestrian Road Crossing Behaviour Epidemiological Model

Context of the Problem

The concept that child behaviour is a major contributing factor to unintentional injuries sustained in traffic-pedestrian collisions is espoused by numerous authorities and researchers including: The Royal Society for the Prevention of Accidents (ROSPA) 2001; United Kingdom (UK) Department of the Environment, Transport and the Regions (1998); and Roberts (1987 in Roberts & Brooks 1987). Immaturity of their cognitive and physical development contributes to the erratic pedestrian
behaviour displayed by some children. As a result of their immaturity, children are most often the innocent victims of traffic-related injury. This view is supported by Sandels (1975:3) when in acknowledging children as innocent victims because they do not comprehend traffic situations stated ‘... that the onus of responsibility for children in traffic must be laid equally on town planners, drivers, and other responsible adults...’. Education programs alone cannot be expected to protect children in traffic situations. Rather, education programs can foster an understanding of road safety concepts and provide children with skills designed to increase their safety as pedestrians. Other strategies include environmental changes, speed restrictions, and informing drivers about how unpredictable children are as pedestrians (Spencer & Blades 1985).

Although a number of studies have evaluated the curriculum of road safety education programs conducted in Australian schools (Penna 1994; Marsh & Hyde 1990; Rush & Castor 1988; Elliott 1985), little attention has been given to the effect such programs have on the behaviour of children as pedestrians (Penna 1994). Wilson and Baker (1987:79) state that with regard to education programs they have found that ‘... education often fails to change behaviour.’ Basically researchers have focussed on the content, teaching aids and strategies employed in formulating and implementing education programs. Therefore, if causes of pedestrian injury are known and education programs have been designed to address such factors and they are presented in such a way that knowledge is increased, then it is timely to evaluate the effect such education programs are having on children’s pedestrian behaviour.

In this research, the pedestrian behaviour of children is examined in relation to one education program, namely the Out and About program, as outlined in a later chapter, offered to Darwin Primary Schools by the RSCNT.

Summary

Statements of key research issues relevant to this study have been presented in this chapter. The major issue has been described as unintentional injury and its relationship to road safety. It has been stated that child pedestrian injury and
fatality, especially in relation to children of primary school age, is a current social and economic problem that is in urgent need of address in Australia. Furthermore, it has been identified that primary school children do not have the physical, cognitive and behavioural and social developmental skills to safely and adequately act independently in pedestrian-traffic situations. It has been posited that an aspect of health promotion, education, is perceived to be necessary to encourage communities and individuals to have control over and improve their health. To that end, the FORS education package *Out and About* has been used in this study. This package has been used in primary schools by the RSCNT in Darwin. The following chapter will describe the literature that informed and guided this study.
CHAPTER 2

LITERATURE REVIEW

Overview

The effect of a specific road safety education program on child pedestrian behaviour, in particular children's road crossing activity as they travel to and from primary school, is a major focus of this research. This literature review does not claim to comprehensively address the diversity of road safety education programs, rather, the more influential studies which guided the design of the study, including the *Out and About* education package. Therefore, this literature review is selective rather than all encompassing. Early studies have had an influential effect on the international understanding of child pedestrian safety. The most influential of these studies were those of Rivara and Mueller (1987), Molen (1984), Rothengatter (1984b), Molen (1983), Molen, Herik and Klaauw (1983), Molen (1981), Molen, Rothengatter and Vinje (1981), Deschamps (1981), Vinje (1981), Cratty (1979), Cohen and Haith (1977), Coote (1976), Fisk and Cliffe (1975), Grayson (1975), Padgett and Waller (1975), Sandels (1975), Routledge, Repetto-Wright and Howarth (1974), Pease and Preston (1967) and Read, Bradley, Morrison, Lewall and Clarke (1963). Reference is made to these seminal studies in this literature review. A search of the literature failed to identify any complete replication of these highly influential studies. Rather, aspects of these seminal studies provided the basis of other studies cited in this literature review. The framework used to guide this literature review consists of the epidemiological triad: host, agent and environmental factors. Host factors relate to children's: age; gender; and capabilities and limitations as pedestrians. Agent factors include: road safety education programs and their effectiveness, adults as role models and supervised crossing sites. Environmental factors relate to: day of week and time of day when the majority of child pedestrian injuries occur, designated crossing sites, traffic density, traffic management devices, and legislated speed limits.
Knowledge of children’s physical and cognitive abilities and behavioural characteristics was perceived to be an important aspect of curriculum design for road safety education programs (Solso 1991; Elliott 1985; Molen 1983; OECD 1983; Molen 1981; Molen, Rothengatter, & Vinje 1981; and Sandels 1975). Consequently, this section of the literature review focuses on: children’s physical and cognitive development, physical and cognitive abilities and limitations, and behavioural characteristics manifested by child pedestrians. Although these aspects will be discussed separately, interaction of these abilities and characteristics contribute to children’s behaviour as pedestrians.

Physical Development

Children’s physical characteristics have an influence on their ability as pedestrians. The younger the children the greater are their limitations to functioning as safe pedestrians. They have visual limitations due to their age and height, increasing the potential to incur injury. Because of their short stature they have difficulty seeing over hedges, fences, bonnets or roofs of parked vehicles or other objects near the road. Children need to tilt their head to see traffic signs, which are usually erected above the height of the average adult (Moses 1989; OECD 1983; and Ross & Seefeldt 1978). Children’s short stature is one factor that explains why they may be easily hidden from drivers by bushes, parked vehicles et cetera. Under normal circumstances, because of their shorter stature and stepping span, it takes a child longer to cross a road than it does for an adult (Pettit 1996). It has been estimated that ‘... an average 5-year-old, running, not walking, covers a distance of only 11.5 ft (3.5 m) per second ...’ and compared to adults, children are slower commencing to walk or run and stopping quickly (Cratty 1979 in Pettit 1996:82).

Children do not attain their maximum visual development until approximately sixteen years of age (Moses 1989). Sandels (1975) and colleagues conducted a study examining the differences between children’s and adults’ range of right lateral peripheral vision, to a limit of 90 degrees. The sample consisted of 40 subjects: ten adults of each sex, aged between 20-40 years; and ten children of each sex, aged
between five years eleven months and seven years and four months. None of the subjects had any known visual defects. Due to time and financial constraints, testing was confined to each subject’s right eye. It was found that children’s peripheral vision was more restricted than that of adults resulting in them perceiving ‘... approaching vehicles from an angle more slowly than would adults ... ’ (Sandels, 1975:76). Sandels (1975) findings that children’s peripheral vision is more limited than that of adults was supported by David, Foot, Chapman and Sheehy (1986) and David, Chapman, Foot and Sheehy (1986).

For a person to gain detailed information about an object it is necessary to move the head so that the line of gaze focuses on the object. Head movement is necessary if a person is to maintain focus on a moving object. Daniel and Lee (1990) conducted research into the head movements, eye coordination and gaze stabilisation of six adults and six infants. Adults were tested once and infants were tested six times at three weekly intervals between 11 and 28 weeks of age. The results revealed that by 28 weeks of age infants’ head turning and gaze stabilisation on a target had developed to near adult level. It is worth noting the size of the sample (n=12) and question if the results would have been the same if the sample had been larger.

By combining the results of Sandels’ (1975) research on children’s peripheral vision and Daniel and Lee’s (1990) study on head movements, eye coordination and gaze stabilisation, it can be presumed that to gain specific details about an object it is necessary to move the head so that the target is in one’s line of gaze. However, when analysing road crossing behaviour Sandels (1975) stated that even though children stop at a kerbside, move their head and appear to be searching for oncoming traffic, it can not be assumed that they have assessed the situation as would an adult.

David, Foot and Chapman (1990) provided contradictory evidence on children’s peripheral vision. These authors were concerned about the high incidence of child pedestrian injuries, which were considered to be related to children’s poor peripheral vision. Their study was designed to assess subjects’ cue utilisation in peripheral vision. The research compared the time it took a sample of 64 subjects consisting of: adults and children aged seven, nine and eleven years to detect objects in foveal (aka central or acute) and peripheral vision. A series of road scenes, which depicted
hazardous and non-hazardous situations, was constructed and photographed. At any one time up to but no more than four vehicles were included in each of the scenes. Although dissimilar in size and appearance these vehicles were readily recognisable by manufacturer’s name and model. The scenes were photographed ‘... from a fixed position at child’s eye-level close to the kerb and facing across the roadway, in the direction the child would have to walk if crossing’ (David, Foot & Chapman 1990:474). Seventy slides were made of which twenty-four were used by subjects to familiarise themselves with the research activity and the remainder were used in the data collection phase of the study. Subjects were seated at a height comparable to standing at a kerbside, 0.76 metres in front of a screen on which the road scenes were projected at 12 second intervals. For each scene subjects were required to verbally indicate if it was safe or dangerous to cross the road and to name the make of vehicle(s) involved in the scene.

The study found that adults’ decision times in foveal vision were faster than that of children aged seven and eleven years but not the nine-year-olds. When a hazardous situation was presented which necessitated the use of peripheral instead of foveal vision, it took all subjects longer to recognise the danger. Nine year olds’ decision times and identification of hazardous road scene responses were similar to that of adults (David, Foot & Chapman 1990). The authors were unable to explain these findings, as they were different to what was predicted. It was concluded that:

Peripheral vision may therefore only marginally be implicated in the over-involvement of children in the pedestrian accident statistics ... (David, Foot & Chapman 1990:483).

This finding is difficult to compare with those of Sandels (1975), as the design of the two studies was very different. The literature suggests that a combination of factors may cause the difference in the peripheral vision of adults and children. These factors include: age, lack of maturation, visual attention, eye movements, cue predictability, visual attention, distance, and reaction time in sighting the target stimuli (Pearson & Lane 1990; Enns & Brodeur 1989; Cohen & Haith 1977).

Concern was also expressed about children’s restricted vision if they cross the road between parked vehicles. In Groningen, Sweden, the percentage of pedestrian
injuries involving children who crossed the road near parked cars was ‘... as high as 80% for children up to 5 years of age, versus 40% for 6-12 year old children’ (Molen 1983:35). In Perth, Western Australia, data revealed ‘... 13% of children [were] injured after stepping onto the road from behind a parked vehicle ...’ (Stevenson, Lo, Laing & Jamrozik 1992:237). Comparison of such data should be undertaken with caution if details of traffic density are not included in the findings (Stevenson et al. 1992).

Children’s ability to hear and discriminate sound direction may cause them problems in traffic. A comparative study was undertaken for the purpose of determining if there was any variation between adults and six year old children in identifying the direction from which a sound originates (Sandels 1975). None of the subjects had hearing anomalies. Subjects sat in the centre of a circle, 1.5 metres in front of hidden loud speakers. The speakers were arranged in a similar position to that of the hands on the face of a clock. A tape recording was made of the sound a car makes as it approaches, passes and drives away from a road crossing. Each subject heard the sound in a pre-determined random order for 3 seconds with a pause of 5 seconds between sounds thus allowing time for the subject to respond. The sound was presented 8 times from each speaker, making a total of 96 sound presentations. At the end of each sound, subjects were required to indicate with a pointer the direction from which the sound came. So that the subjects’ level of concentration was not impeded, a short pause was taken after the first 48 sounds had been presented.

The study showed that there was a significant difference between adults’ and children’s ability to determine the direction from which a sound came. Adults had a high degree of accuracy in perceiving sound from all directions, whereas children were frequently incorrect. Children’s responses were more accurate for sounds from speakers positioned at 11, 12, 1 and 6 o’clock. Adults’ best responses to sound directions were at the 3, 4, 8 and 9 o’clock hand positions (Sandels 1975). This was an important finding when one considers the position of oncoming traffic in relation to a person crossing the road. When a person is about to cross a road, the optimum direction for hearing traffic approaching on the right or left-hand side is at 3 and 9 o’clock. Considering children’s poorest hearing responses were at 3 and 9 o’clock,
they would be more at risk of accurately detecting the sound direction of oncoming traffic. Sandels (1975) recognised that young subjects may have had difficulty concentrating on listening to 96 sounds and in using the pointer to indicate the direction from which the sound came. These limitations could have contributed to subjects’ poor hearing responses.

The appreciation of sound direction varies with age and gender with five year olds having the least acute and twelve-year-olds the most acute hearing sensitivity. Girls tended to be more acute at detecting sound direction than boys (Eagles et al. 1970 in Sandels 1975:87).

Moses (1989:921) provided the following warning with regard to children’s hearing ability:

... Children may appear to look about them correctly and watch out for traffic situations, but in fact, they are looking at entirely different objects, and in a corresponding way, they may also be listening to sounds other than the relevant traffic sounds.

These findings indicate that young children have difficulty hearing and discriminating traffic sounds and this would be further aggravated if density of traffic were heavy.

Nishioka, Ieda, Takahashi, Okajima, Watanabe, Yamakawa and Shibawaka (1991) researched the relationship between sound and visual stimulation, verbal instruction and the safety behaviour of young children. The setting for the experiments was a simulated park area adjacent to a road where there was an approaching motor cyclist. Throughout the research the motor bike was either approaching the park, idling or stopped. Two video cameras were used to individually record the behaviour of 85 five to six year old children. The first experiment examined the extent children use sound-visual information as a cue to behave safely in traffic, in particular in dashing-out situations. Individually the children were taken to the park to play ball with an adult. On arrival at the park, half of the children had the approaching motor cyclist pointed out to them by the adult, the other half of the group had their attention drawn to the sound of the approaching motor bike. After a
period of the child successfully catching the ball, it was thrown high so that it landed on the road behind the child. The child's actions were videoed to determine safe or unsafe behaviour when retrieving the ball from the road. There was virtually no difference in the number of children who exhibited safe and unsafe behaviours in response to visual and aural cues. In a second experiment involving 79 children aged between four and five years, the researchers used the same research design. On arrival at the park each child was given verbal information about the presence of an approaching motor bike. One-third of the group were told that a motor bike was approaching, another third were told that the motor bike was approaching and to be careful as it was dangerous, the remaining children were informed of the approaching motor bike and told that if they went anywhere near the road they must stop and look to the right and left side as it was a dangerous situation. The study results showed that just over two-fifths of children exhibited safe behaviour and nearly three-fifths unsafe behaviour. There was minimal difference between the groups who received no warning of danger, warning of danger, and warning of danger and instructions on how to behave. The researchers concluded that verbal instruction had limited effect on children's dashing-out behaviour in traffic situations. The researchers omitted to indicate if children's behaviour was unobtrusively recorded on the video. In addition, only one item of traffic, a motor bike, was used in the study. This does not reflect real traffic situations which children may confront as pedestrians.

The relationship of age and gender with respect to childhood pedestrian injuries has been investigated by numerous researchers including: Whitebread and Neilson (2000); Durkin, Laraque, Lubman and Barlow (1999); Moses (1989); Sabey (1988); Elliott (1985); Preusser and Blomberg (1984); OECD (1983); Molen (1981); Chapman, Foot and Wade in Osborne and Levis (1980); Howarth and Lightburn in Osborne and Levis (1980); Ross and Seefeldt (1978); and Routledge, Repetto-Wright and Howarth (1974). Male children under the age of 10-11 years were perceived to be more impulsive than girls of a similar age, it was concluded that middle and younger boys level of pedestrian 'risk-taking activities' were considered correspondingly higher than that of girls of the same age (Whitebread & Neilson 2000). The literature indicates the rate of injury for male primary school children is
about twice that of females in the same age group and this disparity continues through to adolescence (Stevenson et al. 1992; and Routledge, Repetto-Wright & Howarth 1974). Boys were perceived to be more impulsive than girls, therefore their 'risk-taking' behaviours were higher (Whitebread & Neilson 1999). Middle aged child pedestrians were perceived to be most at risk of incurring injuries: six to ten years of age (Durkin et al. 1999); and five to nine years of age (Routledge, Repetto-Wright & Howarth 1974). Preusser and Blomberg (1984) cited the findings of Synder and Knoblauch 91971) that the darting or dashing onto the road at midblock sites caused 40% of all urban pedestrian-traffic related injuries that occurred in 13 USA cities. It was reported that approximately three-quarters (71%) of these injuries involved children under the age of nine years (Preusser & Blomberg 1984:49). In Great Britain, of all pedestrian-traffic injuries involving children aged five to fifteen years, it was found that 30% occurred as they travelled to or from school, with the majority associated with children using the roadway as a playground (Preston 1995:187). It was estimated that child pedestrians aged five to nine years were more than twice as likely to die from motor vehicle injuries than all other causes combined (Budnick & Chaiken (1985) cited in Rivara & Mueller 1987:14). In Australia, similar pedestrian injury statistics for this age group were reported (Stevenson et al. 1992; and Elliott 1985).

Social class has been linked to child pedestrian injury (Laflamme and Diderichsen 2000; and Dowswell, Towner, Simpson and Jarvis 1996). These authors indicated that children from lower socioeconomic families were more likely to die from pedestrian injury than other social classes. It was reported that pedestrian injury rates for children from low socioeconomic families were quadruple that of higher socioeconomic families (Dowswell et al. 1996:141). The rationale provided for this statistic was that children from lower socioeconomic families live in high density areas and as a result streets are narrower, recreational areas are limited, on street parking is more intensive, and school student populations are higher than in high socioeconomic areas (Dowswell et al. 1996:141).

In summary, the literature suggests that children’s limited physical development tends to affect their behaviour as pedestrians. Short stature can result in their
inability to see over the bonnet of a parked vehicle or be seen by the driver of an approaching vehicle. Immature peripheral vision limits what they can see out of the corner of their eyes. Young children’s ability to localise sounds is not fully developed resulting in them having difficulty in hearing sounds and accurately identifying their source of direction. Statistics indicate that males are twice as likely to incur a pedestrian injury than females in the same age group. Middle aged children have a higher incidence of pedestrian related injuries than young or older aged children. Children’s limited physical development can hinder their ability to behave safely in traffic situations.

**Cognitive Development**

Level of understanding is also a feature of development across the lifespan. Cognitive development is a cumulative process that involves a number of factors including concentration span, memory, comprehension, mental representations, abstract thinking and decision making (Lefrancois 2000; and Biggs & Telfer 1987). All of these factors contribute to a child’s ability to function safely as a pedestrian and ability to understand and actively participate in road safety education programs.

In the United Kingdom, children between four and ten years of age plus some adults were shown a series of line drawings and video clips which depicted safe and unsafe situations including pedestrian and road crossing behaviours (Dunbar, Lewis and Hill 1999). On two occasions the subjects were shown the set of images and asked to comment on them. At the second viewing the concept of using ‘danger’ as a criterion was suggested to the subjects. It was found that at the first viewing very few of the younger children compared to adults considered the situations to be unsafe. Following cueing, at the second viewing all children were able to identify some of the dangerous situations. It was reported that as children aged so did their ability to accurately judge and classify safe and unsafe situations. The researchers referred to this cognitive ability of the older subjects as ‘commonsense reasoning’ (Dunbar et al. 1999). Although some of the younger children understood what was dangerous they did not have the ability to competently and appropriately apply the knowledge, for example in road crossing skills. Dunbar et al. (1999) provide no information as to the total number of subjects, how many subjects were in each age
group or the time lapse between the first and second showing of the set of visual images.

Lack of cognitive maturation results in children's level of knowledge and skills varying from day to day and their 'accident proneness' (Briem & Bengtsson 2000; Foot, Tolmie, Thomson, McLaren and Whelan 1999; Manheimer & Mellinger 1997; and Ljungblom & Kohler 1991). Based on child development theories espoused by Gesell, Piaget and Erickson, and their own experience, Ljungblom and Kohler (1991) reported that it is not unusual for a child to adhere to road crossing rules for a number of consecutive days and then fail to observe them on another day. Therefore, children's forgetfulness can put them at risk of injury. Briem and Bengtsson (2000) and Dunbar et al. (1999) indicated that a child's attentional and memory capacity increases with age.

Children's cognitive style as part of a reflection-impulsivity continuum is discussed by Coppens (1986). When compared to reflective children, '... impulsive children responded more quickly and with more errors on the tasks' (Coppens 1986:191). Based on Messer (1976) research findings, it was stated that as children chronologically mature and develop problem solving skills, their cognitive style correspondingly becomes more reflective (Messer 1976 in Coppens 1986). Although Foot et al. (1999) referred to the concept of 'distractibility', their findings are akin to that of Coppens (1986). This perspective on the relationship of cognitive style and behaviour may explain why young children who act impulsively appear unable to differentiate between safe and unsafe traffic situations.

Children under the age of six years of age are unable to attend to more than one thing at time and have a poor concentration span (Briem & Bengtsson 2000; The Child Accident Prevention Foundation of Australia 1997; Moses 1989; Elliott 1985; and Ross & Seefeldt 1978). Young children are easily distracted, especially if something seems more appealing or important to them at the time. Examples of children having difficulty remembering more than one thing at a time are: looking only one way to assess traffic situation prior to crossing a road; dashing onto the road to retrieve an object without looking for safe traffic conditions, or talking to a
friend instead of looking for potential pedestrian hazards (Briem & Bengtsson 2000; The Child Accident Foundation of Australia 1997; Molen 1983; and Ross & Seefeldt 1978). Children’s memory capacity and storage is slower and less than that of adults (Elliott 1985; and OECD 1983). This information suggests that education programs designed for young children should contain only one concept at a time and the learning session should be short.

Children have difficulty in: perceiving the presence and position of moving vehicles, judging speed of vehicles, judging distance between moving vehicles, and differentiating between the right and left sides of the body (Foot et al. 1999; The Child Accident Prevention Foundation of Australia 1997; Connelly, Conaglen, Parsonson & Isler 1998; Malek et al. 1990; Elliott 1985; Molen 1983; OECD 1983; Hoffmann, Payne & Prescott 1980; and Sandels 1975). Consequently, primary school aged children may be unable to assess the presence of actual and potential danger. Therefore, it is unwise for them to cross a road without adult supervision.

In New Zealand, real traffic situations were used to assess children’s ability to hear approaching traffic and judge traffic speed and distance gap judgements (Connelly et al. 1998). The study consisted of three groups of 16 school children; each comprised children aged 5-6 years, 8-9 years and 11-13 years. In each group there was an equal number of male and female subjects. In an urban street, subjects were required to stand immediately in front of a parked car, they were positioned two metres from the kerb, four metres from the centre of the road, and on their right hand side nothing impeded their view for at least 150 metres. Maximum speed limit in the area was 50 km/h. Instruments used to assess children’s ability to hear and access speed and distance of approaching vehicles were a portable audiometer and laser speed and distance detector. Prescreening vision and hearing tests were performed on children involved in the study. Initially an adult individually took each child to the roadside site. After ensuring that there was no approaching traffic, the adult walked one metre behind the child and recorded the time it took for the child to cross the road. This activity was recorded a total of four times, then the average road crossing time was calculated for each child. Prior to undertaking the second stage of the research practice trials was undertaken to ensure that each child
fully comprehended the required process. The second stage involved three researchers and each subject individually. One researcher operated the laser equipment, another signalled the other researchers indicating that a vehicle was approaching the test site, and on receipt of this signal the other researcher told the subject to 'look now'. There was a significant difference in subjects' ability to judge distance gap threshold differences. It was shown that there were:

significant differences between the mean distance gap thresholds of 8-9-year-olds and those of both the 5-6-yr-old ($p<0.01$) and the 11-12-year-old ($p<0.01$) children, but not between those of the 5-6-year-olds and the 11-12-year-olds ($p<0.05$), indicating that the effect of age group as a variable did not conform strictly to an age-related developmental sequence (Connelly et al. 1998:44).

It was identified that for the age groups 5-6 years and 11-12 years, boys more accurately assessed safe distances than girls did. However, for the 8-9 year age group gender difference in assessing distances was minimal. It was concluded that ‘... about one in three of the distance gap thresholds judged by the children under 10 years of age was unsafe (Connelly et al. 1998:449). These findings reinforce the view that young children have difficulty in accurately assessing the distance between them and an approaching vehicle and time taken for the vehicle to reach a designated road crossing site.

A laboratory simulated experiment was conducted to assess children’s time-estimate ability (Hoffmann et al. 1980). The study consisted of four age groups, five to six, seven to eight, nine to ten and eighteen to twenty five years, with 10 males and 10 females in each group. Subjects stood in a position that was equivalent to standing at a kerbside waiting to cross the road. They were randomly shown a series of film clips that depicted a vehicle approaching at various speeds and distances. The film clip was stopped when the vehicle was 20, 60 or 100 metres away from the camera. Subjects were required to press a key on estimating the time lapse it would take the vehicle to reach them. Prior to recording the results, researchers had each subject practise the task for a minimum of ten times or until there was no confusion about the requirements of the activity. The study revealed that the ability to estimate the time lapse was age dependent with all subjects underestimating vehicle arrival times.
Adults most accurately assessed estimation of the time taken for an approaching vehicle to arrive at the specified point, and children in the five to six year age group were least accurate. It was concluded that children in the five to six year age group are more likely to be incorrect when deciding if it is safe to cross a road. All female subjects underestimated vehicle arrival times more often than the males (Hoffmann et al. 1980:238-239). The researchers recognised that the study had a number of limitations including: use of laboratory simulation conditions, no sound provided with the film clips, and the subjectivity of time-estimate responses (Hoffmann et al. 1980). Overall the study appeared to be well designed and executed, especially ensuring subjects had the opportunity to familiarise themselves with the task prior to the data collection phase commencing. The researchers stated the data indicated that by the age of twelve years children had similar time estimate abilities as adults, whilst acknowledging that this finding was ‘... out of the range of the data’ (Hoffmann, Payne & Prescott 1980:239). This inference made by the researchers was not part of their study and should not have been included in the Results Section of their study.

The concept of speed estimation was explored by OECD (1983:37), who stated that children below the age of five years consider speed not in time but rather as ‘... fast, not so fast, slow ... ’. Young children’s inability to judge speed and distance accurately disadvantages them in traffic (Acredolo 1989). Piaget’s research findings suggested that by the age of eight or nine years children understand the interrelatedness of time, speed and distance (Acredolo 1989). Contemporary research has shown that by eight or nine years of age children are aware of the interrelatedness of these correlations but are unable to complete the task accurately before eleven to twelve years of age (Acredolo 1989).

A study conducted by Sandels (1975) revealed that children have difficulty in differentiating between right and left sides. A scaled down model depicting a residential area with different types of housing, road systems, vehicles, dolls and cars was used in conjunction with a questionnaire to test road crossing knowledge of children aged between four and twelve years (Sandels 1975). It was found that many children had difficulty understanding the concepts of right and left and lacked
an insight into why they should look in specified directions to monitor traffic (Sandels 1975:68).

The ability of children aged four to eight years to interpret and understand traffic signs relevant to drivers, cyclists and pedestrians was researched by Sandels (1975). It was found that four year old children virtually had no knowledge of traffic signs, but the correct response rate gradually improved with age. Children frequently misinterpreted the meaning of the Children Crossing sign. A common interpretation of the sign was that children should run across the road at that site so that '... no cars will knock them down' (Sandels 1975:95). Another aspect of Sandels' (1975) research was on how children aged six to ten years interpreted traffic terminologies. It was found that children's ability to interpret the terms increased with age. Boys were found to have a greater awareness of traffic terminology than girls (Sandels 1975). Based on Sandels (1975) findings, because of their inability to interpret and understand traffic signs and terms, young children are particularly vulnerable when left to negotiate traffic independently.

Analysis of over 400 stories on road safety obtained from children aged six to twelve years revealed that they treated '...safe places...' to cross the road as '... magical areas ...' where they were safe at all times (Firth, 1975 cited in Russam 1976:103). Children's lack of understanding of safe and unsafe behaviour and choice of suitable places where to cross the road were also revealed in their road safety stories. The researcher concluded that such descriptions suggest that six to twelve year old children do not have a good understanding of safe pedestrian behaviours.

It was noted by Herbert (1979) that children under eight years of age had no concept of the meaning of dangerous behaviour. His research showed that children in this age group equated dangerous with '... something they were punished for doing' (Herbert 1979:8). These findings reinforce the view that children younger than eight years of age are unlikely to understand what situations contribute to danger in relation to pedestrian activities, in particular road crossing. Similar views were expressed by Coote (1976:3), who stated that children often do not understand the
potential danger associated with crossing a road in front of an approaching vehicle. Herbert (1979) strongly recommended that adults be made aware of child pedestrians' limitations in making judgements about traffic situations.

A study was undertaken into how seven to eleven year old children perceive injury risks and possible preventive strategies was undertaken in the United Kingdom by Green and Hart (1998). Although the study did not specifically focus on road safety, the findings can be transferred to the specialty area. Focus groups of girls, boys and a mixture of girls and boys, ranging in size between three and fourteen years of age, were asked a series of questions. The questions focussed on: defining what was meant by the term 'accident'; identifying who was responsible for children’s safety; specifying when, where and how injuries occurred; and determining what they considered were the most effective methods used to prevent accidents. Accidents were perceived to be either 'unpredictable misfortunes' or dependent on the context, the result of deliberate action(s) or series of events. Most children held themselves accountable for an accident occurring and tended to dismiss the possibility of other agent and/or environmental factors contributing to the event. Preventive strategies were perceived to only focus on prohibiting actions. Some children were critical of 'risk free environments' because they were 'boring' and 'no fun' and preferred the option to 'take more care' (Green & Hart 1998:17). It was concluded that:

Children have to negotiate a complex set of sometimes contradictory rules for behaving in their environments, and injury prevention may not always be their first priority (Green & Hart 1998:19).

Further research should be undertaken to ascertain if younger and older children support the findings.

As a result of the study undertaken by Green and Hart (1998), it is suggested that future education programs should acknowledge and build on children’s competence and knowledge, and teach them risk management skills.
In summary, young children have limited information processing abilities including: memory, concentration, mental representations, and abstract thinking. As a consequence, although they may be aware of safe pedestrian behaviours, it is unlikely that they fully understand what factors contribute to unsafe behaviours. Research findings indicate that children under the age of eleven years are unable to accurately judge distance, time and speed. Young children are still in a learning situation, which means that as pedestrians they are more likely to make judgemental errors. It was recommended that with regards to when children are taught road safety education programs take a positive rather than negative approach be adopted.

**Behavioural Factors**

Behavioural factors that contribute to children’s vulnerability as pedestrians include the tempo associated with crossing the road, their impetuosity, and their failure to search for traffic. Children’s pace when crossing the road has been the subject of research by Gardner, Rowley, Bowen, Hayman and Fyfield (1986) and Elliott (1985). It has been argued that it is failure to observe for approaching traffic before and during crossing a road, rather than running across the road which contributes to children’s risk of road injury.

Immaturity, resulting in a tendency to be easily distracted, was found to be responsible for children’s impulsive, impetuous and unpredictable behaviour, thus making them unreliable as pedestrians (Malek *et al.* 1990; Elliott 1985; Jarvis 1983 cited in Aylward & O’Connor 1987; OECD 1983; Ross & Seefeldt 1978; Coote 1976; and Read, Bradley, Morison, Lewall and Clarke 1963). Behavioural characteristics such as: extrovert personality, curiosity, defiance, risk taking, and exuberance make some children more vulnerable than others to injury (Sand 1991). Terms used to describe the behaviour of children who were involved in pedestrian injuries included: impulsive, impetuous, venturesome, aggressive, ‘show-offish’, daring, defiant, and exploratory (Read *et al.* 1963). Comparable child pedestrian characteristics as those identified by Read *et al.* (1963) have been reported by other researchers including, Briem and Bengtsson (2000), Whitebread and Neilson (1999) and Malek *et al.* (1990).
The literature suggests that a child may not see approaching traffic due to a number of reasons including: being pre-occupied by talking, playing, reading whilst walking, daydreaming *et cetera*. Children’s failure to search for traffic before or whilst crossing the road are two precipitating factors commonly associated with child pedestrian injuries. In a review of factors associated with child pedestrian injury, Older and Grayson (1974) found that nearly two-fifths of the children had not searched for oncoming vehicles prior to crossing the road, and three-fifths had not seen the vehicle which hit them (Older & Grayson 1974 cited in Malek *et al.* 1990:305). Children’s impulsiveness was a contributing factor to their failure to search for oncoming traffic (Vinje 1981 in Malek *et al.* 1990).

*Darting out* and *dashing* are two precipitating factors commonly associated with child pedestrian behaviour. It was reported that these behaviours are responsible for 60-70% of pedestrian injuries occurring in children under ten years of age (Harborview Injury Prevention and Research Center 1997:1). Mid-block child *dart outs* were identified as the phenomena most commonly associated with child pedestrian injuries (Kraus, Hooten, Brown, Peek-Asa, Heye and McArthur 1996). These actions are related to children’s immaturity (Malek *et al.* 1990; Pitt, Guyer, Hsieh & Malek 1990; Elliott 1985; Preusser & Blomberg 1984; Molen 1983; OECD 1983; Molen 1981; Molen, Rothengatter & Vinje 1981; and Ross & Seefeldt 1978). In traffic conditions *darting out* refers to when a pedestrian suddenly appears, for example, having been hidden from sight by a parked vehicle, and *dashing* may be defined as rushing with uncontrolled haste. A study undertaken by Pitt *et al.* (1990) found that nearly two-fifths of the pedestrian injuries were associated with children *darting out* onto the road, and just over one-fifth of the incidents were linked to children *dashing out* onto the road at intersection sites. These findings are comparable to research on pedestrian injuries reported by Preusser and Blomberg (1984) and Synder and Knoblauch (1971, in Malek *et al.* 1990).

An Australian study conducted in the Melbourne metropolitan area by Drummond and Ozanne-Smith (1991) examined a range of issues associated with child pedestrians and bicyclists. Observation sessions were undertaken to determine subjects’ traffic behaviour, in particular behavioural variations if accompanied or
unaccompanied, time of day and weather conditions; and risk of being injured as a result of exposure to traffic. Determinants of exposure to traffic included the time subjects spent on the road or footpath; number of road junctions in the area; and vehicles at or near the junction. Trained observers collected data between 0800-1800 hours at 80 randomly selected observational areas at arterial and local streets in metropolitan Melbourne. Field observation sessions totalled 800 hours made up of two 5-hour sessions at each site. The sample comprised 3342 child pedestrians of whom less than one-tenth were under five years of age, two-fifths between five and eleven years and just over half were in the twelve to seventeen year age group. Almost equal numbers of male and female children were observed. The proportion of children accompanied by an adult decreased with age (Drummond & Ozanne-Smith 1991). Child pedestrian behaviour varied depending on whether the subject was observed on an arterial or local road. Prior to crossing the road just over one-tenth of subjects failed to stop at the kerbside of arterial roads compared to nearly three-fifths at local roads. At arterial road sites approximately one-quarter of the subjects failed to search for approaching traffic prior to crossing a road compared to nearly two-fifths of subjects who crossed a local road. Whilst crossing a road, few subjects in any age group monitored the traffic. Approximately one-fifth of subjects entered a road where there was an object, predominantly a parked vehicle, occluding their line of vision. Half of the children crossed the road in local streets when traffic was approaching. These findings highlight the potential injury risk to which child pedestrians aged nought to seventeen years are exposed because of their non-compliance with recommended safe pedestrian behaviours (Drummond & Ozanne-Smith 1991).

A perceived weakness of their research is that there appeared to be no mechanism to verify the age group of subjects. It would seem that the trained observers made an assumption of the subject's age. There is no indication that any of the subjects had been exposed to a formal road safety education program. Therefore, it is not possible to relate the findings of Drummond and Ozanne-Smith's (1991) study to the effectiveness or ineffectiveness of any such program.
In their literature review of the effectiveness and ineffectiveness of children’s road safety education programs, Dowswell et al. (1996) concluded that although it had been shown that such programs had improved children’s knowledge base generally there had been minimal change in their pedestrian behaviour. Limited information is provided about the studies on which the authors’ based their conclusions.

In summary, the literature suggests host factors include: stimulation from the physical and social environment as well as the child’s level of development, cognitive ability, education, and personality traits can all contribute to a child’s pedestrian behaviour. Risk taking associated with road crossing behaviours may be due to a child’s personality and what else they are doing whilst being a pedestrian. Teaching, explaining, encouraging and frequently reminding children of the need to comply with safe pedestrian behaviours, in particular road crossing, are strategies linked with promoting pedestrian safety.

**Agent Factors**

Agents are a major component of any epidemiological study that examines the behaviour of the host. An agent is a factor whose absence or presence can influence the way a host behaves. In pedestrian safety, major agent factors likely to influence the host’s behaviour are: road safety education programs; presence or absence of other people, for example adults, peers, and/or road crossing supervisors, especially at Children’s Crossing sites. These factors are addressed in this literature review, however the road safety education review is very specific, focusing on road safety education programs relating to: the use of real traffic environments; specific road crossing tasks, for example kerbside drill; duration and format of programs including the use of videos and symbolic characters; and Australian programs which influence this study, in particular *Out and About*.

**Road Safety Education Programs**

Numerous pedestrian education packages have been developed for children between the ages of four and sixteen years, parents, teachers, drivers, and community members. Contents of these packages have included: use of animated characters as
role models; learning aids including videos, posters, stickers and workbooks; and evaluation methods (FORS 1988a; FORS 1988b; Gardner et al. 1986; Molen 1984; Preusser & Blomberg 1984; Molen 1983; Fortenberry, & Brown 1982; and Sandels 1975). These programs variously incorporate educational strategies such as: verbal instruction, demonstration of skills, skill development through guided practice, use of role models to reinforce correct pedestrian behaviours, feedback, observation, and reward.

Program Design, Duration, Format and Delivery

Design of education programs which target primary school children should be suitable for their level of development and contain language that is simple, clear, concise and age appropriate (Molen et al. 1983). Whilst endorsing this type of program design and content, Molen and colleagues (1983) also advocated that education sessions be of 10 to 15 minutes' duration with four sessions allocated for each task, and each child's pedestrian behaviour be assessed at the end of the four sessions. Elliott (1985) supported this program structure and implementation process.

Studies have shown that single road safety education lessons were ineffective (Preston 1980; Fisk and Cliffe 1975; and Lewis 1970 cited by Preston 1980). Inadequate time was allocated to teaching road safety (Preston 1980). She also questioned the efficacy of involving children in a one-off road safety education program (Preston 1980). Another critic of the one-off teaching sessions was Lewis (1970) who found that 24 hours after a teaching session, fewer than one-tenth of the children could recall the contents of a poster used in a teaching session or to answer questions relating to the topic. Posters only or posters incorporated into a single teaching session were considered to be ineffective forms of teaching (Lewis 1970).

In the United Kingdom, Fisk & Cliffe (1975) conducted research to determine what cognitive and behavioural effects a single general pedestrian safety lesson had on children in the five to eight year old age group. The subjects were grouped according to age: five to six, six to seven, and seven to eight years. The road safety education program that formed the basis of this research was the Green Cross Code.
The Green Cross Code was designed to provide children with safe pedestrian behaviours. Pedestrian behaviours associated with the Green Cross Code are summarised as: select a safe place to cross the road, wait at kerb, look and listen for traffic, and when no traffic is approaching walk straight across road whilst at the same time observing for traffic.

After a single lesson on the Green Cross Code, children’s pedestrian behaviour was recorded and analysed. It was shown that children’s road crossing behaviour was generally poor but improved according to increasing age. Of the children who crossed the road using the Zebra crossing just over one-quarter stopped before crossing and approximately one-fifth looked before crossing. A single lesson on road crossing behaviour was considered to be ineffective. For any change to be manifested in children’s behaviour it was stated that they should have more lessons on road safety or that different teaching strategies should be adopted (Fisk & Cliffe 1975).

Rote learning has been used as an instructional method to teach children kerbside drill (Howard 1980 in Osborne & Levis 1980; Pease & Preston 1967 in Sheppard 1980; and Schreiber & Lukin 1978). In this form of learning children memorise the routine without understanding the associated principles. Children tend to chant the words of the kerbside drill as if they were ‘... a kind of magic incantation’ (Pease & Preston 1967 in Sheppard 1980:397). Similar findings were reported by Schreiber and Lukin (1978) who also reported that the children who were taught by rote had no understanding of safe or unsafe road crossing behaviours. The teaching of road safety to children using rote learning was also judged to be ineffective by Howard (1980 in Osborne & Levis 1980).

It was advanced that for children to understand concepts and utilise behavioural skills associated with safe pedestrian behaviour, then it would be necessary to utilise a diversity of educational strategies and programs should be more intensive (Preston 1980 in Osborne & Levis 1980; and Schreiber and Lukin 1978). A flow chart outlining abilities associated with general pedestrian tasks was developed and recommended for use by road safety educators (Molen et al. 1981). Use of a flow
chart assists educators to reflect on the road safety needs of children of different ages and to accordingly customise the content of education programs.

In the literature there appears to be general consensus that road safety education programs should be incorporated into school syllabi. In-service programs should be provided for school teachers responsible for the delivery of road safety programs (Ampofo-Boateng & Thomson 1991; Malek et al. 1990; Marsh & Hyde 1990; Rivara & Mueller 1987; Gardner et al. 1986; OECD 1986; Elliott 1985; Molen 1984; Preusser & Blomberg 1984; Molen 1983; Molen et al. 1983; OECD 1983; Maisey 1982; Molen et al. 1981; and Molen 1981).

In this literature review, researchers’ analyses of road safety education programs have been critical of the overall curriculum including design, duration, format and delivery methods used. It has been stated that a number of the programs have been ineffective in improving children’s safe pedestrian behaviours.

**Use of real traffic environments**

The use of real traffic situations as the venue for teaching children safe road crossing behaviour has been recommended by Foot et al. (1999); Ampofo-Boateng, Thomson, Grieve, Pitcairn, Lee and Demetre (1993); Rothengatter (1984b); Molen et al. (1983); Fortenberry and Brown (1982); and Limbourg and Gerber (1981). The need to have a road safety program that combines theory with practical skills using real traffic situations was advanced and developed by Rothengatter (1984b). The practical component of the program used three sites: quiet streets, streets in which cars were parked, and intersections. The on-site program consisted of a minimum of four training sessions with 10-15 minutes allocated at each of the three traffic environments. The practical program was supplemented with audio-visual presentations of young children crossing a road. The study involved children aged four to six years and consisted of a control and subject group. Parents and teachers were recruited to act as role models for the children. These adults were required to demonstrate and explain safe road crossing behaviours and to describe the associated dangers to the children. Under the guidance of a parent or teacher, children
practised until they became proficient at road crossing skills. Each child was praised whenever a road crossing skill was performed correctly and proficiently. Pre and post testing of subjects’ traffic knowledge and behavioural skills was conducted. It was found that children instructed by parents and teachers performed better in both the knowledge and behavioural tests than those in the control group. Children instructed by teachers performed slightly better in the behavioural test than those instructed by their parents. Four months after completion of the education program, children had retained safe road crossing behaviours (Rothengatter 1984b). The researcher acknowledged that when children knew they were being observed, they behaved more safely when crossing the road. It was concluded that: 'The obtained results should, therefore, be considered as an indication of the children’s capabilities to cross the road correctly rather than of their normal behaviour' (Rothengatter 1984b:158). Using real traffic environments and involving parents were the perceived strengths of this study.

A comparative study of the road crossing behaviour of two groups of five year old children and a control group of eleven year olds was undertaken by Ampofo-Boateng et al. (1993). In one subject group each child learnt road crossing principles using a tabletop model of a traffic environment. Subjects in the other group were individually taught the procedure using a real road environment. Road crossing behavioural skills of children in each group was observed. The findings revealed that each subject group performed above expectation for their age and were similar to eleven year old children in the control group. No difference in behavioural skills was observed between the children in the two subject groups (Ampofo-Boateng et al. 1993). A weakness of this study is children in the control group were twice as old as those in the subject group and so maturation could have affected the findings. The reader was not informed of any pre-tests being conducted to document children’s road crossing behavioural skills. No reference was made to children’s informal exposure to road safety education programs.

Use of Teaching Aids - Educational Media

A comparative study on the effectiveness of two videos, which formed the basis of a
road safety education program, was conducted by Rothengatter (1984a). One video depicted a clown-like character explaining and demonstrating correct road crossing behaviour to a six year old boy. The instruction was given step by step and then as a complete activity. A female voice was used to convey the information to the child. As this video used traditional instructional techniques it was referred to as the 'instructional film'. The other video used real traffic situations including parked vehicles and featured a seven year old girl, who whilst searching for her dog, was seen walking on the pavement and crossing a road four times. The video concludes with the girl finding her dog and taking it home. This latter video was called the 'modelling film'. For the remainder of the review on this study, reference to footage used will be referred to as 'video' rather than 'film'. Subjects in Rothengatter’s (1984a) study were 40 children aged four to six years, of whom equal numbers were assigned to viewing each video. In groups of four, children were twice shown their allocated video. Children viewing the modelling video were required to verbalise what the girl was doing at each stage of the road crossing activity. It was found that children's understanding of road safety improved through the use of videos. This understanding was further enhanced if children were required to verbalise the activities as in the modelling video, rather than listening to instructions. Videos were considered to be appropriate learning aids for use in road safety educational programs (Rothengatter 1984a).

A positive aspect of Rothengatter's study was having subjects explain to the teacher what the real-life person was doing. This provided teachers with an opportunity to reinforce safe behaviours and to correct unsafe behaviours. An extension of the study could have been the use of four videos using the same characters. Two of these videos would include verbal instructions to the subjects and the other two would have no dialogue, and require subjects to verbalise the activities. This would enable the researcher to compare the educational use of animated comic type characters with real-life people.

Colour motion films of traffic on dual carriageways near an inner Melbourne school was used to assess children's road safety behaviour (McKelvey 1984). Filming was undertaken on weekday mornings to coincide with times when children were going
to school. The edited footage resulted in one test and four training films. Each training film was of 10 minutes duration and contained 18 traffic sequences that were repeated, resulting in a total of 36 test items. In the study it was considered that vehicle speed intervals of: ‘... 4-6 sec intervals were considered unsafe, 7-9 sec intervals were safe, and 6-7 sec intervals were a transition zone or area of uncertainty’ (McKelvey 1984:59). Subjects were the entire population of a Melbourne metropolitan primary school (n=269). Testing of subjects was based on the grade they attended at school rather than on age. All subjects were involved in a pre-test followed by a two day road safety education program and six weeks later a post-test. Each subject was given a booklet, which contained numerous sketches of a person standing and another walking. After viewing each filmed item, subjects were required to put a mark on the ‘walking’ person if they believed it was safe to cross the road or the ‘standing’ person if they considered that it was safer to wait and allow approaching vehicle(s) to pass. The study showed that when children were provided with information regarding safe and unsafe road crossing situations in relation to approaching vehicles, they could memorise and recall such events. Thus, the research highlighted the importance of providing children with feedback about appropriate/inappropriate behaviour. Children in the fourth grade, that is about 10 years of age, who were provided with feedback regarding safe or unsafe road crossing behaviours, reached the same level as adults in determining when it was safe to cross roads.

In this study, no reference was made to the use of a control group. Furthermore, it would have been beneficial to extend the study to observe if subjects were able to transfer the road crossing knowledge and skills that they obtained in the classroom to actual traffic environments.

*Use of Teaching Aids – Models*

A table top model that represented a street and pavement was used in a study conducted by Rothengatter (1984a). The model contained several vehicles parked on the road adjacent to the kerbside and the figure of a pedestrian whose head could be turned to the left and right. The model was used to test children's road crossing
behaviours. Subjects in this study were the same as those who viewed the instructional and modelling video described earlier in this chapter. Immediately before and one day after viewing the respective videos, children were individually asked to use the figurine to demonstrate how they would cross the road. A comprehensive test was used to assess subjects’ road safety knowledge. The test involved each subject explaining what was happening with the figurine at each stage of the road crossing procedure in addition to answering a series of questions. Pre and post-test results for the table top model revealed a significant difference between subjects in the modelling and instructional groups. The comprehension test showed that children in the modelling group gave more correct responses than those in the instructional group. On average, correct responses for the modelling group was nearly double that of children in the instructional group (Rothengatter 1984a). The use of a table-top model to assess children’s road crossing behaviours does not provide any evidence to suggest that children would be able to transfer their safe road behaviours to real traffic situations.

**Use of Teaching Aids - Hector the Cat**

The animal fantasy character *Hector the Cat* was introduced into Australian road safety education programs in 1971 (Schreiber & Lukin 1978). The target group receiving this teaching strategy was children aged five to eight years. *Hector* was portrayed as an inept cat who lost eight of his nine lives due to unsafe pedestrian behaviours, then over a four year period his road safety behaviours became exemplary. During this period he married his girlfriend *Millie* and they had three kittens, *Willy, Jilly* and *Bob*. As parents, *Hector* and *Millie* took on the responsibility of teaching their children about road safety. *Uncle Tom* was introduced into the road safety education program in 1974, as the ‘naughty’ cat who unwittingly breached road safety rules. *Hector* and his family was depicted in a wide range of educational material including films, comic books, posters and calendars.

The effectiveness of *Hector the Cat* as a role model and communicator of road safety to children three and one-half to eight years of age was investigated by
Schreiber and Lukin (1978). The study was designed to assess if the material produced using *Hector the Cat* was an appropriate and effective strategy to use in teaching children about road safety (Schreiber & Lukin 1978). The study consisted of 124 children from pre and infant schools in three metropolitan Sydney suburbs. The subjects were allocated to one of three age groups: under five, five to six, and seven to eight years. All of the children were able to understand simple English. Subjects were exposed to: one of three *Hector the Cat* films, a 1975 calendar, and a comic book. The duration of the films varied from one, nine and one-half and fourteen and one-half minutes. To determine the effectiveness of *Hector the Cat* film, calendar and comic book, subjects were asked questions about the content of these items. Subjects tended to respond to the content of the story rather than the educational message that was being conveyed (Schreiber & Lukin 1978).

**Program Evaluation**

From the preceding, it appears that to determine the effectiveness of road safety education, evaluation should be carried out before and after children have received the education program. Evaluation should reflect the program's educational objectives and be undertaken in each learning domain, that is, by assessing knowledge, attitudes and behaviour in relation to pedestrian activities. Observation should be performed unobtrusively and in real traffic situations (Penna 1994; Marsh & Hyde 1990; OECD 1986; Bowen 1985; Elliott 1985; Molen 1983; Molen *et al.* 1983; Molen *et al.* 1981; Molen 1981; Fisk & Cliffe 1975; and Sandels 1975).

A study undertaken in Victoria, Australia, during 1994 has some similarities with the research under discussion, namely assessment of children's road crossing behaviour in relation to a specific road safety education program. A review was conducted of the effectiveness of the road safety education program *Streets Ahead* (SA) (Penna 1994). The study consisted of children aged eight to ten years, who attended one of nineteen Melbourne schools. In the study, nine schools were allocated to the control group, nine to the experimental group and one was used in the pilot study. There was variation between schools in time allocated to the teaching of SA. On average the program was taught over a four week period with the intensity of teaching varying between one and six hours per week. A written test
was used to evaluate children’s pedestrian knowledge and attitude. This test was administered to class groups. Children’s road crossing behaviour was unobtrusively observed using a video camera. Observation sessions were recorded near uncontrolled flagged road crossing sites in the mornings, prior to the school day commencing. The rationale for restricting the observation sessions to the mornings was that more children could be observed over a longer time frame. Filming occurred for at least three mornings before and after the children in the experimental group had been exposed to the road safety education program. The data collection instrument used to record children’s road crossing behaviours was divided into three stages: pre-kerb zone, kerb zone, and road crossing. Behavioural elements were evaluated at three levels of performance: well, reasonably, or poorly done. It was also noted if a child was alone or accompanied whilst crossing the road (Penna 1994).

Analysis of the SA program showed minimal improvement in children’s road safety attitude (7%) and knowledge (13%) (Penna 1994:67). Collectively it was concluded that: ‘... the teaching of SA has had little, if any impact on children’s average road crossing behaviour at uncontrolled crossings’ (Penna 1994:52). It was stated that: ‘There was much evidence of incorrect and potentially unsafe behaviours at the crossing sites in this study’ (Penna 1994:69).

One criticism of the Penna study was the restriction of observation sessions to the mornings. It has been shown that the time most child pedestrian injuries occur is after school (Pitt et al. 1990; and Fortenberry & Brown 1982).

An evaluation of a North Carolina traffic curriculum for children in kindergarten through to year nine was researched by Padgett and Waller (1975 cited in Yeaton & Bailey 1978). It was found that there were:
... statistically significant differences on paper and pencil tests of traffic safety knowledge before and after classroom instruction was implemented. However, a similar pre-post comparison using behavioral observations showed virtually no improvement in actual pedestrian skills (Padgett and Waller 1975 in Yeaton & Bailey 1978:316).

These findings support the view expressed in Chapter 1, that acquisition of knowledge does not necessarily mean people will alter their behaviour accordingly.

A two-stage study to determine the effectiveness of a child pedestrian safety program was conducted by Yeaton and Bailey (1978). Children who attended grades 2 and 3 at 'School A' formed one group, and kindergarten and grade 1 children from 'School B' were in the other group. There were twelve children in each school group. All subjects received instruction in safe road crossing skills. The road crossing elements used to teach subjects correct road crossing behaviour were: wait at kerb, look all ways, watch vehicle distance, walk, continue to look, and use crosswalk. The education program was conducted at intersections and involved instructors describing and demonstrating safe road crossing skills to the subjects. Subjects then practised their skills at a supervised crossing site. As subjects practised road crossing skills they were asked to explain and provide the rationale for their actions. Praise was given for correct behaviours and errors were corrected. Duration of education sessions ranged from 10-25 minutes each for 11 days. At crossing sites, which were monitored by adult crossing guards, children were reminded to use safe road crossing behaviours. Observation sessions were undertaken before, during, and immediately after instruction and again one year later. On the days when they were observed, subjects left school early. Observers were positioned at supervised and unsupervised intersections (Yeaton & Bailey 1978).

Post instruction, data obtained from all observation areas revealed that at School A, children's level of compliance to road crossing elements had improved from just over two-fifths to nearly all subjects. Over the same time frame, at School B, subjects' compliance to the road crossing elements improved from just over one-fifth to a little more than four-fifths (Yeaton & Bailey 1978). At the time of the one
In a one-year follow-up study, the number of subjects had reduced to ten at School A and four at School B. Subjects at School A had maintained their high level of compliance to road crossing behavioural elements. School B subjects' level of compliance was approximately halfway between that of the pre and post-test instructional findings. After subjects at School B had received additional instruction they were reassessed and it was found that their level of compliance to safe road crossing behaviours had improved (Yeaton & Bailey 1978).

The researchers acknowledged that there were limitations to their study in particular during the data collection phases of the study. Not all subjects were present, and if there were no vehicles present when subjects crossed the road it was coded as if subjects had watched for vehicle distance. It was suggested that subjects might exhibit different road crossing behaviour when accompanied. Therefore, it was recommended that future research be undertaken comparing the behaviour of child pedestrians when they were accompanied and unaccompanied (Yeaton & Bailey 1978).

A major advantage of the education program researched by Yeaton and Bailey (1978) was the use of real traffic situations instead of a classroom environment for the teaching of road safety. A criticism of the study is the low number of subjects who were recruited for the research. This became very evident when the number of subjects from School B was reduced to four at the time of the one-year follow-up observation session. Such a substantial reduction in subject numbers brings into question the validity of the research (Roberts & Taylor 1998). On the days when they were observed subjects left school early. This could have resulted in subjects being aware that their road crossing behaviour was being observed thus creating the so-called Hawthorne Effect. The Hawthorne Effect occurs when people perform better at a task knowing they are being observed (Ausubel & Robinson 1969). Another criticism of the study is that subjects in the School A group were older than those in the School B group. Subjects' age disparity may be a factor as to why School A subjects retained a higher level of road safety behavioural skills than those from School B.
In Alabama during 1979, a decision was made to implement a new comprehensive pedestrian education program aimed at first and second grade school children, in four cities. These grades were targeted for the program because children aged six to seven years were over-represented in pedestrian injury data in the state of Alabama. Two years before and two years after the introduction of the education program, pedestrian injury data involving children aged 14 years and younger, in the four cities, was analysed. The ratio between pedestrian injuries to six to seven year old children and the total number of injuries occurring to all age groups up to 14 years of age was used in the evaluation. The control group was the total number of pedestrian injuries involving age groups other the six to seven year olds. Program learning activities included:

(1) Taking the students to a street corner and demonstrating the proper way to cross the street;
(2) Discussing with the students the reason that it is safer to cross the street at the corner than in the middle of the block, and telling [sic] them how the signs and signals help them;
(3) Having the students draw two pictures, the first being of a child walking too close to the street, the second being of a child walking a safe distance from the street;
(4) Displaying the major traffic signs and signals, discussing each sign and signal and having the students draw the signs and signals on a sheet of paper, and

Two years after the introduction of the education program, there was a one-third reduction in the number of pedestrian injuries for children aged six to seven years. No similar reduction in pedestrian injuries within this age group was found in the remainder of Alabama. When evaluating the study, an examination was made of other factors that could have affected the findings. These factors included: street or crossing modifications, changes to traffic flow, variation in traffic density, student enrolments et cetera. Other than the education program, no significant factors were found which could have reduced the pedestrian injury data for the six to seven year age group (Fortenberry & Brown 1982).

The Alabama study is commended for its in-depth design, implementation and evaluation. It was introduced because of the high incidence of pedestrian injuries involving the target group. The program had the endorsement and support of the
state of Alabama. The reporting of this study was clear and concise. A criticism of the report is the lack of information given regarding duration or frequency of the lessons.

In Western Australian, the Child Pedestrian Injury Prevention Project (CPIPP) program is designed to promote and improve six to nine year old children's road safety knowledge and skills through educational and environmental interventions (Cross, Stevenson, Hall, Burns, Laughlin, Officer & Howat 2000; and Stevenson, Iredell, Howat, Cross & Hall 1999. School children, teachers, parents and local communities are targeted in educational intervention programs. In the program parents and community members are advised about primary school aged students cognitive, perceptual physical, emotion and behavioural limitations as pedestrians. Adults are advised that children under 10 years of age should not cross the road unless accompanied by an adult. Environmental interventions linked to the CPIPP program include: ensuring designated road crossing sites are easily seen, footpaths are adequate, parking/drop-off areas are safe; mapping and marking Safe-Routes-to-School for children; promoting the installation of traffic calming modifying devices; and lobbying to have speed limits reduced (Cross et al. 2000; and Stevenson et al. 1999).

Evaluation of the CPIPP program was undertaken in metropolitan Western Australia between 1995-1997 and reported by Cross et al. (2000) and Stevenson et al. (1999). For the research, three local metropolitan areas were selected based on their similarity for childhood pedestrian injury rates, number of licensed motor vehicles; and socio-demographic characteristics. In addition, the three areas were perceived to be a suitable distance apart thus minimising any overlap of subjects' assigned to the respective intervention groups. One local area received the school based road safety education program and community and environmental interventions (group 1). Another area received only the school based road safety education program (group 2). The third area did not receive the school based road safety education program and no community and environmental interventions, rather they received health education and nutrition programs that contained a number of road safety related activities (group 3 – comparison group). The school based road safety
education program was given to the two schools during three terms of the three years the study was undertaken. Features of the education program included: three 40-minute lessons at the beginning of the first three school terms; and pedestrian knowledge and skills were taught in classroom and real road environments. Parents were encouraged to take an active part in the program. At the commencement of each year of the study teachers were involved a half-day in-service and additional written information was provided to them throughout the year.

In the study reported by Cross et al. (2000) and Stevenson et al. (1999) subjects were allocated to one of the three groups. The study was designed to follow a cohort of six-year old children for a three-year period. Initially the study consisted of 2356 children, with a 30% attrition rate over the three years. Over the three-year period the attrition rate for each group was similar. Prior to the commencement of the study and at yearly intervals over the three years, subjects completed a questionnaire. Questions related to subjects’ knowledge of pedestrian safety, whether and how they played on or near the road, how they crossed the road, and road safety knowledge and skills they had acquired from their parents. Due to the younger children having limited reading skills, trained administrators read the questions aloud to the subjects. A research staff member followed the subjects and unobtrusively observed and recorded their pedestrian behaviour. Following the observation session the researcher asked the subject two additional questions for the purpose of clarifying adult accompaniment with the child as a pedestrian and when crossing the road. Baseline and three post-test observations were recorded of subjects’ pedestrian behaviour.

Irrespective of the group allocation, over the three year period statistically there was no significant difference in subjects’ pedestrian safety knowledge \( (p=0.084) \) (Cross et al. 1999:184). However, more group 1 and 2 subjects than those in group 3 were observed crossing the road with an adult with the difference being statistically significant \( (p=0.013) \) (Cross et al. 1999:184). In addition, more group 1 and 2 subjects than those in group 3 refrained from playing near the road with the difference being statistically significant \( (p=0.000) \) (Cross et al. 1999:184). These findings indicate that children’s pedestrian behaviour but not knowledge benefited
from the specialised road safety education program and community and environmental interventions (Cross et al. 1999).

Overall, this study has provided a benchmark for future studies pertaining to child pedestrian knowledge and skills. However, although observers received instruction on child pedestrian behavioural skills and based on video scenarios inter-rater reliability was established, the study would have been further enhanced if subjects' pedestrian behaviour were unobtrusively video recorded and then analysed. Although the authors refer to four observation periods, namely, baseline and post 1995, 1996 and 1997, no information is provided as to how soon after receiving the road safety education program were the observation sessions undertaken. Stevenson et al. (2000) and Cross et al. (1999) are to be commended for their frequent reference to and reinforcement of ethical procedures undertaken throughout the research.

In summary, the literature indicates a diversity of opinion about the effectiveness of road safety education programs. Education programs have been successful in increasing children's knowledge of pedestrian safety, in particular elements of road crossing (Stevenson et al. 2000; Cross et al. 1999; Penna 1994; Malek et al. 1990; and Maisey 1982). However, it has been found that increased knowledge did not significantly change or influence child pedestrian behaviour, with the overall results being considered discouraging (Stevenson et al. 2000; Cross et al. 1999; Penna 1994; Downing & Spendlove 1981; Malek et al. 1990; and Morris 1972 in Ampofo-Boateng & Thomson 1991). It was reported that the number of children observing for approaching traffic prior to crossing the road had increased as a result of road safety education programs (Rivara & Mueller 1987; and Preusser & Blomberg 1984). Conflicting evidence has been given about the effect of road safety education programs on the number of child pedestrian injuries. In New Zealand, it was found such programs had no effect on child pedestrian injury rates (Roberts, Norton & Hassall 1992), whereas, in Alabama, reduction of pedestrian injuries has been linked to the effectiveness of school road safety education programs (Fortenberry & Brown 1982).
Out and About

The purpose of this research was to examine child pedestrian behaviour, in particular road crossing activities, before and after exposure to the road safety education program Out and About. Therefore, it is appropriate that a summary of the development, design, implementation and evaluation of the program is presented. The assessment of the education program is limited to the second version of the packages designed for pre and primary school children. Information is also drawn from an earlier evaluation of the Out and About primary school package (Rush & Castor 1989, 1988).

The Out and About education package for primary school children was developed for FORS in 1984-1985 with the first version being distributed in 1986 (Castor & Rush 1988). Following the evaluation of the package by Axia Marketing and Social Research, a modified second version was distributed in 1987 with a reprint in 1988. The second version included two children's workbooks, one for six to seven year olds and another for eight to nine year olds (Marsh & Hyde 1990). In 1988, a video was developed for incorporation into the learning package (Marsh & Hyde 1990). An education package structured along the lines of the primary school package was developed for pre-school children, aged four to five years. In 1987 after a trial period, a second version of this package was compiled and distributed in 1988. The pre and primary school packages were distributed free of charge.

Aims of the program are described as: ‘... to alert children to the dangers they face as road users, and to encourage them to learn and practise safe road behaviour’ (FORS 1988a:4). Programs were designed to teach children a broad range of road safety techniques including pedestrian, vehicular and bicycle knowledge, skills and behaviours depending on the child’s age.

Both the pre and primary school packages utilise symbolic Australian animal characters including: Hairy Nosed Wombat, Koala, Marsupial Mouse, Yellow Bellied Glider Possum, Platypus, and Bilby, to depict and reinforce teaching strategies. The content of both learning packages is similar in that they each contain
a teacher's guide/handbook, parents' guide, children's workbook and various posters and stickers.

General information presented at the commencement of the teacher's booklet incorporates: an overview of the program structure; introduction to the animated animals, who are referred to as 'the team'; program aims; information on how to use the package; and recommended strategies to assess children's knowledge, attitude, skills and behaviours based on specific objectives. Suggested teaching methods include: integrating the program with other curriculum subjects, utilising classroom instruction and outdoor practical activities, having children practice road safety skills in real traffic situations under adult supervision, and involving parents in the teaching process. Teachers are reminded of children's limitations as pedestrians, bicycle riders and vehicle occupants. The teacher's guide provides a cross reference to related activities in the children's workbook.

The parents' guide outlines how children's immaturity and lack of understanding contributes to their vulnerability in traffic. Salient road safety information is provided and suggestions made as to how parents can assist in the education program either at school, home or in traffic situations.

The programs are divided into four major sections pertaining to road safety: seatbelts, roads, footpaths, and playing. Specific topics addressed in the pre-school package are: need for and correct use of seatbelt, harness or child restraint when travelling in a car; that roads are designed to be used by traffic and are dangerous places for children, especially if they are not supervised by an adult; what to do if an item is on the road; that safe places to play are at school, home and in parks; that unsafe places to play are on or near roads, car parks and driveways; and why footpaths are the safest place to walk and the need to be alert for hazards when walking on a footpath (FORS 1988b).

The Out and About education package has a colourful appearance which is used to advantage, especially to highlight program progression: apricot for level one and green for level two. The following information on the content of the primary school
curriculum is taken directly from the booklet. Level one topics are: walking to and from school, crossing the road at a marked crossing and where there is no marked crossing, playing safely, in the car, and in the country (FORS 1988b). Level two topics are: walking safely, crossing the road, playing safely, using public transport, riding your bike, and responsible behaviour (FORS 1988b).

Pre-school children are not taught road crossing behaviour. This skill is taught to primary school children in level one of the program and reinforced in level two. As road crossing behaviour is a focal point of this research, the concepts and procedures taught to the children are presented below:

1. Stop at the kerb.
2. Look to the right, towards the traffic in the lane that is closest to you. Listen for traffic.
3. Look the other way, to the left.
4. Look to the right again. Keep listening.
5. When there is no traffic, walk quickly, straight across the road.
6. As you cross, keep looking and listening for traffic (FORS 1988b:11, 25).

The language used to convey information is clear, concise, comprehensive and easily understood. Material used to augment the program was professionally developed taking cognizance of the age and level of development of the children for whom it is designed. This is especially so with regard to the workbooks, posters, stickers and video.

FORS commissioned Rush and Castor (1988) to evaluate the Out and About education package. The review involved a survey of Australian primary school teachers to determine how they used the road safety education program in their classes. One hundred and forty five teachers were involved in the study. The study found that although the material had been used with all primary school class levels, the main areas of usage were for classes 1, 2 and 3. The Children’s book was the most used item, followed by the Teacher’s Guide with the Parent’s Guide being the least used item in the education package. Teachers perceived the use of animated animals as a positive aspect of the program. Children were interested in the animals and as a result appeared to comprehend the safety concepts they were promoting.
Material in the education package was predominantly used on a weekly basis. The most common area where teaching occurred was in the classroom. Classroom teaching included utilising activities presented in the Children's workbook, specific and general discussions on road safety, use of the video and poster activities. Outdoor activities such as: walks, practising road crossing, watching for approaching traffic, looking at traffic lights, general bicycle safety, and helmet usage were used by approximately half of the teachers. The time teachers allocated to the Out and About program and the frequency of use conformed with that recommended by Molen et al. (1983).

In summary, the road safety education package Out and About contains material for use by teachers, parents and children. The program aims to alert children to safe and responsible behaviours when in traffic situations. It is designed to be used with preschool and primary school aged children.

**Presence of Other People**

The presence or absence of other people may affect the way children behave. The people likely to have the most affect on children's pedestrian behaviours include adults, another child, children, and road crossing supervisors. A United Kingdom study found that the road crossing behaviour of children was adversely affected when they were accompanied by one or more people and was worst when with an adult (Downing & Spendlove 1981). Child pedestrian injury studies showed that at the time of the injury, one-third of the children was accompanied (Grayson 1975). Children's reliance on the direction of another person was a contributory factor to pedestrian injuries (Grayson 1975). When accompanied by another child or with a group of children, children over 11 years of age stopped and monitored traffic situations less often than when unaccompanied (Molen 1981). Studies have shown that children use roads for recreational purposes, thus putting them at risk for incurring a pedestrian injury (Stevenson et al. 1992; Lindqvist 1991; Aylward & O'Connor 1987; Christoffel, Schofer, Jovanis, Brandt, White & Tanz 1986; Chapman, Sheehy, Foot & Wade in Foot, Chapman & Wade 1981; Chapman, Foot & Wade in Osborne & Levis 1980; and Sandels 1975). Children's lack of compliance to elements of road crossing behaviours at supervised crossing sites
prompted Yeaton and Bailey (1978) to recommend road crossing supervisors take an active role in children's road safety education programs. The influence adults have on the behaviour of child pedestrians will be examined in the following sub-section of this literature review.

**Adults**

Roberts (1995) indicated that child pedestrians, accompanied by an adult, have a lower risk of incurring an injury. Pettit (1996) discussed the effects of adult patterns of behaviour on parent-child interactions. The authoritative style was perceived to be conducive to child pedestrian education. The authoritative style of parenting is described as recognising children's developmental needs and interests, and encouraging personal and cognitive growth. This is achieved through the creation of a warm and caring environment, explaining situations, reasoning with the child, listening to the child's point of view whilst still maintaining a high level of control (Pettit 1996; Cole & Cole 1989; and Goldhaber 1986). Although this style of parenting lends itself to instilling in children the relevance of rules and regulation, it has little effect if parents themselves do not conform to the standards they expect from their children.

It has been shown that adults are generally poor role models and allow young children to function independently in traffic. Various studies have been conducted to determine the influence adults have on child pedestrian behaviour (Molen 1983; Molen et al. 1983; Chapman, Sheehy, Foot & Wade 1981; Sandels 1975; and Read et al. 1963). Based on numerous observation sessions of child and adult pedestrians, it was concluded that parents often provide bad examples for their children (Sandels 1975). It was observed that parents: regularly omitted to stop prior to crossing the road, crossed when traffic was approaching, crossed the road at an angle, and frequently did not cross within the bounds of a pedestrian crossing (Sandels 1975). Chapman et al. (1981) supported and elaborated on the views expressed by Sandels (1975) as follows:

> Characteristically, adults cross at an angle and they usually assess gaps in traffic while walking along the pavement. They tend to
turn towards the kerb when they anticipate that a suitable gap is about to appear. In order to maximize gaps between vehicles, they often start crossing while a vehicle is passing or is about to pass. Sometimes they set out to cross a congested road in two or more stages, often in a zig-zag manner; and occasionally, when traffic is dense but still moving, they may resort to walking for a short distance down the middle of the road. It is obvious that for a child to attempt such sophisticated interactions with traffic would be exceedingly dangerous (Chapman et al. 1981:136-137).

The road crossing model utilised by most adults was considered to be unsuitable for children (Chapman et al. 1981).

In their retrospective and concurrent studies concerning child pedestrian injuries, Read et al. (1963) considered the safety consciousness of parents. They found that most parents allowed their children, aged between three and six years, some independence in traffic situations and often permitted children as young as five years to cross the road unsupervised. Nearly half of the parents surveyed were unaware of traffic hazards in their residential area, an example being that a parked vehicle had the potential to be an injury hazard (Read et al. 1963). Approximately two-thirds of children under five years of age travelled to school unaccompanied by an adult (Rothengatter 1984a in Aylward & O’Connor 1987; and Amberg 1979 in Aylward & O’Connor 1987).

Molen (1983) undertook a study of unaccompanied adult pedestrians. In the absence of traffic or when the density of traffic was low, compliance by adults to stopping at the kerbside and monitoring traffic was poor. The conclusion was reached that road crossing behaviour exhibited by adults did not emulate what was taught to children in road safety programs (Molen 1983). A follow-up study was undertaken to observe the behaviour of adult and child pedestrians after they had both been exposed to a road safety education program. In this study it was found that there was an improvement in two road crossing elements: stopping at the kerbside and head movements to observe approaching traffic. It was concluded that following road safety education: ‘... adults set good examples compared to the behaviour of their charges, but that their performance is far from ideal. ... ’ (Molen 1983:193).
Molen and colleagues (1983) conducted another study that involved observing adults and children before and after delivery of a road safety education program. The purpose of the study undertaken was to assess the influence adults had on children's pedestrian behaviour. Prior to the education program, it was observed that adults' behaviour as pedestrians and as reinforcers of safe pedestrian behaviour when they accompanied children was less than satisfactory. Whilst holding a child's hand, an adult did not take the opportunity to instruct the child on the need to monitor traffic. Adults became better role models after road safety education and tended to give more instruction to their children (Molen et al. 1983). These findings supported the earlier research conducted by Molen (1983).

**Children's Crossing Sites**

Designated children's crossing sites are in existence in each Australian State and mainland Territories (Swaminathan 1991). When operational, these crossing sites are clearly marked, for example with flags. The purpose of the crossing sites is to provide children with safer places to cross roads near their school. Most States and the Northern Territory have some form of school crossing supervisor scheme in operation. The recognised criterion for the establishment of supervised crossing sites is based upon vehicle/pedestrian volume per hour. Vehicle/pedestrian volume data is collected an hour before commencement and after conclusion of the school day. The service provided by crossing supervisors can vary from being volunteer, salaried, or part of the role of a full time staff member, for example a Police Officer. Where salaries are paid to crossing supervisors, funds are made available from a government department, local authority or road traffic organisation (Swaminathan 1991). The role of the supervisor is to ensure the safety of children crossing at the designated site. Road crossing supervisors are not involved in teaching on-site pedestrian safety.

The supervisor's role is to assemble the children wishing to cross the road into a group at the kerbside. When there is a break in the level of approaching traffic, the supervisor utilises a double sided 'STOP' sign to control the traffic and signals to the children when to cross the road. When the children have safely crossed the road,
the supervisor then returns to the kerbside. This action signals that the flow of traffic can resume. In the event that the crossing site is on a divided carriageway, a similar two stage process is undertaken, with the children going from kerbside to median strip then median strip to the opposite kerbside (RSCNT 1995). The grouping of children so that they cross the road together and the control of traffic so that the flow is not continually interrupted. This road crossing technique is referred to by the researcher as a *platoon system*, that is, children cross the road in convoy under the supervisor’s orders and protection.

Lack of maturity and problem solving skills may contribute to children incorrectly perceiving themselves to be safe when crossing a road at a designated crossing site (Firth 1975 cited in Russam 1976). Analysis of pedestrian injuries that occurred in Stuttgart, Germany, showed that approximately one-third of child pedestrian injuries occurred on zebra or at signalised crossings (Wolf 1996). In Perth, Western Australia, ‘... 10% of pedestrian injuries occurred at a site where there was some form of traffic control ... while 3% actually occurred on school crossings’ (Stevenson *et al.* 1992:236). United Kingdom data for 1986 showed that one-fifth of pedestrian injuries occurred within 50 metres of a designated crossing site. It was indicated that the safest place at which to cross a road was at zebra crossings and the most dangerous was adjacent to light controlled crossings (Sabey 1988). No explanation is given for this latter finding however, one possible reason could be that drivers may be concentrating on their approach to the traffic lights and do not expect pedestrians to attempt crossing the road outside the confines of the light controlled area. Pedestrians should be encouraged to observe for approaching traffic when at a signalised crossing (Sabey 1988).

This section of the literature review has highlighted that adults are poor role models for child pedestrians and they appear to be unaware of children’s capabilities and limitations in traffic situations. It is suggested that adults need to reflect on what they can do to prevent pedestrian related injuries occurring to children.
Environmental Factors

Environmental factors are those physical, biological, legal and socio-economical external conditions that can affect the host. In relation to child pedestrian safety, traffic density and vehicular speed can create potential hazardous situations. To address these issues, strategies such as traffic management devices, mandatory speed limits and designated crossing sites have been adopted to afford child pedestrians some degree of protection. Other environmental factors associated with child pedestrian injuries are time of day and day of week. These issues form the basis of this section of the literature review.

Causation analysis of pedestrian injuries detected that two contributing situations were heavy traffic flow and time of occurrence (Molen 1983). Observations of pedestrian behaviour were undertaken when traffic density was low, moderate and high. Low density of traffic was defined as less than one car per minute progressing to high density of more than two cars per minute (Molen 1983). It was observed that children displayed more caution in the presence of high density traffic (Molen 1983). The most common time for child pedestrian injuries was in the afternoon (Durkin et al. 1999) and more specifically between: three and seven p.m. (Stevenson et al. 1992); and three and six p.m. (Pitt et al. 1990). Most injuries occurred after school hours on weekdays, particularly on Fridays (Stevenson et al. 1992; and Fortenberry & Brown 1982), and within half a kilometre of the child’s home (Fortenberry & Brown 1982). In metropolitan Perth, the lowest incidence of child pedestrian injuries occurred in summer, near equal numbers in autumn and spring, and the highest incidence was in winter (Stevenson et al. 1992). This finding is contrary to that of Durkin et al. (1999) who identified that in northern Manhattan the highest incidence of school-aged child pedestrian injuries occurred in summer. Regardless of the season of the year, most injuries occurred in ‘... clear, light and dry conditions’ (Stevenson et al. 1992:236).

Traffic Management Devices

The estimated mean vehicle speed in local Australian streets is between 65-70 kilometres per hour (km/hr) with an 85th percentile speed of 75 km/h (Brindle...
A motor vehicle travelling at 45 miles per hour (mph), that is approximately 75 km/h, which is involved in an injury with a pedestrian, is likely to inflict major injury on the pedestrian in all cases and usually results in the pedestrian's death (Convissor 1995). Mclean, Anderson, Farmer, Lee and Brooks (1994) undertook analysis of 176 fatal pedestrian injuries that occurred in Adelaide, South Australia between 1983 and 1991. It was concluded that reduction of vehicular speed would result in less serious pedestrian injury.

In Dusseldorf, Germany, between January 1993 and March 1995, all pedestrian and cyclist injuries that involved children aged between six and fourteen years and reported to the police were the subject of a study by Kries, Kohne, Bohm and Voss (1998). The purpose of the research was to assess the effect environmental factors had on child pedestrian and cyclist injuries. One of the features of the study was the speed limit in the vicinity of subjects' residential area. Although there were more streets with a speed limit of 30 km/h near control subjects' homes than case subjects, it was found that for every five streets with a speed limit of 30 km/h so the injury risk was reduced by nearly 50%. A possible reason for this finding was that the residential streets with speed limits of 30 km/h appeared to have a lower traffic density than streets with a speed limit of 50 km/h. This finding suggests the need for further research to be undertaken comparing pedestrian-traffic injuries, traffic density and speed limits.

In an endeavour to make the road environment safer for pedestrians, environmental aids have been installed in roadways, especially local streets. These environmental aids are referred to as Local Area Traffic Management (LATM) devices and include: road humps, roundabouts, chicanes, street closures, and route changes (Brindle 1992). An appropriate means of increasing pedestrian safety would be the development of 'sleeping policemen' by raising the height of a pedestrian crossing to footpath level, thus forming a combined road hump and crossing (Hillman undated). The introduction of 'sleeping policemen' would be reassuring to parents of child pedestrians who independently negotiate traffic (Hillman undated). LATM devices have not received uniform public acceptance. Some criticisms of road humps have included: '... discriminate against law-abiding road users ... dangerous
to cyclists and motorcyclists especially when wet ... cause unnecessary wear and tear on vehicles ... waste taxpayers’ money ... makes some motorists more aggressive and impatient ...’ (Brindle 1992:32). An additional disadvantage of LATMs could occur if traffic transfers to another route, for example if drivers choose an alternative route through local streets. Although this route may be quicker, it also puts child pedestrians more at risk especially when they use local streets in residential areas. Since their Australian introduction in the mid 1970s there has been a paucity of evaluation of traffic management devices (Brindle 1992).

**Speed Restrictions**

Reference has already been made to the relationship of speed and pedestrian injuries in Kries et al. (1998); Convissor (1995); Mclean et al. (1994); and Brindle (1992). Speed limit restrictions are in place around most Australian schools. The speed limit, time imposed and area where the restrictions apply vary between States and Territories. In South Australia there is a 25 km/h restriction within 30 metres of a school crossing site. This compares to speed restrictions in zones adjacent to schools in the Australian Capital Territory (ACT) – 40 km/h; and Northern Territory (NT) 40 km/h (RSCNT 1995; and Swaminathan 1991). Although this was the official speed restriction in the NT, as stated in the Methodology Chapter, in reality the speed restrictions varied from 30-60 km/h. In the ACT the speed restrictions are in place between 0800 - 1600 hours on school days, whereas in the NT the time restrictions vary at different school locations (RSCNT 1995; and Swaminathan 1991).

A study of vehicle speed compliance at part time speed restriction zones was undertaken in Victoria, (Uber 1992). It was found that in areas where the part time school speed zone was 60 km/h in a normal 80 km/h speed zone, vehicle speeds were reduced by 13 to 19 km/h. In part time school speed zones of 60 km/h in a normal 100 km/h speed zone, vehicle speeds were reduced by approximately 30 km/h. The overall results from six crossing sites indicated that over half of the vehicles were exceeding the part time school speed limits (Uber 1992). These
findings indicate that where speed restriction measures have been implemented driver compliance rate is poor.

Summary

This literature review has addressed child pedestrian behaviour and road safety education programs, in particular *Out and About*. Health and well being are not determined by a single factor, but rather by the interaction of the host, agent and environment: the epidemiological triad. The literature suggests that prior to designing a road safety education program it is necessary to consider: children’s physical, cognitive and behavioural capabilities and limitation; and the analysis of road crossing tasks. Education programs should include objectives designed to increase the level of children’s pedestrian skills and knowledge so that they function as safe pedestrians. A range of strategies should be utilised when teaching children road safety knowledge and skills, including: verbal explanation, demonstration, positive feedback, and guided practice. It has been argued that road safety education programs should be a compulsory component of the school curriculum and that all programs should be evaluated. Adults were identified as being poor role models for child pedestrians and it was recommended that they should be encouraged to always manifest safe pedestrian behaviours. The need to alert drivers to the presence and unpredictable behaviour of child pedestrians was identified as a priority. When endeavouring to create safe pedestrian environments, children’s capabilities and limitations in traffic situations need to be a primary consideration by road safety authorities, politicians, local planners and the community at large when planning, designing or modifying roadways and imposing speed limits in residential areas. Furthermore, aspects discussed in this literature review provide the basis for the agent, environmental and host hypotheses presented in the Methodology Chapter. In conclusion, the literature indicates that in isolation, road safety education programs designed to increase children’s knowledge and behavioural skills have limited effect.
CHAPTER 3

METHODOLOGY

Details of the methodology undertaken in the study are outlined in this chapter. The chapter is divided into two sections, namely:

1. methodological overview which addresses: Child Pedestrian Safety Model; research questions; hypotheses and rationale; clustering and definition of variables; and characteristics of research design including participating schools and subjects;

and

2. method, namely: unobtrusive structured field observation and associated equipment; teaching of the Out and About program; data collection and analysis; format used for recording analysis; ethical principles and procedures undertaken to gain approval to engage in the research.

Section One: Methodological Overview

Catalysts in the design of this research were epidemiological theoretical concepts and the Out and About road safety education program. To facilitate information attaining to the pedestrian behaviour of children, epidemiological concepts were utilised to develop the child pedestrian safety model. This was achieved by using a quasi-experimental research design in which the dependent variable was change in road crossing behaviour and the independent variable was the Out and About program. The effect of host and agent variables on the children's road crossing behaviour was also investigated using a correlational design.
This section also addresses: determination of subjects and schools involved in the research; mechanism associated with the allocation of control and experimental subjects; and characteristics of the research sample.

**Child Pedestrian Safety Model**

The Child Pedestrian Safety Model was developed based on the epidemiological triad (Figure 3.1). Agent factors include: if child accompanied; hand held; and/or crossing site supervised. In the model, environmental factors include: day of week; time of day; season of year; position child alights from a vehicle parked on roadside furthest from school; traffic density; traffic management devices in place, e.g. chicanes, road humps and/or roundabouts; and speed restrictions in the area. Host factors related to the child's age, gender and attentiveness to the environment, i.e. appeared to be looking for hazards. Agent, environmental and/or host factors were likely to impinge on children's level of compliance to road crossing elements. In addition, it was perceived that the model would provide a suitable framework for investigating the effect the Out and About road safety education program had on the pedestrian behaviour of Darwin primary school children.

Although unsupervised and designated crossing sites can be considered as environmental factors, the findings for them are incorporated within supervised crossing sites and road crossing behavioural elements respectively.

Information about traffic management devices and speed restrictions in the research environment is presented later in this chapter.

**Road Crossing Elements**

The following road crossing elements emanate from the Out and About program. Thus they were used to assess subjects' level of compliance to crossing the road:

(a) refrained from crossing between parked vehicles;
(b) crossed within designated area;
(c) view of approaching traffic not obstructed by vehicle parked on left;
(d) view of approaching traffic not obstructed by vehicle parked on right;
(e) stopped at kerbside prior to crossing the road;
(f) appeared to monitor traffic by moving head prior to crossing the road;
(g) appeared to monitor traffic whilst crossing the road;
(h) crossed the road at walking pace;
and
(i) crossed the road at a right angle to the kerbside, that is, straight.

**Figure 3.1 Child Pedestrian Safety Model**

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**Agent Factors**
- Accompanied
- Handheld
- Supervised crossing site

**Environmental Factors**
- Time of day
- Day of week
- Season of year
- Traffic density
- Traffic management devices
- Speed restrictions
- Position child alights from vehicle parked on roadside furthest from school

**Host Factors**
- Age
- Gender
- Attentiveness to environment

**Out and About Program**

**Road Crossing Behaviour**
Research Questions

The Child Pedestrian Safety Model and road crossing elements provided the framework for investigating the effect the Out and About road safety education program had on the pedestrian behaviour of Darwin primary school children. The following three research questions provided the main focus for the research:

1. To what extent do child pedestrians conform to safe pedestrian behaviours:
   1.1 When first observed, what associated activities are child pedestrians undertaking?
   1.2 Concerning attentiveness to their environment?

2. To what extent do the following agent, environmental and host factors affect children's compliance in relation to road crossing elements:
   2.1 Agent Factors
      2.1.1 Accompanied
      2.1.2 Hand held
      2.1.3 Supervised crossing site
   2.2 Environmental Factors
      2.2.1 Time of day
      2.2.2 Day of week
      2.2.3 Season of year
      2.2.4 Traffic density
      2.2.5 Alight from vehicle parked on roadside furthest from school
   2.3 Host Factors
      2.3.1 Age
2.3.2 Gender
2.3.3 Attentiveness to Environment

3 To what extent does the *Out and About* program affect children's compliance to road crossing elements:

3.1 Agent Factors

3.1.1 Experimental versus Control Subjects

3.2 Host Factors

3.2.1 Experimental versus Control Subjects: Age group
3.2.2 Experimental versus Control Subjects: Gender

**Research Design: Overview**

Prior to discussing the research design, it is acknowledged that any child approaching primary school age may have been introduced to the basic road safety concepts by parents, carers or through the media. Such education could be through direct teaching or by children mentally absorbing pedestrian behaviours of others. These forms of instruction were extraneous variables and a situation which, although not stated, would have been noted by researchers who had previously undertaken evaluation of road safety education programs (Stevenson *et al.* 2000; Cross *et al.* 1999; Penna 1994; Molen 1983; and Sandels 1975). These extraneous variables were not measured in the study, but minimised by including a pre-test and a control group in the design.

The research was exploratory, descriptive, correlational and quasi-experimental in design. That is, it provided an in-depth exploration of child pedestrian behaviour and associated subject and demographic variables as a result of the researcher using field study techniques for data gathering (Foot, Chapman & Wade in Chapman, Wade & Foot 1982). The study consisted of the observer standing in a fixed position and using a video camera to observe primary school children’s pedestrian
behaviour. The study consisted of two groups: control and experimental, that is, subjects who had and had not been exposed to the Out and About program. Observation sessions were conducted once before and twice after subjects in the experimental group had been exposed to the Out and About road safety education program. Similar timelines were utilised for observing control subjects. The relationship of subjects from experimental and control schools, observation sessions and subject's exposure to the Out and About road safety education program is shown in Table 3.1.

Table 3.1 Relationship of experimental and control groups, observation sessions and subjects' exposure to the Out and About road safety education program.

<table>
<thead>
<tr>
<th>Group</th>
<th>Observation 1</th>
<th>Out and About Education Program</th>
<th>Observation 2</th>
<th>Observation 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Experimental</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Control</td>
<td>✓</td>
<td>x</td>
<td>✓</td>
<td>✓</td>
</tr>
</tbody>
</table>

As with much research involving education, it was not possible to randomise the subjects since the researcher had to work with existing groups. Therefore the design was quasi-experimental. In particular, this was due to the nature of the study situation, as the researcher had no control over participating schools or allocation of schools to control and experimental groups. The researcher was advised that if this restriction was not complied with permission to undertake the research would not be forthcoming (Northern Territory Department of Education Adviser, 1994, pers. comm.). The same Senior Departmental Advisor informally told the researcher that research had previously been undertaken within the school system without the Department of Education’s authorisation. Furthermore, prior to publication, the Department was not made aware of the research findings. Hence, the Department
was being very restrictive in permitting research to be undertaken at public schools. The researcher was advised that the schools in the study were reasonably similar to all primary schools located in the greater Darwin area (Northern Territory Department of Education Adviser, 1994, pers. comm.). This information was supported in the findings of a population survey (Australian Bureau of Statistics 1995).

It is acknowledged that information about socio-economic differences may provide valuable information about the way that primary school children interact in traffic situations. However, the researcher was advised that in the greater Darwin area there was no restriction as to the location of the school children attended (Northern Territory Department of Education Adviser, 1994, pers. comm.). At the same time the N T Department of Education Advisor informed the researcher that it was not uncommon for children to be enrolled in a school 20 or more kilometres from their residential address. Informally, this information was supported by a number of School Principals associated with the research. Access to the postal code of subjects' residential address was denied. Therefore, in this research, it was not possible to explore the relationship of socioeconomic factors and pedestrian behaviour of primary school aged children.

The use of control schools would enable comparisons to be drawn between control and experimental subjects. It was expected that the pedestrian behaviour of children in the control group would be relatively constant over each of the three observation sessions, as they had not been exposed to the formal education program. The same procedures would be used for both the control and experimental groups, that is, data would be collected unobtrusively, and as outlined in Table 3.1, involve three distinct observation sessions.

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4 The Senior N T Department of Education Officer refused to be identified by name, rather position.
Figure 3.2 Summary of Research Design

- Agent Variables
- Host Variables
- Environmental Variables

- Compliance to Elements of Road Crossing Behaviours
  - Crossing Score
  - Monitoring Score

- Experimental Group
- Control Group
- Out and About Road Safety Program
- Gender
- Age
- Road Crossing Behaviour:
  - Crossing Score
  - Monitoring Score

- Obs 1
- Obs 2
- Obs 3
Hypotheses – General Related Activities

Based on the preceding research questions and the literature review, the following hypotheses were formulated.

Agent Variables

Hypothesis 1

Accompanied subjects' level of compliance to road crossing elements would be significantly lower than that of unaccompanied subjects.

Rationale for Hypothesis 1

Pettit (1996) and Roberts (1995) indicated that when accompanied by an adult, child pedestrians had a lower risk of incurring an injury. These findings are contrary to those of earlier studies undertaken in the 1970s and 1980s where it was showed that when child pedestrians were accompanied their general pedestrian and road crossing behaviour was adversely affected (Downing & Spendlove 1981; Molen 1981; and Grayson 1975). Based on these latter findings, it is possible that children would devolve responsibility for their safety to the person who is accompanying them.

Hypothesis 2

Subjects whose hand is held would have significantly lower levels of compliance to road crossing elements than that of subjects whose hand is not held.

Rationale for Hypothesis 2

A review of the literature failed to provide any information on the behaviour of child pedestrians who had their hand held. The researcher anticipated that child pedestrians who had their hand held would devolve responsibility for their safety to
the person holding their hand. Therefore, in such a situation the child would take a passive rather than active role in complying to road crossing elements.

Hypothesis 3

Subjects would have significantly lower levels of compliance to road crossing elements at supervised crossing sites than that at unsupervised crossing sites.

Rationale for Hypothesis 3

Concern was expressed by Yeaton and Bailey (1978) at children's lack of compliance to road crossing elements at supervised crossing sites. These authors recommended that road crossing supervisors take an active role in children's road safety education programs. In the Northern Territory, the road crossing supervisor's role has not been broadened to reinforce safe road crossing behaviours to child pedestrians. As a result, it is unlikely that crossing supervisors play an active role in inculcating safe road crossing behaviours in children. Rather, it is likely that at supervised road crossings children devolve the responsibility for their safety to crossing supervisors, especially searching for approaching traffic prior to crossing the road or monitoring traffic whilst they are crossing the road.

Environmental Variables

Hypothesis 4

At morning observation sessions, subjects would have significantly higher levels of compliance to road crossing elements than that at afternoon observation sessions.

Rationale for Hypothesis 4

The most common time that child pedestrian injuries occur is in the afternoons
(Durkin et al. 1999; Stevenson et al. 1992; and Pitt et al. 1990). At the conclusion of the school day it is not unusual for children to leave the classroom talking to their friends or appear eager to leave the school environment. It was thought that after school activities would divert children's attention from performing safe road crossing behaviours. Therefore, it is expected that in the afternoons, children would have lower levels of compliance to safe road crossing behaviours.

Hypothesis 5

At Friday observations, subjects would have significantly lower levels of compliance to road crossing elements than that on Monday to Thursday.

Rationale for Hypothesis 5

Friday was the day when proportionately more child pedestrian injuries occurred (Stevenson et al. 1992; and Fortenberry & Brown 1982). Realisation that Friday is the last school day for the week is likely to override primary school children's ability to concentrate on maintaining safe road crossing behavioural skills. As a result, it was expected that children would have a lower level of compliance to safe road crossing behaviours on a Friday than on Monday to Thursday.

Hypothesis 6

During the Dry Season, subjects would have significantly higher levels of compliance to road crossing elements than that during the Wet Season.

Rationale for Hypothesis 6

In northern Manhattan, the highest incidence of school-aged child pedestrian injuries occurred in summer (Durkin et al. 1999). However, it was reported that regardless of the season of the year, in Perth, Western Australia, most injuries occurred in '... clear, light and dry conditions (Stevenson et al. 1992:236). In a review of the literature, the researcher failed to find any reference to the incidence of pedestrian
injuries occurring during tropical rain. Features of the Wet season are intermittent monsoonal rains and thunderstorms (Fernon 1993). As a resident in a tropical environment for over 25 years she had observed that rain tends to occur suddenly, showers are intense and may last for an indefinite period. In Darwin, during unexpected torrential tropical rain periods, it is not unusual to see pedestrians moving quickly in an attempt to seek shelter.

As the data collection phase included the Wet season it was considered worthwhile to investigate whether inclement tropical weather conditions contributed to any variation in subjects' road crossing behaviour.

Hypothesis 7

When traffic density is heavy, subjects' level of compliance to road crossing behaviour would be significantly higher than when traffic density is classified as other or none.

Rationale for Hypothesis 7

It was observed by Molen (1983) that children displayed more caution in the presence of high density traffic. It therefore seemed logical that regardless of age and maturity, Darwin primary school children would exhibit more care crossing the road when traffic density was heavy.

Hypothesis 8

When a vehicle is parked on the roadside furthest from the school, significantly more subjects would alight from the vehicle kerbside compared to non-kerbside.

Rationale for Hypothesis 8

Persons alighting from a vehicle take up the role of a pedestrian. A review of the
literature failed to find any information on the incidence of children who alighted from a parked vehicle on the roadside furthest from the school. Consequently, prior to crossing the road, it was appropriate to investigate if children alighted from a parked vehicle on the roadside furthest from the school did so on the kerbside or non-kerbside.

**Host Variables**

Hypothesis 9

Older subjects' level of compliance to road crossing elements would be significantly higher than that of younger subjects.

Rationale for Hypothesis 9

As children grow older, their concentration span, comprehension ability and problem solving skills develop (Briem & Bengtsson 2000; Whitebread & Neilson 2000; Durkin *et al.* 1999; Foot *et al.* 1999; Manheimer & Mellinger 1997; Ljungblom & Kohler 1991). Children under the age of 12 years are unable to accurately perceive the interrelatedness of road safety concepts (Whitebread & Neilson 2000; Acredolo 1989; and Herbert 1979). It was expected that cognitive maturation would result in older children being able to function more safely as pedestrians, including adherence to safe road crossing behaviours.

Hypothesis 10

Female subjects' level of compliance to road crossing elements would be significantly higher than that of male subjects.

Rationale for Hypothesis 10

The rate of pedestrian injury for male primary school children is approximately twice that of females of the same age (Stevenson *et al.* 1992; and Routledge *et al.* 1974). Male children under the age of 10-11 years were perceived to be more
impulsive than girls of a similar age, therefore, they were more at risk of being involved in pedestrian-traffic injury (Whitebread & Neilson 2000). This suggests that male subjects would manifest a lower level of compliance to road crossing elements than that of females.

Hypothesis 11

Subjects who appear to be attentive to their immediate environment would have significantly higher levels of compliance to road crossing elements than that of subjects who do not appear to be attentive to their environment.

Rationale for Hypothesis 11

A component of road safety education programs is the need for pedestrians to observe for actual and potential situations in their immediate environment which, if not avoided, may result in injury. Pedestrian hazards include holes in the footpath, objects obstructing the footpath, for example tree branches, hedges obstructing a clear view of other pedestrians and traffic, uneven ground et cetera. A search of the literature failed to find any research related to pedestrians’ attentiveness to their immediate environment. Therefore, similar criteria were used to assess if a subject appeared to be attentive to their environment as searching for approaching traffic prior to crossing the road, that is, subject rotated their head at least 45 degrees to the right and/or left from the midline.

Hypotheses - Out and About Program

In this research, teaching of the Out and About program was an agent factor, whereas subjects’ age group and gender were host factors.

Agent Variables

Hypothesis 12

After exposure to the Out and About program, experimental subjects would
have significantly higher levels of compliance to road crossing elements than that of control subjects.

**Host Variables**

Hypothesis 13

After exposure to the *Out and About* program, 5-7 year old experimental subjects would have significantly higher levels of compliance to road crossing elements than that of 5-7 year old control subjects.

Hypothesis 14

After exposure to the *Out and About* program, 8-10 year old experimental subjects would have significantly higher levels of compliance to road crossing elements than that of 8-10 year old control subjects.

Hypothesis 15

After exposure to the *Out and About* program, 11-13 year old experimental subjects would have significantly higher levels of compliance to road crossing elements than that of 11-13 year old control subjects.

Hypothesis 16

After exposure to the *Out and About* program, male experimental subjects would have significantly higher levels of compliance to road crossing elements than that of male control subjects.

Hypothesis 17

After exposure to the *Out and About* program, female experimental subjects would have significantly higher levels of compliance to road crossing elements than that of female control subjects.
Rationale for Hypotheses 12, 13, 14, 15, 16 and 17.

An individual's ability to retain and recall information is associated with many factors, including: rote or logical memory, short term long term and/or working memory, age, attitude to learning, learning environment, opportunity to use new information, methods of studying, motivation to learn and attitudinal bias (Lefrancois 2000; Biggs & Telfer 1987; Gagne 1985; Kolesnik 1976; and Ausubel and Robinson 1969). Retention of information is also dependent on an individual's attitude to learning, especially the cognitive and affective components. Over a period of time it is not unusual for stored memory to deteriorate (Lefrancois 2000; Biggs & Telfer 1987; and Gagne 1985). Taking these factors into consideration, it could then be expected that after being exposed to new information and skills, subjects' road crossing behaviour would increase initially and then slightly decline over time.

An objective of the road safety program Out and About was to teach children the skills associated with safe pedestrian behaviour including road crossing. Assessment of the effectiveness of the education program would be displayed by an improvement in the road crossing behavioural skills of subjects from experimental schools when they were observed during the second and slightly less at the third observational sessions. It was anticipated that children who did not participate in the road safety program would maintain the same level of compliance to road crossing behavioural skills, over the three observational sessions.

In summary, there was an expectation that, based on age and gender, at the second and third observation sessions subjects exposed to the Out and About program would manifest safer road crossing behaviours than that of subjects not exposed to the program.

**Variables**

Components of the features chosen for the evaluation of child pedestrian behaviour were clustered into host (subject), agent, environmental, and extraneous or
additional variables. Included in host variables were subject’s: age group; gender;
general pedestrian behaviours, for example, attentiveness to environment, that is,
appears to be looking for hazards; and road crossing behaviours. As stated earlier in
this chapter, the Out and About primary school education program was used by the
Field Officer, RSCNT. This program is designed for children between five and
thirteen years of age. The Field Officer delivered the curriculum targeting three age
groups: five to seven, eight to ten and eleven to thirteen years. Therefore, children
involved in this study were divided into these age groups. It was recorded and
notation made of what each subject was doing when first observed. This data was
analysed to identify any relationship between activity and pedestrian behaviour, for
example a subject who was talking whilst walking may have failed to search for
approaching traffic prior to crossing the road.

Agent variables included:

- accompanied;
- hand held;
- presence or absence of road crossing supervisor.

Environmental variables included:

- time of day;
- time of year;
- climatic situation;
- season of year;
- location of stopped vehicle from which child alights or enters;
- amount of passing traffic in vicinity of subject, et cetera.

Extraneous variables were identified to provide more depth to the research. In this
study, extraneous variables included:

- angle at which vehicle parked;
• colour of subjects' clothing; road type within observation area;
• school student population;
and
• demographic features such as, area where subject was located when first observed, for example on a footpath or verge; if subject crossed road; road type within observation area; if subject travelled to or from school in a vehicle; school population; and type of vehicle from which subject entered or alighted.

All participating schools had a designated student uniform. Although it was not compulsory for students to wear the uniform when attending school, it was an expectation. Therefore, subjects who wore school uniform had no control over the colouring of their clothing. Even though the colour of subjects' clothing is not related to pedestrian behaviour, this variable was recorded as variation in colour may have an affect on the wearer's visibility to drivers, for example, dependent on the background, light colours may be easier to see than dark colours.

A vehicle could be parked at the kerbside adjacent to or opposite the school. A driver who parks a vehicle at the kerbside opposite to the school forces a subject to cross the road to get to or from the school. The location of a stopped vehicle from which the subject alights or enters was an environmental variable. However, what the subject did after alighting from a vehicle, for example, moved to kerbside, was a host variable.

The northern part of the N T of Australia has two distinct climatic seasons commonly known as the *Dry* and the *Wet*. The data collection phase of this study traversed both seasons. Therefore, the season of the year was considered to be a variable that could affect child pedestrian behaviour. As the data collection phase was to extend over a six-month period, it was expected that more children would travel by vehicle to and from school during the *Wet* season.

In the greater Darwin area there is minimal variation in sunrise and sunset times between the *Dry* and *Wet* seasons. On average, throughout the year, sunrise is at
0650 hours and sunset is at 1850 hours (April 8, 1998, pers. comm.). Therefore, it was realised that darkness would not be an issue in relation to the time when data was collected.

Criteria used in this study pertaining to traffic density were: more than two vehicles per minute to be classified as heavy; moderate was one vehicle per minute; and light was less than one vehicle per minute (Molen 1983:107). When viewing the video footage to analyse subjects' pedestrian behaviour, the researcher noted if vehicles were moving or temporarily stopped, for example at a crosswalk area or bus stop. When traffic was observed, the density was confirmed using the timer, which appeared on the video footage.

The researcher was aware that all of the schools participating in the study had been operational for four years or longer. Although the positioning of a school in relation to area of land on which it is located and the type of road, which fronted the school, are environmental variables, they were unchangeable. Therefore, for the purpose of this study they were considered to be extraneous variables.

Road crossing behaviour is predominantly a host variable, however, it also comprises agent variables. Tasks associated with road crossing behaviour were clustered together into a separate variable to facilitate analysis of this aspect of subjects' pedestrian behaviour. Road crossing behavioural variables used in this study were, subject: stopped at kerbside, observed for oncoming traffic, moved head and appeared to observe for traffic, crossed within designated area, crossed between parked vehicles, monitored traffic whilst crossing road, crossed road at an angle, and crossed road at a walking pace.

Under normal circumstances, the process to detect presence of traffic involves looking and listening. Listening was unable to be detected using unobtrusive observation techniques. As a result, listening was not incorporated into the elements associated with kerbside drill and monitoring traffic when crossing the road. Head movements are no guarantee that children are searching for approaching traffic

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5 Duty Forecaster, Bureau of Meteorology, Darwin.
(Molen 1983; and Sandels 1975). However, head movements may indicate that children are attempting to behave in a safe manner, so they were incorporated as a variable in this study. A criterion of head rotation of at least 45° from the mid-line was set when determining if children turned their head: when standing at the kerb prior to crossing the road or whilst crossing the road; and being attentive to hazards within their immediate environment.

When drivers reverse vehicles parked at an angle to the kerbside, they may have difficulty in observing children of short stature walking between parked vehicles. Therefore, the angle of the parked vehicle has the potential to create a hazardous situation for child pedestrians. Notation was made of the number of vehicles, which were parked at an angle within subjects’ immediate environment.

**Clustering and Definition of Variables**

For the purpose of this research the following definitions were formulated. Definitions have been grouped according to variable category.

**Agent**

Road safety education program: The road safety education program, which was a focus of this research, namely *Out and About*.

Accompanied: Subject was observed in the company of one or more people.

Held hand: Subject's hand was held by an adult or child.

Supervised crossing site: A designated road crossing site, which was overseen and controlled by another person.

**Environmental**

Area where subject first observed: The precinct where the subject was first observed included: footpath, verge, road, park, school ground,
Climatic conditions: Generalisation was made regarding the weather conditions when observations were undertaken. Terms used to distinguish specific climatic conditions included: sunny; humid; overcast; build-up, that is hot and humid; raining; and thunderstorms.

Day of week: Observations were undertaken on weekdays, that is, Monday to Friday.

Road site where subject crosses:

- **Location:** Notation was made as to whether a subject crossed the road at an intersection, mid-block or T Junction.

- **Road Crossing Site:** Designated crossing site:
  A marked area of road, thus recommending an area at which pedestrians should cross from one side to the other.

- **Non-designated crossing site:** A non-marked area of road at which a may subject cross from one side to the other.

**Supervised crossing site:** A marked area of road, thus recommending an area at which pedestrians should cross from one side to the other, and which is overseen or controlled by another person.

**Unsupervised crossing site:** A road crossing site which is not overseen or controlled by another person.

**Local area traffic management devices:** Environmental aids designed to reduce vehicular speed including: road humps, roundabouts, chicanes, street closures and route changes (Brindle 1992).
Season of year: Observations recorded between July to September were coded as *Dry* season. Observations undertaken between October to December were coded as *Wet* season.

Time of day: Observation times were limited to mornings and afternoons.

Traffic density: The coming and going of traffic within the observation areas were noted. Traffic density was referred to as being either: *heavy*, *other* or *none*. For this study, these terms were defined as: *heavy* - to two or more vehicles observed per minute (Molen 1983); *other* - less than two or more vehicles observed per minute; *none* - no vehicles observed per minute.

Vehicle parked on left of subject obstructing their view of approaching traffic: Notation was made if a vehicle was parked on the left hand side of the road in the area immediately adjacent to where a subject planned to cross the road, thus obstructing the subject's view of traffic approaching from the far side of the road.

Vehicle parked on right of subject obstructing their view of approaching traffic: Notation was made if a vehicle was parked on the right hand side of the road in the area immediately adjacent to where a subject planned to cross the road, thus obstructing the subject's view of traffic approaching from the near side of the road.

**Host**

Age group: To coincide with the Field Officer, RSCNT, delivery of the *Out and About* road safety education program, subjects were allocated to one of three age group categories: A= five to seven years, B= eight to ten years,
and C= eleven to thirteen years. As these age groups traversed the recognised childhood developmental stages, where necessary in the text, the following terms were used to distinguish between the various age groups: young childhood = five to seven years, middle childhood = eight to ten years, and older childhood = eleven to thirteen years.

**Crossed road:**
As part of their pedestrian behaviour, it was noted whether subjects did or did not cross a road.

**Gender:**
Subjects were identified as being either male or female.

**Attentiveness to environment:**
When a subject directed their gaze to observe for any obstacles that may put them at risk of injury, this was referred to as 'attentiveness to environment'. An obstacle could include a tree branch, open gate projecting into pathway, irregularity in path surface et cetera. If the subject rotated their head at least 45° from the midline either right and/or left and appeared to be looking for obstacles in their immediate environment, this was recorded as such.

**General pedestrian behaviours**

**Head movement:**
As it could not be confirmed if subjects looked for hazards and/or traffic, subjects’ head movements were used as a criteria for these variables. If subjects rotated their head at least 45° from the mid-line, they were deemed to have moved their head. Notation was made as to the direction of subject’s head movement(s), for example, right, left and right.

**Subject’s activity at time of initial**
Notation was made of what each subject was doing when first observed, for example: walking, running, skipping,
observation: playing, reading, talking, chasing or retrieving object on road, eating, drinking, walking and wheeling bicycle, walking whilst drinking, walking whilst talking et cetera.

Subject moved to kerbside after alighting from vehicle: After alighting from a vehicle notation was made if the subject moved to the kerbside adjacent to the stationary vehicle.

Road crossing behaviours

Road crossing behaviour: A series of host and environmental variables related to the subject’s task of crossing a road. Although observed separately, these variables were grouped together to form one road crossing behaviour variable which was related to subjects’ behaviour. Elements, which formed this composite variable, are as follows:

Subject stopped at kerbside prior to crossing road: Before crossing a road, if the subject came to a halt on the verge adjacent to the kerbside, this was categorised as stopping at kerbside.

Subject’s view of approaching traffic was not obstructed by parked vehicle on left: Notation was made if there was a vehicle parked on the left of subject thus obstructing subject’s view of approaching traffic.

Subject’s view of approaching traffic was not obstructed by parked vehicle on right: Notation was made if there was a vehicle parked on the right of subject thus obstructing subject’s view of approaching traffic.

Subject observed for traffic prior to crossing: Subject moved their head and appeared to be observing for traffic or displayed no head movement(s). Possible
Subject crossed road within designated area:

Notation was made if subject crossed the road within a designated area, for example Children’s Crossing site.

Subject refrained from crossing road between parked vehicles:
Parked vehicles have the potential to obstruct the pedestrian’s view of approaching traffic. If a pedestrian crosses the road between parked vehicles, it is recommended that they move to the front outside edge of the vehicle and stop to observe for approaching traffic. Therefore it was considered relevant to observe if the subject crossed the road between parked vehicles. If this did occur, notation was made if the subject moved forward and stopped to observe for approaching traffic prior to crossing the road.

Subject monitored traffic whilst crossing road:

Whilst crossing the road, notation was made as to whether a subject appeared to regularly, intermittently or not look for approaching traffic.

Subject’s pace when crossing road:

This referred to the subject’s mode of crossing the road and included: walked, ran, walked and ran, skipped, cycled, skated et cetera.

Angle at which subject crossed road:

If a subject crossed the road at a right angle to the kerbside, this was termed straight; any variation to this line was referred to as angled.

Extraneous

Angle of parked vehicle:

Vehicles were parked either parallel to the kerbside or at a
Colour of clothing: Light clothing referred to soft, pale and bright hued colours, dark clothing lacked light colouration; and mixed

Location of stopped vehicle when subject alighted or entered a vehicle: The vehicle, which a subject alighted from or entered, could be stopped at a range of positions including: car park, roadside closest to school, and roadside opposite school.

Observation Session: A series of three observation sessions were undertaken outside each of the participating schools. Each observation series consisted of at least one morning and afternoon session.

Position where subject alighted from a vehicle: A subject could exit a vehicle from the: left front, right front, left rear, right rear, left side, and back.

Position where subject entered a vehicle: A subject could enter a vehicle at the: left front, right front, left rear, right rear, left side, and back.

Relationship of school to area of land on which it is located: A school could be situated on a full block, mid block or on the corner of a block.

Road type within observation area: Road types were specified as arterial, sub-arterial and local. An arterial road is a main road but not a highway; sub-arterial road connects two arterial roads but is not situated in a residential area; and local road is situated in a residential area.

School codes: Schools participating in the research were allocated a pseudonym and corresponding code number, for example
School population: Student population at the sixteen participating schools ranged from 96 to 592. Within the student population there were two seemingly natural divisions: small-medium (<350) and large (>350).

Type of traffic observed near subject: The types of traffic observed in close proximity to subjects included: cars, utilities, trucks, vans, buses, motor cycles, bicycles, and a mixture of these vehicle types.

Type of vehicle in which subject travelled to or from school: The types of vehicles in which subjects travelled to or from school included: car, van, utility, bus, and motor cycle.

**Participating Schools and Subjects: Experimental and Control Groups**

The RSCNT Field Officer divided all primary schools within the greater Darwin area into two groups. The School Road Safety Education Program was offered to the first group in School Terms 1 and 2, and the second group in Terms 3 and 4. Prior to the conclusion of Term 2, the Field Officer provided the researcher with the names of schools that had participated in the School Road Safety Education Program in the first half of the year. This was to ensure that these schools were excluded from the study, which commenced at the beginning of Term 3. This step was taken to minimise the likelihood of children participating in the study having been exposed to the road safety education program prior to the research being undertaken. There were eighteen primary schools in the greater Darwin area identified as being eligible to participate in the road safety education program in Terms 3 and 4.

The three N T Department of Education Superintendents who oversaw all of the Darwin Primary Schools were advised of the research and informed that the researcher would be approaching Principals of these eighteen schools. Written and verbal permission was sought from each School Principal to discuss aspects of the
research with teachers and School Council members. Principals at two schools did not respond to the researcher’s approach, even though messages were left with a member of each school’s administrative staff on three occasions. Once teaching staff indicated support for the research, arrangements were made for the research to be discussed with members of the School Council. Permission to undertake the research was sought from each School Council either by the researcher or through the School Principal. If the school did not intend to participate in the road safety education program in the second half of the year then permission was sought from the School Council for the researcher to use that school as a Control Group. Schools that chose to participate in the education program formed the Experimental Group.

Teaching Staff and School Council members of the sixteen schools approached endorsed the research and agreed to participate in the study. Consequently, the study involved a total of 16 schools. Thus, the control group schools on average had a slightly larger population than the experimental group schools. This was, however, unavoidable, due to the researcher’s lack of control over the assignment of the schools to the treatment. The control group consisted of six schools which had a total student population of 2466, that is a group average of 411. Ten schools formed the experimental group. This group had a total population of 3550 students, with an overall average of 355 students. The approximate number of children attending the sixteen schools was 6000. Population statistics indicated that there were 7255 children aged five to fourteen years of age residing in the suburban areas where this study was conducted (Australian Bureau of Statistics 1995). Children in this study were between five and thirteen years of age. Table 3.2 outlines the pseudonyms allocated to each participating school, control or experimental status of the school and approximate student population of each one.
Table 3.2 Participating schools forming the experimental and control groups with allocated pseudonyms.

<table>
<thead>
<tr>
<th>Pseudonym of Schools in the Experimental Group</th>
<th>Approximate Student Population</th>
<th>Pseudonym of the Schools in the Control Group</th>
<th>Approximate Student Population</th>
</tr>
</thead>
<tbody>
<tr>
<td>Banksia</td>
<td>514</td>
<td>Pandanus</td>
<td>592</td>
</tr>
<tr>
<td>Hibbertia</td>
<td>506</td>
<td>Livistonia</td>
<td>518</td>
</tr>
<tr>
<td>Heliotropium</td>
<td>492</td>
<td>Calytrix</td>
<td>438</td>
</tr>
<tr>
<td>Melaleuca</td>
<td>402</td>
<td>Cycus</td>
<td>417</td>
</tr>
<tr>
<td>Adonsonia</td>
<td>367</td>
<td>Grevillea</td>
<td>405</td>
</tr>
<tr>
<td>Ficus</td>
<td>271</td>
<td>Leucaena</td>
<td>096</td>
</tr>
<tr>
<td>Gronophyllum</td>
<td>266</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ipomoea</td>
<td>260</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Acacia</td>
<td>257</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Eucalyptus</td>
<td>215</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Characteristics of the Research Sample

A major consideration which needs to be addressed when determining a sample size is that subjects accurately represent the population being studied, that is similarities and dissimilarities (Graziano & Raulin 1993). Factors that limit sample size include: impracticability of studying the whole population, associated costs, time limitations, and lack of accessibility to the population (Roberts & Taylor 1998; Graziano & Raulin 1993; and Treece & Treece 1982). Guidelines used to determine an adequate sample size for this study were time line for obtaining data, accessibility to subjects, and estimated student population. The Field Officer, RSCNT, indicated that students should not be deprived of access to the road safety education program for more than two school terms. In the Northern Territory, terms three and four extended from 18 July to 16 December 1994, with a two-week break at the beginning of October. A decision was made to utilise this time frame. Accessibility to subjects was also linked to the time frame available for data collection. As the
Northern Territory Department of Education rejected access to any demographic information about students, observing children's pedestrian behaviour was limited to their travel to or from school. The maximum observation area was dependent on the magnification capabilities of the video camera. Therefore, observation sites were within 300 to 400 metres of an entrance to each school. As the study involved only one observer, this also contributed to the number of children who could be observed during each observation session. As previously stated, information provided by the Northern Territory Department of Education indicated that the estimated total student population at all the participating schools would be approximately 6000 children. Three observation sessions were held at each school, thus increasing the potential sample size to 18000 children. The sample size was not based on statistical power calculations because there were no reports of similar studies available from which to estimate variances and the multivariate analyses involved in this study made power calculations excessively complex. To minimise the risk of finding non-significant results a conservative estimate was made that the minimum sample size would be approximately 1800 children, aged five to thirteen years. The number of subjects observed in each session was expected to be relatively constant in relation to age group, gender, and experimental and control groups. It was thought that of the subjects observed in the study, adults would accompany more children aged five to seven years compared to other ages.

The study comprised observations of three thousand, one hundred and seventy four child subjects (n=3174), 41% in the control group and 59% in the experimental group. Nearly equal numbers of subjects were observed in each session, that is 32%, 36% and 32%, respectively. Although 3174 subjects were observed, this study represents an excess of 5000 pedestrian activities, since some subjects demonstrated more than one behaviour during the observation. A total of one thousand, eight hundred and twenty seven subjects (n=1827) were observed crossing the road.

As previously stated, as part of the ethical clearance and permission to conduct the research, the NT Department of Education required the researcher to enter into an agreement whereby the researcher would only be provided with the chronological age grouping of subjects. No other information would be provided regarding the development or social background of children observed. Therefore, an assumption
was made that children’s cognitive development would on average be consistent with that expected for their particular age group.

In summary, this section has addressed the development of the Child Pedestrian Safety Model, outlined the research questions and hypotheses; clustered and defined variables associated with the study; process used to determine participating schools and subjects; and indicated that the research was exploratory, descriptive, correlational and quasi-experimental in design.

Section Two: Method

This section focuses on specific methodological aspects associated with the study, namely: structured field observation; characteristics of schools involved in the research; delivery of the Out and About program to Darwin primary school children; process involved in data collection, recording and analysis; and relevant ethical considerations.

Structured Field Observation

Structured field observation was used in this study. It is a method of data collection in which the researcher observes and records events and analyses them according to pre-determined categories. This method of data collection is very appropriate when the researcher is investigating specific behaviours, environmental features, objects, activities or actions (Roberts & Taylor 1998; Kellehear 1993; Roberts & Burke 1989; Foot, Chapman & Wade in Chapman, Wade & Foot 1982). Observations are recorded in a natural setting with the researcher being as unobtrusive as possible. Using this method of data collection, the researcher can record additional descriptive comments about the area, for example, demographic features such as, day of week, time, weather conditions and specific events that occurred. Structured field observation can be covert or overt. Covert refers to situations where subjects are unaware of the researcher’s presence. Overt observation occurs when subjects are aware that the research is being conducted and the researcher is recording observations.
Advantages of unobtrusive structured field observation include: gaining a realistic perspective of group dynamics and behaviour, and identifying unpredictable events and behaviours (Kellehear 1993; Sapsford & Abbott 1992; Roberts & Burke 1989). Unobtrusive observation is perceived to be more: '... likely to provide an estimate of the probability of correct behaviors' (Michon 1981:164). The major disadvantage of unobtrusive structured field observation as a research technique is the length of time taken to gather the relevant information, as it is labour intensive.

Unobtrusive field observation is a method that can be used when the researcher aims to maintain the subject's normal environment (Kellehear 1993; and Brink & Wood 1988). When unobtrusively observing children's pedestrian behaviour, the researcher noted that within minutes of being aware that their behaviour was being observed, children quickly resumed their normal pedestrian behaviour, thus supporting the finding of Molen (1983).

Unobtrusive observation can be combined with a method of data collection referred to as programmed sampling. Programmed sampling is defined as:

... filming according to a predetermined plan – deciding in advance what, where, and when to film (Marshall & Rossman 1989:86).

This method is specifically useful when data is observed to determine if the subject’s behavioural patterns change, for example, before and after exposure to a particular education program, such as pedestrian safety.

In this study, education administrators, school staff, parents and the police were aware of the research. Whilst collecting data, the researcher was prepared to explain the research to those who made enquiries. In fact this situation very rarely arose.

Unobtrusive Observation Utilising Video Recordings

Videotaping is perceived to enhance data recording and to clarify any uncertainties that may occur during the observation period. Advantages of unobtrusive observation using videotaping are the: ability to be selective with regard to what to
record, preservation of the original sequence and duration of actions, and opportunity to be systematic and focussed when analysing the footage (Malin, M. 1994, pers. comm.). A fully automatic camera with zoom lens facilities enables filming to be undertaken at some distance from the subject, thus enhancing unobtrusive observation (Malin 1994; Kellehear 1993). A camera which has an in-built microphone enables relevant information to be recorded at the time of the observation, for example, specific details about the observation site can be noted (Malin 1994).

Additional advantages of the use of videotaping stated by Kellehear (1993) and Marshall and Rossman (1989) were: provides a visual record of the research, and preserves the activity under observation. This form of data collection enables the researcher to revisit footage and re-examine sequences by reversing, replaying and/or pausing the tape so that data can be confirmed or more details recorded. Analysis of the data content can also be undertaken at a convenient time. This is particularly important if the researcher is tired: then the analysis session can be scheduled for another time, thus minimising the potential for error. The material can be re-examined to confirm analytical interpretation of events and the behaviour of those observed. Videotaped footage allows a more complex level of analysis to be undertaken compared to when a paper and pencil type recording system is used to record data. Moreover, the film can be copied, thus ensuring a backup record of the observation session. Videotaping subjects' behaviour makes it possible for the researcher to copy and edit segments of the footage. Another person can use these edited video segments for specific tasks, for example, identify age group to which a subject should be assigned. However, filming using a video camera can give rise to public curiosity. This and the cost of the equipment, including tapes, are the main disadvantages of using videotaping for research purposes (Kellehear 1993).

**Characteristics of the Study Sites**

All schools participating in the research had frontage on at least one arterial road. For the purpose of the study, an arterial road was specified as being a main road but

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6 Lecturer, Faculty of Education, N.T. University
not a highway. Roads adjacent to the schools were designed to accommodate through-traffic. Two-way traffic traversed the roads outside all the schools involved in the study. One road adjacent to Hibbertia school had a central traffic island which separated the two-way traffic. None of the observation sites had intersection traffic lights, signalised cross walks or pedestrian overpasses. Zebra striped street markings were not used to designate any of the road crossing sites. On the road, Children's Crossing sites were designated by marked white lines. Children's Crossings were situated in close proximity to schools involved in the study. Details of Children's Crossings and other traffic control mechanisms including speed control devices, and supervised road crossings specific to this research are presented later in this chapter.

Street parking bays were angled outside Ipomoea school, that is parking was at a 45° angle with the front of the vehicle usually facing the kerb. Parallel parking was available outside all the other schools. Hibbertia and Pandanus schools had angled and parallel street parking areas. A car park facility was situated within the grounds of each school. The opportunity to unobtrusively observe children's pedestrian behaviour in the car park areas was restricted due to the site and layout of the parking bays.

Constants used at each school in the study for the three observations sessions were time of the day and positioning of the video camera. These strategies were used in an attempt to maintain consistency during the observation sessions.

Traffic Control Mechanisms

The safety of young children as they journey to and from school is of concern to a number of Darwin agencies: N T Government through the N T Police, Department of Education, Department of Transport and Works, Darwin City Council, Palmerston Town Council, RSCNT, community residents, and members of Primary School Councils. These agencies and individuals are aware that causes of pedestrian injuries are complex and require numerous intervention strategies to reduce the risk of trauma to young children. Traffic control mechanisms used to protect pedestrians
include: traffic legislation, speed control devices, and supervised road crossings. The interaction of government and non-government agencies and community members forming partnerships working towards promoting a healthy environment is referred to as either the *Healthy Cities Project* (McMurray 1999) or *Healthy City Movement* (Anderson & McFarlane 1996).

During the pilot study phase of the research, an example of community involvement using the *Healthy Cities* model was reflected in the action of residents of two northern suburbs of Darwin. These residents were concerned that numerous vehicles were being driven at high speed through residential streets, thus putting the safety of pedestrians at risk. Residents collaboratively lobbied politicians, local councillors, business and professional groups, the media and education authorities to have the issue addressed. The health promotion actions initiated by the residents were successful. Changes initiated included: reduced speed limits in residential areas, designation of limited-access roads, construction of roundabouts, road humps, and chicanes. The mass media publicised the successful community action. In the time leading up to the main study, the researcher noted that in these particular residential areas there was an obvious police presence in the area to enforce the traffic regulations. *Leucaena* and *Livistonia*, two schools participating in the study under discussion, were located in these suburbs. However, the traffic regulations had been operational for over six months before data was collected in these areas. Therefore, they should not have affected the results of this study. During the data collection phase of the study it was noted that police surveillance in these areas appeared to be comparable to other areas.

Due to the success of this local community action, traffic management devices and speed restrictions in the near vicinity of all participating schools in the main study were noted by the researcher. At participating schools, the number of *Children’s Crossing* sites varied from one to four (Table 3.3).
Table 3.3. Number of *Children’s Crossing* sites at participating schools

<table>
<thead>
<tr>
<th>Number of Schools</th>
<th>Number of Crossing Sites</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>8</td>
<td>2</td>
</tr>
<tr>
<td>4</td>
<td>3</td>
</tr>
<tr>
<td>2</td>
<td>4</td>
</tr>
</tbody>
</table>

There was a paucity of traffic management devices in evidence in the near vicinity of schools. A chicane was outside one school, the roadway in front of four schools was narrowed, and one school had a sleeping policeman incorporated into the Children’s Crossing site.

**Legislation**

The N T Traffic Regulations (1991), specifies that a *Children’s Crossing* is a special form of crossing situated near schools. Cross walk lines are painted on the road from kerbside to kerbside, thus signifying the crossing site. A vehicle stopping line precedes these lines. Children’s Crossings are distinguished by the words Children Crossing on an orange coloured flag which is erected on a red and white kerbside post adjacent to the painted cross walk lines at each side of the road. These crossings are operational only when the flags are in place. Crossing sites are predominantly located away from an intersection, that is, mid-block. The kerbside concrete is not always adjusted to footpath level (mountable kerb). This may create access difficulties, for example, for children wheeling a bicycle or an adult pushing a pram.
At the time the data was collected for this research, N T Traffic Regulations (1991) requirements placed on drivers in relation to operation of Children’s Crossings were:

1. A driver approaching a children’s crossing shall drive at such speed as to be able, where necessary, to stop before reaching that crossing.
2. A driver shall stop before reaching a children’s crossing and shall not cross over or allow any part of the vehicle being driven to enter on that crossing, where-
3. (a) a person is, or is apparently about to enter, on the crossing; or (b) a Stop banner sign is displayed facing the driver; (c) a driver shall not overtake a vehicle which has -
   (a) reduced speed; or
   (b) stopped,


In addition, the N T Traffic Regulations (1991) indicates that it is illegal to park within nine metres of the departure side and eighteen metres of the approach side of a Children’s Crossing (Northern Territory of Australia 1991:46).

School zone speed restrictions are another form of legislation designed to reduce pedestrian injury. At the time of the research a school zone speed restriction of 40 kilometres per hour was operational outside 13 of the participating schools. A 30 kilometres per hour speed restriction was set outside Gronophyllum school. No school zone speed limit was in operation outside Calytrix and Heliotropium schools. The normal speed limit for these areas was in force, namely, 60 kilometres per hour. The time period during which speed restrictions applied varied for the schools in the study, this was to address the variations in time when schools started and completed their day. The earliest time a participating school commenced classes was 0800 hours and the latest was 0830 hours. Conclusion of the school day at the participating schools varied between 1430 and 1500 hours. Time variations in speed restrictions were:

<table>
<thead>
<tr>
<th>Time Segment</th>
<th>Days</th>
<th>Days</th>
<th>Days</th>
<th>Days</th>
</tr>
</thead>
<tbody>
<tr>
<td>7:30 - 9:15 a.m.</td>
<td>2:00 p.m.</td>
<td>4:30 p.m.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>7:30 - 8:30 a.m.</td>
<td>11:00 a.m.</td>
<td>3:00 p.m.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>7:30 - 8:30 a.m.</td>
<td>11:00 a.m.</td>
<td>3:30 p.m.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>7:30 - 8:30 a.m.</td>
<td>2:00 p.m.</td>
<td>3:30 p.m.</td>
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</table>
Speed restrictions were in force at each school when data was collected. Variation in speed restriction times and speed limits was brought to the attention of the Executive Officer, RSCNT. Following the data collection phase of this study, the time periods when speed restrictions applied were standardised and 40 kilometres per hour speed restrictions became operational outside Calytrix and Heliotropium schools.

It was considered that variation in speed restriction times would have no effect on subjects’ general pedestrian behaviours, in particular, road crossing behavioural skills, because the restrictions were in effect when children were travelling to and from their respective school. Different speed limits at three of the sixteen schools was also considered unlikely to affect child pedestrian behaviour, rather driver behaviour. Driver behaviour was not the subject of this study.

**Supervised Crossings**

Children’s Crossings were supervised outside Banksia, Gronophyllum and Livistonia schools. The Assistant Principal at Banksia school advised the researcher that if the pedestrian and vehicular traffic reached a specific level, School Councils could apply to the NT Department of Education for funds to employ a supervisor for the Children’s Crossing. If a Children’s Crossing site is supervised, the school can arrange for the RSCNT to provide on-site education to the crossing supervisor (RSCNT 1991).

**Teaching of the Out and About Program to Darwin Children**

After reviewing the Out and About program, the researcher decided that to gain an increased understanding of the way it was taught, it would be necessary to spend some time with the Darwin Field Officer RSCNT. Increased understanding of the program would be advantageous when revising the study design including frequency and timing for collection of data. In 1993, during the planning stage of the study, the researcher accompanied the Field Officer whilst he provided road safety education to children enrolled at a number of Darwin Primary Schools. These education sessions were held either at the respective primary school or at the
RSCNT Parap Education Centre. Several meetings took place between the researcher and Executive Officer and/or Field Officer, RSCNT. During discussions, the Field Officer stated that cognitive and behavioural learning strategies were the instructional methods he used when teaching the school road safety pedestrian education program. In relation to crossing a road at a marked crossing site, children were required to: outline the purpose of traffic lights; indicate the meaning of the light sequence; identify potentially hazardous situations, for example a stationary bus; look for approaching traffic and to continue monitoring for oncoming traffic until safely across the road; and to explain why they should cross the road away from parked vehicles. The Field Officer used normal everyday language appropriate to the age of the children he was instructing. To emphasise or reinforce a specific point, he also incorporated current events into his teaching, for example press cuttings or photographs of recent child traffic accidents. One example that was used was the then recent death of a young child who without looking dashed out in front of a stopped bus into the path of an oncoming vehicle.

The learning program was designed to promote the storage of information into children’s long-term memory. The Field Officer believed that one way in which this could be achieved in a classroom situation was through the provision of visual imagery and an active learning environment for the children. Using traffic lights as an example, the learning techniques used by the Field Officer can be illustrated as follows. Initially the children were asked to verbally identify and repeat the meaning of the colour sequence of the traffic lights. Correct responses were reinforced by a number of techniques including praise and, giving the child(ren) road safety education stickers or posters. Videos in which a symbolic animal character and/or real-life media or sporting personality reiterated particular road safety behaviour were shown to the children. The Field Officer considered these videos provided children with instructional information and role modelling techniques similar to those described by Rothengatter (1984). Another strategy used to reinforce information was to ask the children to draw a picture of themselves wearing a brightly coloured outfit and standing at the kerbside looking for traffic or to colour-in a picture of a set of traffic lights.
Through negotiation with the relevant school authority, children were invited to attend the RSCNT external simulated street environment centre at suburban Parap, where they could practice road crossing techniques and bicycle safety. Rehearsal of this psychomotor skill aids the encoding of information and transforming it from short to long term memory. What is learned through such a reinforcement process is available for future recall and use by the individual (Lefrancois 2000; and Gagne 1985). The content of the teaching sessions utilised material from the *Out and About* program. The duration of sessions varied with the age of the children and what was being taught. As stated in Chapter 1, classroom teaching sessions tended to be for about 30 minutes per group. On average, outdoor sessions, either at the school or at the Parap Education Centre were approximately 60 minutes for most of the children. These outdoor sessions were mainly focussed on safe bicycle behaviour.

At the time of the research, the aim of the RSCNT education program was to improve child pedestrian safety knowledge, attitudes and behaviours with resulting reduction in unintentional injuries. Although the principles of the road safety education program remained the same, presentation and content varied for different age groups. The Field Officer specified the age groups as early childhood (five to seven years of age), middle primary (eight to ten years of age) and upper primary (eleven to thirteen years of age). These age groups were incorporated into the research design and formed the three subject groups.

**Observation of Child Road Safety Behaviour: Pilot Study**

The researcher carried out a preliminary study to observe the road safety behaviour of school children by means of sitting in a car and/or standing on the verge at various points outside two Darwin primary schools, observing and manually recording the actions of children as they travelled to and from the respective schools. The researcher was informed that the schools chosen for the pilot study reflected similar characteristics as other Darwin Primary Schools (Northern Territory Department of Education School Superintendent, 1994, pers. comm.)\(^7\). One school

\(^7\) NT Department of Education School Superintendent refused to be identified by name, rather position.
had a student population of approximately 450, whilst there were more than 550 students attending the second school. To avoid any possible misinterpretation of the researcher’s motives, she advised the Assistant Principal of each school and a member of the Community Relations section of the N T Police of the observation sessions.

The pilot study consisted of nine observation sessions: five morning sessions were conducted to coincide with children arriving at the schools, and four were undertaken in the afternoons at the end of the school day. It was planned to undertake five afternoon observation sessions but the school involved conducted a sports carnival on the particular day, which incidentally coincided with the last day of term. The morning observation sessions began twenty minutes prior to school commencing and afternoon observation sessions lasted for approximately twenty minutes after conclusion of the school day. With a secondary school located within a comfortable walking distance of both primary schools it was difficult to identify the age group of older children, especially if they were not in uniform. The weather was fine and sunny for each of the observation sessions.

During these sessions there was no restriction in relation to observing children’s behaviours or activities, for example children as pedestrians or cyclists. The pilot study showed that there was great variation in the road safety behaviour of children as they travelled to and from school. Examples of observed pedestrian behaviour included children: looking or not looking for hazards such as driveways, uneven ground, oncoming or reversing traffic; crossing the road at designated crossings and non-designated sites; reading or talking with another person whilst walking; and getting out of a vehicle on the left-hand side, that is kerbside, or the right-hand side, that is traffic side. Behaviours observed in relation to child cyclists included the wearing and non-wearing of helmets; looking or not looking for hazards when riding on the footpath, cycle path or road; and talking and waving whilst riding.

Findings of the pilot study were that: some children arrived at school earlier than the commencement of observation sessions; it was difficult for the researcher to unobtrusively collect fine details of children’s behaviour; and manual recording of
data resulted in a large amount of detail being missed in the observation sessions. The pilot study confirmed that there were many aspects of child road safety, which could be addressed, in the main study. However, to ensure that the research was manageable and to focus on specific behaviours, it was decided to restrict the main study to one aspect of road safety, namely pedestrian ethology. Pedestrian ethology involves the study of pedestrians' behaviour in relation to their normal environment (Molen 1983). Part of this normal environment includes the alighting and/or boarding private and public vehicular transport.

Following informal discussion with some teachers, it was decided that observation periods should commence 30 minutes prior to the beginning of the school day. Based on the pilot study findings and literature, an instrument was designed to aid recording of data. Information recorded on the data collection instrument included: subject number, date of observation, subject's age group, school code, school population, observation session, time of day, day of week, season of year, climatic conditions, observation environment, types and amount of traffic observed near subject, designated street crossing, crossing supervised, subject's gender, colour of subject's clothing, subject accompanied, subject's activity at time of observation, subject crossed road, specific road crossing behaviours, subject travelled in a vehicle, et cetera. A copy of the data collection instrument is presented in Appendix A.

**Data Collection**

Several procedures were used in the process of collecting data. The process included: undertaking a pilot study to visually note children's road safety behaviour, follow-up observation sessions observing children's pedestrian behaviour using video equipment, learning to use the video equipment efficiently, and scheduling for collection of data for the main study. Data collection observation sessions were undertaken outside a number of primary schools located in the greater Darwin area.

**Data Collection Using Videotaping**

As a result of the pilot study, it became obvious to the researcher that the method
used to collect data had to be improved. Arrangements were made to discuss alternative data collection options with Dr Merridy Malin, Lecturer, Faculty of Education, Northern Territory University. Given that videotaping was deemed to be an unobtrusive form of data collection (Kellehear 1993 and Drummond & Ozanne-Smith 1991), a decision was made to use a video camera to tape child pedestrian behaviour. After consultation with Malin (1994, pers. comm.) the following criteria for videotaping were formulated:

- tapes were to be labelled with the pseudonym assigned to the school and the date of filming;
- each tape was to be copied so that there would be a backup of the original data; and
- a written record was to be kept of each school, including the pseudonym assigned to the school, population size, if control or experimental group and date when videotaping was undertaken.

Therefore, in this study, data collection involved unobtrusive observation of subjects in real traffic situations using a ten-magnification zoom lens video camera. Filming was undertaken adjacent to, opposite or within the boundary of participating schools. When close to the school boundary, to facilitate unobtrusive observation, the researcher was positioned adjacent to a tree or other structure, for example, telephone booth.

**Schedule for Data Collection**

The study incorporated a time-series design to measure children's pedestrian behaviour. Each participating school was surveyed on three occasions. Sequencing of the observation sessions at participating schools was at least one week prior to and one week after subjects in the experimental group had participated in the road safety education program. Follow-up observations were done within a five-week period after the conclusion of the education program. The five-week time frame was chosen firstly to identify if children transferred the information into long-term memory and secondly to ensure completion of data collection by the end of the
school year. The acquisition of long-term memory is subject to material being transferred from short-term memory through the processes of rehearsal and coding (Lefrancois 2000 and Biggs & Telfer 1987). However, no timeframe is given for the transfer of material from short to long-term memory (Lefrancois 2000 and Biggs & Telfer 1987). The researcher believed that if children were to encode and store the road safety education concepts into long-term memory and be able to recall information when required; this ability would be manifested within the five-week time frame. Furthermore, if children in the experimental group consistently manifested positive pedestrian behaviour during the third observation session, it was more likely to be the result of the education program rather than developmental and maturational experiences. Observation sessions were undertaken over a similar time frame at the schools that formed the control group.

The Field Officer requested data collection be completed within six months of commencement so that participating schools could have access to the road safety education program after that time.

In consultation with the Principal or nominated contact person from each school, a decision was made regarding the number of filming schedules required for each observation session. Two schools were immediately adjacent to one road, therefore, it was decided that at these schools filming be restricted to one morning and afternoon session for each of the three observation sessions. The remaining schools were located close to more than one road. It was recommended that at these schools each observation session consist of two morning and two afternoon filming sessions. A timetable was developed to undertake videoing of the children arriving and departing from schools involved in the research. Time-tabling arrangements ensured that filming was undertaken prior to children in the experimental group being exposed to the road safety education program and post education observation sessions were scheduled as previously stated. A draft timetable was given to the Principal or nominated contact person at each participating school for comment and/or endorsement. The final schedule for data collection in the main study is presented in Appendix B.
**Data Collection in the Main Study**

Data for the main study was collected between July and December 1994. In consultation with a senior school staff member, specific observation sites were selected at each school. Single and multiple positioning locations were utilised. These positions were defined as:

*Single positioning* is staying put for a period of time so as to gain a greater familiarity with one station. *Multiple positioning* means moving around the setting to observe in different locations (Wilson 1985:380).

Once a site was decided upon, it was recorded to enable the same location to be used in follow-up videotaping sessions. Location details were stated and thus recorded using the video in-built microphone. In addition, when viewing the video footage, details of the observation sites were written in a notebook. This technique was utilised in an attempt to capture on video tape the same children on subsequent observation sessions and to maintain consistency throughout the study.

**Research Equipment**

FORS provided the researcher with a grant, which covered the cost of the video equipment required for the research. Equipment purchased included a *Panasonic NV-A1A* 10 power zoom lens, auto-focus VHS-C, that is Video Home System using Compressed Tape, Movie Camera with in-built microphone, date and time facility, heavy duty back up battery pack, *Optex* carry bag, *Mars* heavy duty VT-67 tripod and a supply of compressed and full VHS tapes.

**Learning to use the Video Equipment**

Initially the researcher had basic skills in the use of videotaping and related activities. However, after the equipment was purchased, she further refined these skills. This was achieved by: practising using the video equipment in a variety of settings; copying video tapes; and compiling edited film footage in what the researcher termed *cameo shots*, that is the compilation of short video tape segments.
of child pedestrians from the original footage. Cameo shots were used to enable staff members at participating schools to view the edited footage for the purpose of allocating each subject to one of the three age groups used in the research.

**Follow-up Observation Session**

Arrangements were made with the Principal of a school which had been involved in the road safety education program earlier in the year to undertake video filming practice outside the school on July 18 and 19, 1994. This activity proved invaluable to the researcher in that video filming skills were honed. In particular, with the camera mounted on a tripod, it was possible to point the camera in one direction and by using peripheral vision, that is, catching sight of movements at the side, the tripod extension arm could be gradually moved so that the camera lens was slowly rotated. This method further enhanced the unobtrusive observation activity. To the naked eye it would appear that the researcher was looking in a particular direction whilst in effect with the camera pointed in another direction, the behaviour of a child could be followed, often for a prolonged period of time. This technique helped the researcher to identify and discretely capture child pedestrian behaviours.

Videotaping of child pedestrian activities using a ten-magnification zoom lens enabled filming to commence when the child was up to 300 metres away from the researcher. At this distance children’s dress features and general behaviour were visible. When the children were approximately 110 metres from the researcher, facial features were clearly distinguishable. Use of the zoom lens meant that the child was unaware of when filming was initially undertaken. Unobtrusive data collection of child pedestrians, whose behaviour was perceived to be associated with skylarking, was not deleted as such an action may have underestimated the seriousness of the problem. Close-up footage of the child was only recorded so that material could be edited from this section of the footage for the purpose of compiling the cameo shot.

Initially, when videotaping, the researcher endeavoured to capture everything on the video film and this resulted in a mixture of pedestrian activities, which were difficult
to analyse. Therefore, the researcher decided to follow one child or a group of children at a time from a distance to a close-up point. This had the advantage of unobtrusively recording child pedestrian behaviours and utilising close-up footage of subjects for the cameo shots. Thus, by positioning the video camera in a strategic position, the researcher captured typical child pedestrian behaviours. It is interesting to note that initially when children were aware that they were being filmed some skylarking occurred. However, within a very short time, the children’s interest in the researcher diminished. This phenomenon was also experienced in the main study and was similar to that observed by Molen (1983).

Another advantage of undertaking this additional filming was having an independent person comment on the quality of edited footage, which formed the cameo shots. It was recommended that instead of the cameo shots lasting three to five seconds, they be extended to 10-20 seconds duration, with a few seconds of black tape leading into the next shot. It was also suggested that a numbering system specifying each cameo shot be incorporated into the edited footage. The purpose of the numbering system was to make it easier for the staff member(s) to identify the student and assign them to the correct age group category.

Data Analysis

As the RSCNT road safety curriculum is tailored to specific age groups, it seemed appropriate to the researcher to identify child pedestrians by specific age group categories. On the advice of Malin (1994, pers. comm.), it was decided to edit the main footage and assemble short cameo shots of subjects on a separate video tape. Individual cameo shots were restricted in length but were to be of sufficient footage to ensure that the age group of each child could be noted by relevant school personnel.

Editing of Video Footage

The purpose of editing the original video footage was to assemble short segments that showed each research subject. An individual or group of people from the school
that the child attended could then indicate subjects' age groups. All background
sounds and any comments made by the researcher at the time of observation were
edited out. The new footage consisted of a series of silent cameo shots. No positive
or negative behaviours were included in this footage, thus ensuring that each child's
actions remained confidential to the researcher.

Editing, using a Panasonic AG 750 editing system, was undertaken by the researcher
in the Educational Technology Centre at the NT University. The editing system
comprised two video decks, television monitors, and an editing controller. A For A
VTW 400 video typewriter was also used to label and number segments. The
following information describes the method used in editing the cameo shots. The
original VHS tape was inserted into the source deck and a blank tape loaded into the
recording deck. A thirty-minute control track was laid down on the blank tape. This
process enables video segments to be inserted onto the tape, using designated in and
out points, thus ensuring a more stable end product. After putting down thirty
seconds of black colouring at the start of the tape, the number assigned to the school
and observation session number was put onto the tape using the video typewriter.
This was followed by five to ten seconds of black then the number 1, to signify that
the first cameo shot was to follow. The next stage of the process was to view the
original footage and select the section, which was to be copied onto the receiving
tape. Using the edit controller, an input point was set and an outpoint set for
approximately twenty seconds later. Using the editing controller, the selected
footage was then edited onto the receiving tape. This was followed by ten seconds
of black colouring. The next number was recorded, followed by the subsequent
cameo shot. This process was repeated until all cameo shots had been copied onto
the new tape. The editing process was a very time consuming segment of the
research process.

During the editing process the advantage of having a ten-magnification zoom lens
video camera became evident. Considerable length of footage of children's
pedestrian behaviour could be obtained unobtrusively. Only footage of children
who appeared to be unaware that they were being filmed was used in data analysis,
thereby diminishing the Hawthorne Effect. Cameo shots consisted of a reasonable
close-up picture of the child(ren), thus making the task of identifying the subject by age group easier for the nominated school representative(s).

Data Processing

Schools were requested to indicate the age group category of each subject depicted in the cameo shot. To facilitate the process, an *Age Identification Sheet* was developed. At the top of the page was a key that indicated the age groups relevant to the study, a number allocated to the school and observation session number. Coded age groups used in the study were A= five to seven years, B= eight to ten years and C= eleven to thirteen years. The body of the page enabled recording of the following information: cameo number, and a brief description of each subject that included gender and clothing worn. Where appropriate, other identifying information about the subject was included, for example, colours of backpack, position in group and headgear worn. The video tape that contained cameo shots of subjects, an age group identification sheet and covering letter were hand delivered to each school after each season of videotaping had been completed. When advised by a member of the school staff, the researcher collected the completed identification material.

Two video cassette recorders and two television monitors were used to facilitate the data coding process. A video cassette and television monitor were utilised to play the video tape which contained the edited cameo shots whilst the other was employed to view the full video footage. Once the subject was viewed on the edited footage, the researcher then watched the full video footage and recorded the subject’s pedestrian behaviour on the data collection instrument. Use of nominal data was a design feature of the data collection instrument. Therefore, it was relatively easy for the researcher to allocate the numerical value to a specific variable. The researcher was able to review video footage to confirm interpretation of events and behaviours observed.

Events were viewed repeatedly, each time focusing on a different variable or aspect of the subject’s pedestrian behaviour, for example, traffic density, subject’s activity
throughout the observation session, *et cetera*. In addition, footage could be *frozen* and/or re-played so that the child's behaviour was observed in discrete segments. Video tape footage could be replayed as many times as needed until the researcher was satisfied that pedestrian behaviour had been correctly coded. Even though it was a very time consuming process, this repetitive analysis activity was a critical factor in ensuring that child pedestrian behaviour was accurately analysed.

**Data Entry**

A data file was created using *SPSS for Windows* statistical package for the research (Norusis 1998). Variable names were determined. Labels, values and missing values were assigned to these variables.

Once all original footage had been reviewed and subjects’ pedestrian behaviour and other variables noted, nominal data was coded and entered into an *IBM* (International Business Machine) compatible personal computer. In an attempt to minimise entry errors, data was entered twice to verify correctness of entry.

**Initial Data Analysis**

The data typology was nominal or categorical thus facilitating classification; for example, child’s gender, age group or activity at time of observation. Descriptive statistics were used to obtain meaningful information about the data. These statistics included frequency and percentages for each variable. Descriptive quantitative data enabled incidences to be enumerated and cross-tabulated.

Contingency tables were initially used to identify what variables impinged on child pedestrian behaviour. To identify which variables were predictive, a logistic regression was performed. In this step, the dependent variables of road crossing elements were clustered into two variables viz., crossing score and monitoring score. Analysis was then undertaken of these new clustered variables to identify:

- high and low compliance on the crossing score (CS) and monitoring score
(MS) for each independent variable;

and

• which independent variables may have associated with the dependent variable(s) resulting in predicting variables likely to have an adverse effect on child pedestrian road crossing behaviour.

Subsequent Data Analysis

Based on factors outlined in the Child Pedestrian Safety Model, descriptive and inferential statistical analysis of subjects’ pedestrian behaviour was undertaken. Crosstabs, Pearson’s Chi-Square and Fisher’s Exact tests were undertaken to obtain significance levels for nominal data. All reported significance tests were conducted at the 95% level of confidence. Due to the large sample size, if less than 30 or five percent of subjects were observed complying with one or more aspect of the activity at each observation session, for example subject accompanied or alone, the results will not be reported. All results were rounded to the nearest whole number.

Logistic regression analysis was undertaken to measure the level of association between variables. Logistic regression was considered to be an appropriate test for this research because it could test for the relative influence of a number of categorical level variables on subjects’ compliance to road crossing behaviour elements after the latter were recorded to a nominal level variable. It was suitable because it:

• makes no assumption about the distribution of independent variables;

• uses beta weights to determine the strength of variable relationships by a process in which independent variables having the least effect on the dependent variable are deleted at each analytical stage, i.e. backward stepwise elimination, with variables left in the analysis probably having a significant effect;

• identifies whether independent variables do or do not have a significant effect on the dependent variable.
Therefore, logistic regression was used to predict the likelihood specific epidemiological factors had of significantly influencing child pedestrian road crossing behaviour.

Initially, data was analysed in relation to all subjects who were observed crossing a road at the first observation session. This was done as it represented baseline data not affected by the Out and About road safety education program which was used by the RSCNT Field Officer at the time this research was undertaken.

Initial data analysis found that subjects had nearly perfect compliance (98-99%) to three road crossing elements: didn't cross between parked vehicles; view not obstructed by vehicle parked on left; and view not obstructed by vehicle parked on right. They were therefore eliminated from further analysis, as there was no variance to explain. The remaining six road crossing elements divided into two distinct groups, one associated with crossing behaviour and the other with monitoring behaviour. The first group, crossing behaviour, with a compliance score of between 80-90%, addressed the following elements: walked whilst crossing; crossed straight; and crossed within designated area. This cluster of variables was named Crossing Score (CS). The second group, monitoring behaviour, with a compliance score of less than 55%, addressed the following elements: stopped at kerb; head movements; and monitored traffic whilst crossing road. This cluster of variables was named Monitoring Score (MS). Using a 0-3 coding scale, each group was recoded into high and low compliance levels. Within each group, if a subject complied with none or one element his score was coded as low compliance, whereas, if a subject complied with two or three of the elements his score was coded as high compliance. Hypotheses outcomes were tested separately on the CS and MS respectively. It should be noted that the elements grouped to form MS were those that the researcher had previously identified as critical road crossing elements.

According to Wiersma (2000) and Roberts and Taylor (1998), large samples may contribute to analyses identifying small differences as being statistically significant. However, such results are unlikely to be of practical significance. A statement to this effect is made where this appeared to be a possibility.
The Expert Panel

Following discussion between the researcher and her supervisor and co-supervisor, Professor Kay Roberts and Dr. John Condon respectively, a decision was made to undertake an additional level of analysis. Weightings for the behavioural components of road crossing behaviour were to be used so that a comparison could be made between these findings and those related to the Out and About program. The use of a weighting scale for behavioural components of road crossing behaviour was used by Fisk & Cliffe (1975). In their study they provided weightings for some road crossing tasks, but no information was provided on how these scores were determined (Fisk & Cliffe 1975).

An expert panel was formed to consider a number of elements associated with road crossing behaviour, other aspects of child pedestrian behaviour, and compile weightings for road crossing behaviours. The panel comprised police officers, road safety educators, primary school teachers and parents. The panel members were asked to assign a loading score between 1 and 5 on nine pre-determined road crossing elements and to score specific behavioural actions using a range of minus 10 to plus 10. The loading and road crossing behavioural action scores were multiplied, so that specific road crossing behaviours would have a maximum and minimum score of plus and minus 50 respectively, with zero being the neutral point. The minus scores signified unsafe behaviours and the positive scores safe behaviours.

However, the panel allocated a loading of five for each road crossing element except the angle used by a child when crossing. Even though the panel met twice they could not differentiate between values for the other road crossing elements. In effect this implied that the same importance should be assigned to all but one crossing element, which did not allow discrimination between elements and therefore construction of a loading that reflected the importance of the elements. This method of analysis was therefore abandoned. The original classification of compliance/non-compliance was used instead.
**Additional Information**

In this study the researcher intended to focus specifically on children's pedestrian behaviour and analyse these actions based on what is taught in the road safety education program *Out and About*. However, additional observations noted by the researcher during the study will be presented in the result section.

**Ethical Procedures**

As the research in this study crossed a number of different boundaries, ethical clearances were obtained from three different sources. Authorisation to engage in the research under the auspices of the RSCNT was sought and received (Appendix C). Permission to undertake the research, gain access to data, and an ethical clearance were sought from the N T University. A copy of the original research approval and ethics clearance from the University is in Appendix D. Subsequently, annual ethical clearances were sought from and approved by the N T University. As participants in the study were primary school children, consent to proceed with the study was sought and received from the N T Department of Education (Appendix E).

In addition to ethical clearances, special care was taken to safeguard the rights of children. It was indicated by Roberts and Taylor (1998) and Herd (1994, pers. comm.)\(^8\) that with the exception of areas where there is public constraint, for example law courts and art galleries, there is no common law restricting photographing or video filming in a public place such as a street, footpath or park. However, because school staff members, particularly teachers, were needed to identify children's ages, permission to undertake the research was sought from teaching staff at all schools involved in the study. School staff members were advised that to ensure subjects' anonymity and confidentiality age group would be used to code the children. School staff members were also assured that no child would be identified by name. On receipt of approval, School Councils were approached either by the researcher or the School Principal to inform them of the

\(^8\) Senior Lecturer in Law, N T University
proposed research. Council members were reassured that through the use of pseudonyms, coding systems and alphabetic categories for subject age groups the school and subject's anonymity would be maintained at all times. By negotiation between the school administration and the researcher, the school was to identify if it was to be a control or experimental group in the study.

It was suggested that at each participating school the researcher request that information about the proposed research to be included in school newsletters, as this was the most appropriate method of informing parents or caregivers of the research (N T Department of Education, Advisor, 1994, pers. comm.). As no adverse response was received following the dissemination of this information in school newsletters, it was assumed that parents and caregivers had no objection to the research. Occasionally during observation sessions, an adult who was accompanying a child, told the researcher that s/he had read about the research in the local school newsletter, thus confirming the effectiveness of this means of communication.

Access to original research data was restricted to the researcher and academic supervisor. A number that was marked on the outer side of each video tape coded each school. Storage of all original video tape footage was locked in a cupboard within the School of Health Science, at the N T University. For the duration of data analysis, when not in use, back up video tapes and data collection instrument forms were stored in a locked cupboard at the researcher's home.

The study was designed to obtain aggregated data rather than individual data. Subjects were coded by number and assigned to one of three age group categories, namely five to seven, eight to ten and eleven to thirteen years; this was to ensure that their anonymity was maintained.

As a way of ensuring school anonymity, pseudonyms were assigned to each school. The pseudonyms used in the research were given in Table 3.2. A code number was allocated to each of the pseudonyms. It was this code number which appeared on the data collection instrument.
Arrangements were made to provide each participating school, N T Department of Education, FORS, RSCNT, N T Police, relevant local government councils, local members of N T Legislature, and members of the Expert Panel with a copy of preliminary research findings.

In summary, section two addressed structured field observation including unobtrusive data collection; mechanisms utilised to facilitate streamlining data collection; characteristics of the study sites; and the researcher’s attendance at road safety education sessions conducted by the RSCNT Field Officer. The section concludes with an outline of the ethical considerations relevant to this research.

Summary

The research design of this study was exploratory, descriptive, correlational and quasi-experimental. The study involved three observation sessions to observe the behaviour of child pedestrians as they travelled to and from Darwin primary schools. The main independent variable used to analyse subject’s behaviour was exposure or non-exposure to the road safety education program *Out and About*. This process was undertaken to determine the effectiveness of the program. The research methodology utilised in this study was observation utilising videotaping to unobtrusively record the pedestrian behaviour of primary school children. Sixteen Darwin primary schools participated in the research; six formed the control group and the remaining ten were in the experimental group. As the road safety program *Out and About* is tailored to specific age groups, those age groupings were adopted for the study.

Pedestrian behaviours were coded and entered into an *IBM* compatible personal computer and analysed using *SPSS for Windows* statistical package. Comparisons were made between pedestrian behaviours taught in the *Out and About* road safety education program and subject’s pedestrian behaviour depicted on film. The purpose of this was to determine what effect the education program had on children’s pedestrian behaviour.
An expert panel was formed to compile weightings for the components of road crossing behaviour. Comparisons were to be made between these weightings and pedestrian behaviours of subjects in control and experimental schools, as outlined in the *Out and About* program. Due to lack of discrimination between road crossing elements this exercise proved to be ineffectual, and the previous method of analysis was utilised.

Permission to conduct the study and ethical clearances were sought and received from the relevant authorities.
CHAPTER 4

RESULTS

Purposes of Study

The study had three main purposes to describe: the general characteristics of child pedestrians and their surroundings; to identify all subjects' level of compliance to elements of road crossing behaviour, hereafter referred to as 'levels of compliance'; and to investigate the effect the Out and About road safety program had on subjects' level of compliance to road crossing elements.

Consequently, this chapter focuses on the results of the research observation sessions on primary school children's pedestrian behaviour and analysis of the data. The chapter is divided into four sections, namely:

1. agent, demographic, host and general factors associated with child pedestrians;
2. road crossing behaviour of all subjects at the first observation session, that is before exposure to the Out and About road safety education program;
3. road crossing behaviour of control and experimental subjects, the latter group before and after exposure to Out and About;
   and
4. additional factors that may influence child pedestrian behaviour that the researcher noted during the data collection phase of the study.

Due to subjects' almost complete compliance to three road crossing elements, analysis of hypotheses will be based on the compliance score for the remaining six road crossing elements, referred to as overall compliance score (OCS). In addition, subjects' level of compliance will be analysed using satisfactory compliance score (SCS) and unsatisfactory compliance score (UCS), as explained in the Methodology Chapter. In relation to specific hypotheses, the results are not reported if within a variable sub-category fewer than 30 or five percent of subjects were observed at each observation session complying with a component of the activity. Statistically significant results are presented in either detail or tabular form in the body of the
report. Other tables of results are presented in Appendix F. All results have been rounded to the nearest whole number; therefore, in some tables the final percentage scores may have a slight rounding error. The Child Pedestrian Safety Model provided the framework for presentation of findings throughout the chapter.

Section One: Child Pedestrian Agent, Demographic, Host and General Factors

This section is concerned with sample characteristics, epidemiological and general factors associated with child pedestrians and their behaviour. When viewing the video footage, in the event that a child was observed more than once, only the initial observation was analysed. This was because the researcher could not guarantee that each child would be observed at subsequent observation sessions.

Sample Characteristics

The study comprised observations of 3,174 child subjects. Nearly equal numbers of subjects were observed at each session, that is, 32%, 36% and 32% respectively. Although 3174 subjects were observed, this study represents in excess of 5000 pedestrian activities, since some subjects demonstrated more than one behaviour during the observation.

By observation session and age group there was no discernible difference in the colouring of clothes worn by male or female subjects. All the schools involved in the study had a specified student uniform. These uniforms tended to be either light in colour or a mixture of light and dark colours. Most subjects wore their school uniform although this was not compulsory. Half of the subjects (52%) wore light coloured clothing while most of the remainder (42%) wore a mixture of light and dark coloured clothes and hardly any (6%) wore dark coloured clothing.

Agent Factors

In this sub-section an overview is presented pertaining to the number of subjects who were accompanied, had their hand held and crossed the road at a supervised
road crossing site. Three-fifths (61%) of subjects were accompanied by an adult or at least one other child. One quarter (26%) of subjects crossed the road at a supervised crossing site. Over the three observation sessions, very few (6%) of the subjects had their hand held when initially observed. At the first observation session, fewer than five percent of subjects observed had their hand held; therefore, this variable will not be discussed further.

**Environmental Factors**

The environmental variables presented in this section address: precinct where subject first observed; climatic conditions; season of the year; day of the week; time of day; traffic density; and position child alights from vehicle. Children are unlikely to have any control over where a vehicle is parked to allow them to alight or enter. However, information regarding the position from which a child alights from a vehicle parked on the roadside furthest from the school is included in this section.

When first observed, the majority of subjects (53%) were observed on the footpath and one-fifth or fewer were in the school ground (15%), on the verge (13%), road (10%) and park (5%) or vacant block (5%).

Almost equal numbers of subjects were observed in the *Wet* (54%) and *Dry* seasons (46%). The majority (58%) of subjects were observed alighting from a vehicle in the *Wet* compared to two-fifths (42%) in the *Dry* season. As stated earlier, unexpected tropical showers in the *Wet* season may have influenced whether subjects travelled to and from school by vehicle and thus this finding. Equal numbers of subjects crossed the road in the *Dry* (51%) and *Wet* (49%) seasons. Likewise, equal numbers of subjects crossed the road at a designated crossing site in the *Dry* (79%) and *Wet* (77%) seasons. It would appear that some adults guarded against the effect of weather conditions by driving children to school. In the mornings during the *Wet* season there was a slight increase (5%) in the number of subjects who travelled to school in a vehicle. Almost none (<1%) of the observations was undertaken in humid conditions or when it was raining.
Nearly one-third (31%) of the subjects travelled to or from school in a vehicle and were observed either alighting from or entering it (n = 996). The majority (67%) of children travelled in a car and the remaining subjects travelled in the following vehicular types: four-wheel drive (10%), van (9%), utility (7%) and bus (7%). At each observation session, one-quarter (24%) of the subjects travelled in a vehicle. Of the subjects who travelled in a vehicle, approximately three-quarters (77%) alighted from a vehicle in the mornings and the remainder entered a vehicle in the afternoons. The majority (69%) of these subjects alighted from or entered a vehicle that was parked kerbside, adjacent to the school. Of the subjects who alighted from a vehicle parked on the roadside opposite the school, most (86%) exited on the kerbside, with fewer than 30 subjects alighting on the non-kerbside. Hypothesis 8 stated that when a vehicle is parked on the roadside furthest from the school, there will be significantly more subjects alight from the vehicle kerbside compared to non-kerbside. As fewer than 30 subjects alighted on the non-kerbside of a vehicle parked opposite the school, no further analysis was undertaken on this hypothesis.

At the afternoon observation sessions, very few (2%) of the subjects who entered a vehicle were previously observed crossing a road. Of the subjects who travelled in a vehicle, nearly half (43%) were aged 8-10 years, with nearly equal numbers of 5-7 year olds (30%) and 11-13 year olds (27%).

Very few (7%) of the subjects who travelled to or from school were observed entering or exiting a vehicle in a school car park. At the majority of observation sessions, the researcher was not in a position to have a clear vision of the school car park and unobtrusively obtain video footage of subjects' pedestrian behaviour. Therefore, no further analysis was undertaken of subjects entering or exiting a vehicle in a school car park.

Over the three observation sessions, twice as many subjects were observed in the mornings (66%) as the afternoons (34%). It was noted that children tended to arrive at school over a much longer period of time in the morning, whereas, once the school day ended, they quickly dispersed from the school precinct, thus limiting the number of individual observations possible. The number of subjects observed
varied by the day of the week ranging from one-fifth (17%) on a Monday to one-quarter (24%) on a Tuesday. This variation could possibly be related to a number of public holidays occurring on a Monday.

As stated in the Methodology Chapter, Molen's (1983) criteria for traffic density were utilised in this study. Traffic was recorded in the observation area at two-thirds (64%) of all observation sessions. Two-thirds (65%) of the traffic observations were classified as heavy, that is, more than two vehicles per minute. This level of traffic density was generally consistent at all observation sessions. As would be expected in residential areas, cars, including utilities and station wagons, comprised the most frequent type of moving vehicles observed (93%).

**Host Factors**

In this sub-section, data will be presented pertaining to the number of subjects observed in relation to age group and gender. In the study almost half (43%) of the subjects were in the 8-10 year age group, with 5-7 year olds comprising about one-third (30%) and 11-13 year olds approximately one-quarter (27%). These percentages were evenly divided by gender for each age group. The gender balance in the overall study was almost equal, with 48% male and 52% female subjects. These percentages were constant by observation session.

**General Pedestrian Factors**

General pedestrian behaviour addressed two specific subject behaviours: activity at time of initial observation; and if when first observed, subject appeared to be attentive to their immediate environment, that is looking for hazards. The activity of subjects at the time of initial observation varied. However, the most common activities were walking (41%), alighting from a vehicle (24%) and talking whilst walking (22%). Percentages for most of the other observed activities were four percent or fewer per activity: standing, running, walking whilst talking and eating, walking whilst wheeling a bicycle, eating while walking, and walking and playing. Activities which scored fewer than one percent included: reading while walking,
sitting, skipping, playing, talking, eating, drinking while walking, skating, and bouncing a ball while walking. Therefore, no further analysis was undertaken of activities in which there were less than four percent observed. Some subjects were observed undertaking more than one pedestrian activity, for example, alighting from vehicle and crossing road. When initially observed, nearly all subjects (96%) appeared to be looking for hazards within their immediate environment. At each observation, fewer than five percent of subjects did not appear to be attentive to hazards in their immediate environment, therefore, no further analysis of this variable was undertaken. In summary, most subjects were attentive to the environment while engaging in walking and alighting from a vehicle; some were talking while walking.

Based on the Child Pedestrian Safety Model, a succinct summary of sample characteristics, agent, demographic, host and general factors associated with the study has been presented in this section.

Section Two: Road Crossing Behaviour Prior to Out and About Program

This section addresses the road crossing behaviour of all children observed at the first observation round. The first observation session was selected, as it was the road crossing behaviour uncontaminated by experimental subjects’ exposure to the Out and About program. Initially sample characteristics, then agent, environmental and host factors, as outlined in the Child Pedestrian Safety Model, provide the basis of analysis for subjects observed crossing a road. Logistic regression findings are presented, outlining the variables likely to have a detrimental effect on children’s road crossing behaviour. The final component of the section addresses findings for hypotheses related to first observation session findings associated with epidemiological factors and children’s road crossing behaviour.

Sample Characteristics

One-third (33%) of all subjects observed crossing a road did so at the first observation session (n = 597). One-fifth (21%) of the subjects attended schools that
had fewer than 350 students and four-fifths (79%) were from schools with more than 350 students. Approximately equal numbers of subjects were male (53%) and female (47%). About one-quarter of all subjects was in the 5-7 (30%) and 11-13 (27%) year age groups while the majority (43%) were aged 8-10 years. When first observed, about one-half (49%) were walking, approximately one-fifth were either talking whilst walking (18%), alighting from a vehicle (17%) or undertaking some other activity (15%). Nearly all (95%) of the subjects appeared to be looking for hazards in their immediate environment, with fewer than 30 subjects not appearing to be attentive to their immediate environment. Approximately two-thirds (63%) of the subjects were accompanied. Fewer than 30 subjects had their hand held. Three-quarters (74%) of the subjects were observed on Mondays to Thursdays inclusive. Nearly twice as many subjects crossed the road in the mornings (68%) compared to afternoons (32%). Similarly, nearly twice as many subjects were observed crossing the road in the Dry (63%) than Wet (37%) season. One-quarter (25%) of subjects crossed the road at a supervised crossing site. Traffic density was classified as heavy on two-fifths (41%) of occasions when subjects crossed a road.

A summary of the number of subjects observed crossing a road at the first observation session and their percentage compliance to road crossing elements is outlined in Table 4.1.

As discussed in the Methodology Chapter, ideally the sequence of pedestrian behaviour prior to crossing a road can be summarised as: stopping at kerbside, searching for and detecting traffic, evaluating the degree of safety, and deciding on the course of action. If it is deemed safe to cross the road, then while walking straight across the road, the pedestrian looks to the right and left and observes for approaching traffic. To facilitate the analytical process, independent variables were clustered together and described as Road Crossing Behaviours (RCB). For convenience, the following abbreviated titles have been use to describe each of the road crossing elements outlined in the Out and About program:

- didn’t cross between parked vehicles;
- crossed within designated area;
- view not obstructed by vehicle parked on left;
- view not obstructed by vehicle parked on right;
- stopped at kerb;
- head movements;
- monitored traffic whilst crossing road;
- walked whilst crossing;
  and
- crossed straight.

Overall, subjects' compliance to the nine road crossing elements varied: three were very high, three were high and the remaining three were average or lower. In descending order, Table 4.2 depicts subjects' compliance to the road crossing elements at the first observation session.

As stated in the Methodology Chapter, due to almost complete compliance scores, the top three road crossing elements were eliminated from further analysis. The remaining six road crossing elements divided into two distinct groups, one associated with crossing behaviour and the other with monitoring behaviour. The first group, crossing behaviour, with a compliance score of between 80-90%, addressed the following elements: walked whilst crossing; crossed straight; and crossed within designated area. This cluster of variables was named Crossing Score (CS). The second group, monitoring behaviour, with a compliance score of less than 55%, addressed the following elements: stopped at kerb; head movements; and monitored traffic whilst crossing road. This cluster of variables was named Monitoring Score (MS). Using a 0-3 coding scale, each group was re-coded into high and low compliance levels. Within each group, if a subject complied with none or one element his score was coded as low compliance, whereas, if a subject complied with two or three of the elements his score was coded as high compliance. Therefore, in the remainder of this section, discussion of subjects' level of compliance will be measured on CS and MS respectively. Level of compliance was considered high when there was a high percentage of subjects in the high compliance group and conversely low when there was a low percentage of the subjects in the low compliance group.
Table 4.1  Number and compliance of all subjects to epidemiological factors at first road crossing observation session (%)

<table>
<thead>
<tr>
<th>Epidemiological Factors</th>
<th>n</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Agent Factors</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Accompanied</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>374</td>
<td>63</td>
</tr>
<tr>
<td>No</td>
<td>223</td>
<td>37</td>
</tr>
<tr>
<td>Supervised Crossing Site</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>120</td>
<td>25</td>
</tr>
<tr>
<td>No</td>
<td>356</td>
<td>75</td>
</tr>
<tr>
<td>NB 121 subjects crossed road at a non-designated crossing site</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Environmental Factors</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Day of Week</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Monday-Thursday</td>
<td>445</td>
<td>74</td>
</tr>
<tr>
<td>Friday</td>
<td>152</td>
<td>26</td>
</tr>
<tr>
<td>Time of Day</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Morning</td>
<td>407</td>
<td>68</td>
</tr>
<tr>
<td>Afternoon</td>
<td>190</td>
<td>32</td>
</tr>
<tr>
<td>Season of Year</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Wet</td>
<td>221</td>
<td>37</td>
</tr>
<tr>
<td>Dry</td>
<td>376</td>
<td>63</td>
</tr>
<tr>
<td>Traffic Density</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Heavy</td>
<td>246</td>
<td>41</td>
</tr>
<tr>
<td>Other</td>
<td>156</td>
<td>26</td>
</tr>
<tr>
<td>None</td>
<td>192</td>
<td>32</td>
</tr>
<tr>
<td><strong>Host Factors</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Age Group</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5-7 years</td>
<td>177</td>
<td>30</td>
</tr>
<tr>
<td>8-10 years</td>
<td>256</td>
<td>43</td>
</tr>
<tr>
<td>11-13 years</td>
<td>164</td>
<td>27</td>
</tr>
<tr>
<td>Gender</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>318</td>
<td>53</td>
</tr>
<tr>
<td>Female</td>
<td>279</td>
<td>47</td>
</tr>
</tbody>
</table>
There was a much higher proportion of subjects (79%) with a high compliance score for crossing behaviour than monitoring behaviour (22%).

Table 4.2 All subjects’ compliance to all road crossing elements at the first observation session (%)

<table>
<thead>
<tr>
<th>Road Crossing Element</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Didn't cross between parked vehicles</td>
<td>99</td>
</tr>
<tr>
<td>View not obstructed by vehicle parked on left</td>
<td>98</td>
</tr>
<tr>
<td>View not obstructed by vehicle parked on right</td>
<td>98</td>
</tr>
<tr>
<td>Walked whilst crossing</td>
<td>87</td>
</tr>
<tr>
<td>Crossed straight</td>
<td>82</td>
</tr>
<tr>
<td>Crossed within designated area</td>
<td>81</td>
</tr>
<tr>
<td>Stopped at kerb</td>
<td>51</td>
</tr>
<tr>
<td>Head movements</td>
<td>20</td>
</tr>
<tr>
<td>Monitored traffic whilst crossing road</td>
<td>19</td>
</tr>
</tbody>
</table>

**Crossing Behaviour**

Using the epidemiological factors described in the Child Pedestrian Safety Model, subjects’ compliance, as measured on the CS, is presented in this sub-section. A summary of subjects’ level of compliance to individual agent, environmental and host factors is presented in Table 4.3.

**Agent Factors**

The effect of accompaniment and supervised crossing site in relation to subjects’ road crossing behaviour are agent factors presented in this sub-section.
Table 4.3  Summary of subjects’ level of compliance to individual agent, environmental and host factors, as measured on the CS (%)

<table>
<thead>
<tr>
<th>Epidemiological Factors</th>
<th>High Compliance %</th>
<th>$p =$</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Agent Factors</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Accompanied</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>84</td>
<td>0.06</td>
</tr>
<tr>
<td>No</td>
<td>91</td>
<td></td>
</tr>
<tr>
<td>Supervised Crossing Site</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>85</td>
<td>0.71</td>
</tr>
<tr>
<td>No</td>
<td>87</td>
<td></td>
</tr>
<tr>
<td><strong>Environmental Factors</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Time of Day</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Morning</td>
<td>89</td>
<td>0.01</td>
</tr>
<tr>
<td>Afternoon</td>
<td>79</td>
<td></td>
</tr>
<tr>
<td>Day of Week</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Monday-Thursday</td>
<td>89</td>
<td>0.04</td>
</tr>
<tr>
<td>Friday</td>
<td>81</td>
<td></td>
</tr>
<tr>
<td>Season of Year</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Wet</td>
<td>98</td>
<td>0.00</td>
</tr>
<tr>
<td>Dry</td>
<td>80</td>
<td></td>
</tr>
<tr>
<td>Traffic Density</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Heavy</td>
<td>88</td>
<td>0.97</td>
</tr>
<tr>
<td>Other</td>
<td>82</td>
<td></td>
</tr>
<tr>
<td>None</td>
<td>89</td>
<td></td>
</tr>
<tr>
<td><strong>Host Factors</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Age Group</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5-7 years</td>
<td>83</td>
<td>0.40</td>
</tr>
<tr>
<td>8-10 years</td>
<td>88</td>
<td></td>
</tr>
<tr>
<td>11-13 years</td>
<td>87</td>
<td></td>
</tr>
<tr>
<td>Gender</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>83</td>
<td>0.04</td>
</tr>
<tr>
<td>Female</td>
<td>90</td>
<td></td>
</tr>
</tbody>
</table>
Accompaniment

Accompaniment had no significant effect on the CS ($p = 0.06$). Just over four-fifths (84%) of accompanied subjects were in the high compliance group, while nearly all (91%) unaccompanied subjects were. Although this result does not support hypothesis 1, namely that accompanied subjects’ compliance with road crossing behaviour is lower than that of unaccompanied subjects, the finding was of borderline statistical significance thus suggesting some support for the hypothesis.

Supervised Crossing Site

Crossing site had no significant effect on the CS ($p = 0.71$). More than four-fifths of subjects crossing at supervised crossing sites (85%) and unsupervised crossing sites (87%) were in the high compliance group. This result does not indicate that road crossing behaviour is worse at supervised crossing sites (hypothesis 3).

Environmental Factors

Subjects’ level of compliance is assessed in relation to time of day, day of week, season of year and traffic density in this sub-section.

Time of Day

Time of day had a significant effect on the CS ($p = 0.01$). Most (89%) subjects crossing in the morning were in the high compliance group, while four-fifths (79%) of subjects crossing in the afternoon were. This result does support hypothesis 4, that compliance with recommended road crossing behaviour is higher at morning observation sessions.

Day of Week

Day of week had a significant effect on the CS ($p = 0.04$). Most (89%) subjects crossing the road on Monday to Thursday were in the high compliance group, whil
four-fifths (81%) crossing on a Friday were. This result does support hypothesis 5, that compliance with recommended road crossing behaviour is lower on a Friday.

**Season of Year**

Season of year had a significant effect on the CS ($p = 0.00$). Nearly all (98%) subjects crossing the road in the *Wet* season were in the high compliance group, while four-fifths (80%) crossing during the *Dry* season were. This result was opposite to that expected in hypothesis 6, therefore it was not supported.

**Traffic Density**

Traffic density had no significant effect on the CS ($p = 0.97$). Over four-fifths of subjects crossing the road when traffic density was classified as *heavy* (88%); *other* (82%) or *none* (89%) respectively, were in the high compliance group. This result does not support hypothesis 7, that compliance with recommended road crossing behaviour is higher when traffic density is *heavy*.

**Host Factors**

The effect of age group and gender in relation to subjects' road crossing behaviour are host factors presented in this sub-section.

**Age Group**

Age group had no significant effect on the CS ($p = 0.40$). Most subjects aged 8-10 (88%) and 11-13 (87%) years of age were in the high compliance group, while about four-fifths (83%) subjects aged 5-7 years were. This result does not support hypothesis 9, that 11-13 year old subjects' compliance to road crossing behaviour is higher than that of 5-7 and 8-10 year old subjects. However, there was a tendency for older subjects to demonstrate higher compliance than 5-7 year old subjects, thus suggesting some support for the hypothesis.
**Gender**

Gender had a significant effect on the CS \((p = 0.04)\). Nearly all (90%) female subjects were in the high compliance group, while only approximately four-fifths (83%) male subjects were. This result does support hypothesis 10, that female subjects’ compliance with recommended road crossing behaviour is higher than that of male subjects.

In summary, time of day, season of the year and gender had a significant effect on crossing behaviour. A higher proportion of female subjects crossing the road in the morning and the *Wet* season were in the high compliance group for crossing behaviours. Hypotheses supported were: subjects’ crossing the road in the morning had a significantly higher level of compliance than that of subjects’ crossing the road in the afternoon (hypothesis 4); subjects crossing the road on a Friday had a significantly lower level of compliance than that of subjects crossing Monday to Thursday (hypothesis 5); and female subjects had a significantly higher level of compliance than that of male subjects (hypothesis 10). Subjects’ higher level of compliance during the *Wet* season was significantly different than during the *Dry* season; this was opposite to that expected (hypothesis 6).

**Logistic Regression**

Season of year, time of day, gender and day of week were the variables identified as most likely to contribute the most to compliance to the crossing score cluster of variables. The variables remaining in the equation on the sixth step of the backward regression were; season of year, time of day and gender. In the univariate analysis, day of week was statistically significant \((p = 0.04)\). However, after adjustment for the other factors it was eliminated after the fifth step of the backward regression. In descending order, on the fifth step of the backward regression, beta weights, odds-ratio and significance levels for coefficient variables on the CS measurement are in Table 4.4.
Table 4.4  \( \beta \)ta weights, odds-ratio and significance levels for coefficient variables on the CS at the 5th\(^{th} \) backward step

<table>
<thead>
<tr>
<th>Variable</th>
<th>( \beta )</th>
<th>Odds-ratio</th>
<th>( p = )</th>
</tr>
</thead>
<tbody>
<tr>
<td>Season of year</td>
<td>2.35</td>
<td>10.45</td>
<td>0.00</td>
</tr>
<tr>
<td>Time of day</td>
<td>0.73</td>
<td>2.08</td>
<td>0.01</td>
</tr>
<tr>
<td>Gender</td>
<td>-0.58</td>
<td>0.56</td>
<td>0.05</td>
</tr>
<tr>
<td>Day of week</td>
<td>0.37</td>
<td>1.45</td>
<td>0.21</td>
</tr>
</tbody>
</table>

Thus, season of the year had the most predictive influence on crossing behaviour, followed by time of day and gender, while the other variables had little effect. At the sixth step of the backward regression, Wet season (odds-ratio = 10.88), morning (odds-ratio = 2.16) and female gender (odds-ratio = 0.56) were associated with high compliance to CS. Day of week was eliminated at step five of the equation.

In summary, as characterised through the utilisation of logistic regression and subjects’ percentage levels of compliance, as measured on the CS, variables likely to contribute the most to children’s overall compliance were season of the year, time of day and gender. However, it is noted that gender is of borderline significance as a predictor variable.

**Monitoring Behaviour**

Using the epidemiological factors described in the Child Pedestrian Safety Model, subjects’ compliance to monitoring behaviours, as measured on the MS, is presented in this sub-section. A summary of subjects’ level of compliance to individual agent, environmental and host factors is presented in Table 4.5.

**Agent Factors**

The effect of accompaniment and supervised crossing site in relation to subjects’ road crossing behaviour are agent factors presented in this sub-section.
Table 4.5  Summary of subjects’ level of compliance to individual agent, environmental and host factors, as measured on the MS (%)

<table>
<thead>
<tr>
<th>Epidemiological Factors</th>
<th>High Compliance %</th>
<th>( p = )</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Agent Factors</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Accompanied</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>18</td>
<td>0.02</td>
</tr>
<tr>
<td>No</td>
<td>27</td>
<td></td>
</tr>
<tr>
<td>Supervised Crossing Site</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>18</td>
<td>0.39</td>
</tr>
<tr>
<td>No</td>
<td>22</td>
<td></td>
</tr>
<tr>
<td><strong>Environmental Factors</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Time of Day</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Morning</td>
<td>20</td>
<td>0.19</td>
</tr>
<tr>
<td>Afternoon</td>
<td>25</td>
<td></td>
</tr>
<tr>
<td>Day of Week</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Monday-Thursday</td>
<td>21</td>
<td>0.95</td>
</tr>
<tr>
<td>Friday</td>
<td>21</td>
<td></td>
</tr>
<tr>
<td>Season of Year</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Wet</td>
<td>22</td>
<td>0.95</td>
</tr>
<tr>
<td>Dry</td>
<td>21</td>
<td></td>
</tr>
<tr>
<td>Traffic Density</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Heavy</td>
<td>26</td>
<td>0.24</td>
</tr>
<tr>
<td>Other</td>
<td>14</td>
<td></td>
</tr>
<tr>
<td>None</td>
<td>22</td>
<td></td>
</tr>
<tr>
<td><strong>Host Factors</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Age Group</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5-7 years</td>
<td>20</td>
<td>0.15</td>
</tr>
<tr>
<td>8-10 years</td>
<td>18</td>
<td></td>
</tr>
<tr>
<td>11-13 years</td>
<td>28</td>
<td></td>
</tr>
<tr>
<td>Gender</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>19</td>
<td>0.31</td>
</tr>
<tr>
<td>Female</td>
<td>23</td>
<td></td>
</tr>
</tbody>
</table>
**Accompaniment**

Accompaniment did have a significant effect on the MS \( p = 0.02 \). Only approximately one-fifth, (18%) of accompanied subjects were in the high compliance group, but over one-quarter (27%) of unaccompanied subjects were. This result does indicate that accompanied subjects’ compliance with road crossing behaviour is lower than that of unaccompanied subjects (hypothesis 1).

**Supervised Crossing Site**

Crossing site had no significant effect on the MS \( p = 0.39 \). Approximately one-fifth of subjects crossing at supervised crossing sites (18%) and unsupervised crossing sites (22%) respectively, were in the high compliance group. This result does not indicate that road crossing behaviour is worse at supervised crossing sites (hypothesis 3).

**Environmental Factors**

Subjects’ level of compliance is assessed in relation to time of day, day of week, season of year and traffic density in this sub-section.

**Time of Day**

Time of day had no significant effect on the MS \( p = 0.19 \). One-fifth (20%) of subjects crossing in the morning and one-quarter (25%) subjects crossing the road in the afternoon were in the high compliance group. This result does not indicate that road crossing behaviour is worse in the afternoon (hypothesis 4).

**Day of Week**

Day of week had no significant effect on the MS \( p = 0.95 \). Irrespective of whether they crossed the road on Monday to Thursday or Friday, one-fifth (21%) of both subjects were in the high compliance group. This result does not indicate that road crossing behaviour is worse on a Friday (hypothesis 5).
**Season of Year**

Season of year had no significant effect on the MS ($p = 0.95$). One-fifth of subjects crossing the road in the *Wet* (22%) and *Dry* seasons (21%) respectively, were in the high compliance group. This result does not indicate that road crossing behaviour is better during the *Dry* season (hypothesis 6).

**Traffic Density**

Traffic density had no significant effect on the MS ($p = 0.24$). One-quarter (26%) of subjects crossing the road when traffic density was classified as *heavy* were in the high compliance group compared to less than one-fifth (14%) when traffic density was *other* and one-fifth (22%) when traffic density was *none*. This result does not indicate that road crossing behaviour is better when traffic density is *heavy* (hypothesis 7).

**Host Factors**

The effect of age group and gender in relation to subjects’ road crossing behaviour are host factors presented in this sub-section.

**Age Group**

Age group had no significant effect on the MS ($p = 0.15$). One-fifth of subjects aged 5-7 years (20%) and 8-10 years (18%) respectively, were in the high compliance group while nearly one-third (28%) of 11-13 year old subjects were. This result does not indicate that 11-13 year old subjects’ road crossing behaviour is better than that of 5-7 and 8-10 year old subjects (hypothesis 9).

**Gender**

Gender had no significant effect on the MS ($p = 0.31$). Nearly one-quarter (23%) of female subjects were in the high compliance group, while almost one-fifth (19%) male subjects were. This result does not indicate that female subjects’ road crossing behaviour is better than that of male subjects (hypothesis 10).
In summary, only accompaniment had a significant effect on monitoring behaviour. A higher proportion of unaccompanied subjects were in the high compliance group, therefore, hypothesis 1 was supported.

**Logistic Regression**

Accompaniment was the variable identified as likely to contribute the most to high compliance to the monitoring score cluster of variables. In descending order, on the seventh step of the backward regression, beta weights, odds-ratio and significance levels for coefficient variables on the MS measurement are in Table 4.6.

**Table 4.6** Beta weights, odds-ratio and significance levels for coefficient variables on the MS at the 7th backward step

<table>
<thead>
<tr>
<th>Variable</th>
<th>Beta</th>
<th>Odds-ratio</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Accompanied</td>
<td>0.57</td>
<td>1.78</td>
<td>0.01</td>
</tr>
<tr>
<td>Time of day</td>
<td>0.41</td>
<td>1.51</td>
<td>0.09</td>
</tr>
</tbody>
</table>

As measured on the MS, the beta weights indicated that accompaniment and time of day had the most influence on high compliance to road crossing behaviour, while the other variables had little influence. Unaccompanied subjects (odds-ratio = 1.78) were associated with high compliance to MS. However, since time of day was not statistically significant at Step 7 of the logistic regression, accompaniment was the only variable with a significant predictive effect on monitoring behaviour.

Summarising section two, at the first observation session, 597 subjects were observed crossing a road. All subjects exhibited 98-99% compliance to the road crossing elements: didn’t cross between parked vehicles; view not obstructed by vehicle parked on left; and view not obstructed by vehicle parked on right. Consequently, these three elements were eliminated from further analysis. The remaining variables were clustered into two groups, namely: elements in which subjects attained a compliance level between 80-90%; and elements where subjects had a compliance level of less than 55%. Respectively these groups were named:
crossing score (CS), which specifically measured crossing behaviour and monitoring score (MS), which measured specifically monitoring behaviour.

It was identified that being female, and crossing the road during the Wet season, in the morning and on Monday to Thursday were associated with higher compliance to crossing behaviour, as advocated by authorities. It was also found that being unaccompanied was associated with higher compliance to monitoring behaviour, as advocated by authorities.

Section Three: Out and About Road Safety Education Program

This section is concerned with results for control and experimental subjects' compliance to the Out and About road safety education program. First and second and where relevant third observation sessions provided the basis for data analysis. This was because experimental subjects were not exposed to the road safety education program until after the first observation session. The previously described road crossing elements form the analytical framework. As stated in the Methodology Chapter, individual students were not identified, rather the group to which they collectively belonged: control and experimental. Therefore, in this section, the term subject refers to children observed who were in either the control or experimental group. The proportion of subjects whose compliance to road crossing behaviour was within the high and low compliance groups was used to analyse data. Subjects who attained a 2 or 3 on the CS or MS variable, at the first, second or third observation sessions were in the high compliance group for that session, and those who attained 0 or 1 were in the low compliance group. Level of compliance was considered high when control and experimental subjects were in the high compliance group and conversely low when they were in the low compliance group. Where there was a significant difference, that is, \( p < 0.05 \) at the first session, then comparing control and experimental subjects' road crossing behaviour at subsequent observation sessions in the text would not be appropriate. In such situations, change in control and experimental subjects' road crossing behaviour at subsequent observation sessions was analysed. In these circumstances, the change in compliance by control and experimental subjects between the first and second
observation session is reported as: experimental \( p = \); and/or control \( p = \). Results for the third observation session are presented in tabular form in Appendix F.

The effect the *Out and About* program had on the crossing and monitoring behaviours of experimental compared to control subjects forms the basis of hypotheses. Hypotheses specifically relate to age and gender of experimental subjects. Support for hypotheses associated with this section required that at the second observation session experimental subjects would have significantly higher levels of compliance to road crossing behaviours than control subjects would. Therefore, statements pertaining to the effectiveness of the *Out and About* program relate to the second observation significance level. On some of the variables, there was a lack of initial equivalence and in these cases, the hypotheses were investigated by examining the relative amount of change for each group between the first and second observation sessions. Where control subjects’ compliance did not change significantly, but the proportion of experimental subjects with a high compliance score increased to a significance level of \( p =<0.05 \) for the change between observation sessions one and two, the hypothesis was considered to be supported. If the amount of change that occurred between the first and second observation sessions for experimental subjects was between \( p = 0.05 \) and \( p = <0.1 \), this was considered to be indicative of some support for the hypothesis.

The section commences with the presentation of specific data pertaining to control and experimental groups in relation to demographic data associated with epidemiological factors.

**Demographic Data**

Over the three observation sessions 1827 subjects were observed crossing a road \((n=1827)\). Nearly equal numbers of subjects were observed at each observation session, that is 33%, 35% and 32%. Nearly one-half (47%) were in the control group and just over one-half (53%) in the experimental group. Number and percentage of control and experimental subjects crossing the road at each observation session is presented in Table 4.7.
Table 4.7 Control and experimental subjects at each observation session (n & %)

<table>
<thead>
<tr>
<th>Group</th>
<th>Obs Session 1</th>
<th></th>
<th>Obs Session 2</th>
<th></th>
<th>Obs Session 3</th>
<th></th>
<th>Overall Total</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>n</td>
<td>%</td>
<td>n</td>
<td>%</td>
<td>n</td>
<td>%</td>
<td>n</td>
<td>%</td>
</tr>
<tr>
<td>Control</td>
<td>286</td>
<td>16</td>
<td>314</td>
<td>17</td>
<td>256</td>
<td>14</td>
<td>856</td>
<td>47</td>
</tr>
<tr>
<td>Experimental</td>
<td>311</td>
<td>17</td>
<td>329</td>
<td>18</td>
<td>331</td>
<td>18</td>
<td>971</td>
<td>53</td>
</tr>
<tr>
<td>Total</td>
<td>597</td>
<td>33</td>
<td>643</td>
<td>35</td>
<td>587</td>
<td>32</td>
<td>1827</td>
<td>100</td>
</tr>
</tbody>
</table>

At the time of data collection the RSCNT used the *Out and About* program to instruct Darwin primary school students on road safety education, in particular road crossing behaviour. In this study, observation sessions were conducted once before and twice after subjects in the experimental group had been exposed to the education program. It was expected that at the first observation session control and experimental subjects would exhibit comparable road crossing behaviour.

**Control and Experimental Subjects' Compliance to Road Crossing Behaviour**

At the first observation session control and experimental subjects had similar levels of compliance to six of the nine road crossing elements, namely: *didn't cross between parked vehicles*; *crossed within designated area*; *view not obstructed by vehicle parked on left*; *view not obstructed by vehicle parked on right*; *stopped at kerb*; and *walked whilst crossing* (Table F1) in Appendix F. The groups were therefore treated as initially equivalent on these variables. There was no corresponding level of compliance between control and experimental subjects for the remaining elements. Experimental subjects had statistically significantly higher levels of compliance than control subjects to the elements: *head movements* ($p = 0.03$) and *monitored traffic whilst crossing road* ($p = 0.00$) (Table F1) in Appendix F. Whereas, control subjects had a significantly higher level of compliance to the element *crossed straight* than experimental subjects ($p = 0.02$) (Table F1) in Appendix F. The groups were therefore considered non-equivalent on these variables. Control and experimental subjects' compliance to road crossing behaviours at the first, second and third observation sessions respectively, are presented in Table F2 in Appendix F.
A correspondingly very high pattern of compliance for all subjects, as reported earlier in this chapter, was exhibited by control and experimental groups to the elements: didn’t cross between parked vehicles; view not obstructed by vehicle parked on left; and view not obstructed by vehicle parked on right. Therefore, subsequent analysis of control and experimental subjects’ compliance with road crossing behaviour in relation to Out and About, and the age group and gender variables were only measured on the CS and MS.

**Out and About and Crossing Behaviour**

The percentage of control and experimental subjects with a high compliance score for crossing behaviour, as measured on the CS, is presented in this section. Agent factor: exposure to the Out and About program; and host factors: age group and gender, were the variables analysed. It was found that the Out and About program had a negligible demonstrable effect on experimental subjects’ compliance with crossing behaviour. A summary of the percentage of control and experimental subjects with a high compliance score, by agent and host factors, at the first observation session is presented in Table 4.8. At the first observation session a higher proportion of control subjects and male and 11-13 year old control than experimental subjects were in the high compliance group. Therefore, these subjects were not initially equivalent prior to exposure to the Out and About program. As previously stated, where the groups were not initially equivalent, that is, \( p = < 0.05 \), then further analysis of experimental subjects’ change in compliance over time is discussed separately in the text and results presented in tabular form in Appendix F.

**Agent Factor**

At the first observation session, a significantly higher proportion of control than experimental subjects were in the high compliance group \( (p = 0.01) \) (Table 4.9). Thus the groups lacked initial equivalence.

The increase in proportion of subjects in the high compliance group was greater for the experimental group \( (+6, \ p = 0.04) \) than for the control group \( (+2, \ p = 0.23) \)
(Table 4.9). The increase for the experimental group was statistically significant, while that for the control group was not. This supports the hypothesis that road crossing behaviour in the experimental group would increase after exposure to the *Out and About* program (hypothesis 12).

However, the practical importance of such a small improvement is questionable, particularly as the road crossing behaviour of the control group was superior to the experimental group at both observation sessions.

Table 4.8 Summary of control and experimental subjects' levels of compliance at 1st observation session by agent and host factors, as measured on the CS (%)

<table>
<thead>
<tr>
<th>Factor</th>
<th>1st Observation Session</th>
<th>( p = )</th>
</tr>
</thead>
<tbody>
<tr>
<td>Agent Factor</td>
<td>High Compliance %</td>
<td></td>
</tr>
<tr>
<td>Pre Exposure to <em>Out and About</em></td>
<td>Control</td>
<td>Experimental</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Control</td>
<td>82</td>
<td>73</td>
</tr>
<tr>
<td>Experimental</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Host Factors</th>
<th>1st Observation Session</th>
<th>( p = )</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age Group</td>
<td>High Compliance %</td>
<td></td>
</tr>
<tr>
<td>5-7 years</td>
<td>73</td>
<td>69</td>
</tr>
<tr>
<td>8-10 years</td>
<td>85</td>
<td>78</td>
</tr>
<tr>
<td>11-13 years</td>
<td>85</td>
<td>69</td>
</tr>
<tr>
<td>Gender</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>80</td>
<td>70</td>
</tr>
<tr>
<td>Female</td>
<td>84</td>
<td>76</td>
</tr>
</tbody>
</table>
Table 4.9  Control and experimental subjects’ level of compliance as measured on the CS before and after exposure to *Out and About* (%)

<table>
<thead>
<tr>
<th>Group</th>
<th>1st Observation Session High Compliance %</th>
<th>2nd Observation Session High Compliance %</th>
<th>Obs 1→Obs 2 Change %</th>
<th>p  =</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control</td>
<td>82</td>
<td>84</td>
<td>+2</td>
<td>0.23</td>
</tr>
<tr>
<td>Experimental</td>
<td>73</td>
<td>79</td>
<td>+6</td>
<td>0.04</td>
</tr>
<tr>
<td>Control versus Experimental</td>
<td>0.01</td>
<td>0.049</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Host Factors**

In this section, age group and gender are the variables associated with control and experimental subjects’ crossing behaviour.

**Age Groups: Experimental versus Control Subjects**

At first and second observation sessions, findings pertaining to 5-7 year old, 8-10 year old and 11-13 year old experimental and control subjects’ compliance, are presented in this sub-section.

**5-7 Year Olds**

Exposure to the *Out and About* program had no significant effect on 5-7 year old experimental subjects’ crossing behaviour compared to that of control subjects who were not exposed to the program (p = 0.41). The groups were initially equivalent on this variable and did not demonstrate a significant difference at the second observation session. Both groups increased their level of compliance by an equal
amount (11% and 12% respectively) (Table 4.10). This result does not support hypothesis 13, that after exposure to the *Out and About* program, 5-7 year old experimental subjects' compliance with recommended road crossing behaviour would be higher than that of control subjects. The increase for both groups was probably caused by some intervening event.

Table 4.10 5-7 year old control and experimental subjects' level of compliance as measured on the CS before and after exposure to *Out and About* (%)

<table>
<thead>
<tr>
<th>Group</th>
<th>1(^{st}) Observation Session High Compliance</th>
<th>2(^{nd}) Observation Session High Compliance</th>
<th>Obs 1→Obs 2 Change</th>
<th>Obs 1→Obs 2 (p =)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control</td>
<td>73</td>
<td>84</td>
<td>+11</td>
<td>0.07</td>
</tr>
<tr>
<td>Experimental</td>
<td>69</td>
<td>81</td>
<td>+12</td>
<td>0.03</td>
</tr>
<tr>
<td>Control versus Experimental (p =)</td>
<td>0.32</td>
<td>0.41</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

8-10 Year Olds

Exposure to the *Out and About* had no significant effect on 8-10 year old experimental subjects' crossing behaviour compared to that of control subjects who were not exposed to the program \(p = 0.06\). The groups were initially equivalent on this variable and did not demonstrate a significant difference at the second observation session (Table 4.11). This result does not support hypothesis 14, that after exposure to the *Out and About* program, 8-10 year old experimental subjects' compliance with recommended road crossing behaviour would be higher than that of control subjects.
Table 4.11 8-10 year old control and experimental subjects' level of compliance as measured on the CS before and after exposure to Out and About (%)

<table>
<thead>
<tr>
<th>Group</th>
<th>1st Observation Session High Compliance</th>
<th>2nd Observation Session High Compliance</th>
<th>Obs 1→Obs 2 Change</th>
<th>Obs 1→Obs 2 P =</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control</td>
<td>85</td>
<td>85</td>
<td>0</td>
<td>0.55</td>
</tr>
<tr>
<td>Experimental</td>
<td>78</td>
<td>77</td>
<td>-1</td>
<td>0.49</td>
</tr>
<tr>
<td>Control versus Experimental</td>
<td>0.08</td>
<td>0.06</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

11-13 Year Olds

At the first observation session, a significantly higher proportion of 11-13 year old control than experimental subjects were in the high compliance group (p = 0.01) (Table 4.12). Thus the groups lacked initial equivalence.

Although the increase in proportion of subjects in the high compliance group was greater for the experimental group (+10, p = 0.08) than for the control group (-1, p = 0.54) (Table 4.12) it was not statistically significant. This result does not support hypothesis 15, that after exposure to the Out and About program, 11-13 year old experimental subjects' compliance with recommended road crossing behaviour would be significantly higher than that of 11-13 year old control subjects. However, the borderline significance of the 10% improvement in the experimental group, especially in such a large sample, does lend some support for the hypothesis.

Gender: Experimental versus Control Subjects

At first and subsequent observation sessions, findings related to male and female experimental and control subjects’ compliance are presented in this sub-section.
Males

At the first observation session, a significantly higher proportion of male control than experimental subjects were in the high compliance group ($p = 0.04$) (Table 4.13). Thus the groups lacked initial equivalence.

The increase in proportion of subjects in the high compliance group was higher for the control group ($+7, p = 0.09$) than for the control group ($0, p = 0.51$) (Table 4.13). The increase for the experimental group was not significant and did not reach the control groups' initial compliance level. This result does not support hypothesis 16, that after exposure to the Out and About program, male experimental subjects' compliance with recommended road crossing behaviour would be higher than that of male control subjects. However, experimental subjects' 7% improvement, which was of borderline significance, does lend some support for the hypothesis, especially in such a large sample.

Table 4.12 11-13 year old control and experimental subjects' level of compliance as measured on the CS before and after exposure to Out and About (%)

<table>
<thead>
<tr>
<th>Group</th>
<th>1st Observation High Compliance</th>
<th>2nd Observation High Compliance</th>
<th>Obs 1 → Obs 2 Change</th>
<th>Obs 1 → Obs 2 $p =$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control</td>
<td>85</td>
<td>84</td>
<td>-1</td>
<td>0.54</td>
</tr>
<tr>
<td>Experimental</td>
<td>69</td>
<td>79</td>
<td>+10</td>
<td>0.08</td>
</tr>
<tr>
<td>Control versus Experimental $p =$</td>
<td>0.01</td>
<td>0.28</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Table 4.13  Male control and experimental subjects’ level of compliance as measured on the CS before and after exposure to Out and About (%)

<table>
<thead>
<tr>
<th>Group</th>
<th>1st Observation Session High Compliance</th>
<th>2nd Observation Session High Compliance</th>
<th>Obs 1→Obs 2 Change</th>
<th>Obs 1→Obs 2 p =</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control</td>
<td>80</td>
<td>80</td>
<td>0</td>
<td>0.51</td>
</tr>
<tr>
<td>Experimental</td>
<td>70</td>
<td>77</td>
<td>+7</td>
<td>0.09</td>
</tr>
<tr>
<td>Control versus Experimental</td>
<td>0.04</td>
<td>0.30</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Females

Control and experimental groups were initially equivalent on this variable and did not demonstrate a significant difference at the second observation session ($p = 0.05$) (Table 4.14). Exposure to the Out and About program had no significant effect on female experimental subjects’ crossing behaviour compared to male experimental subjects who were not exposed to the program ($p = 0.05$). This result does not support hypothesis 17, that after exposure to the Out and About program, female experimental subjects’ compliance with recommended road crossing behaviour would be higher than that of female control subjects.

In summary, the Out and About road safety program had a statistically significant effect on experimental subjects crossing behaviour (hypothesis 12), although the increased compliance was only 6%. However, none of the other hypotheses concerning host factors were supported, although two were borderline: hypothesis 15 – 11-13 year old experimental subjects’ compliance with road crossing behaviour would be significantly higher than that of 11-13 year old control subjects; and hypothesis 16 – male experimental subjects’ compliance with road crossing behaviour would be higher than that of male control subjects. However, these findings indicate that the Out and About program had a negligible demonstrable
effect on experimental subjects' compliance to the crossing behaviours, as advocated by the authorities.

Table 4.14  Female control and experimental subjects' level of compliance as measured on the CS before and after exposure to *Out and About* (%)

<table>
<thead>
<tr>
<th>Group</th>
<th>1st Observation High Compliance %</th>
<th>2nd Observation High Compliance %</th>
<th>Obs 1→Obs 2 Change %</th>
<th>Obs 1→Obs 2 p =</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control</td>
<td>84</td>
<td>88</td>
<td>+4</td>
<td>0.19</td>
</tr>
<tr>
<td>Experimental</td>
<td>76</td>
<td>81</td>
<td>+5</td>
<td>0.16</td>
</tr>
<tr>
<td>Control versus Experimental p =</td>
<td>0.05</td>
<td>0.05</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Out and About* and Monitoring Behaviour

The percentage of control and experimental subjects with a high compliance score for monitoring behaviour, as measured on the MS, is presented in this section. Agent factor: exposure to the *Out and About* program; and host factors: age group and gender, were the variables analysed. It was found that the *Out and About* program had no demonstrable effect on experimental subjects' level of compliance with monitoring behaviour. A summary of the percentage of control and experimental subjects with a high compliance score by agent and host factors at the first and second observation session is presented in Table 4.15. At the first observation session, a higher proportion of experimental subjects and female experimental subjects than control subjects was in the high compliance group. Therefore, these subjects were not initially equivalent prior to exposure to the *Out and About* program. As previously stated, where the groups were not initially equivalent, that is, $p = < 0.05$, then further analysis of experimental subjects' change in compliance over time is discussed separately in the text and results presented in tabular form in Appendix F.
Table 4.15 Summary of control and experimental subjects' levels of compliance at 1st observation session by agent and host factors, as measured on the MS (%)

<table>
<thead>
<tr>
<th>Factor</th>
<th>1st Observation Session</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>High Compliance %</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Control</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Experimental</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Agent Factor</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Post Exposure to</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Out and About</td>
<td>20</td>
<td>27</td>
<td>0.03</td>
</tr>
<tr>
<td>Host Factors</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Age Group</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5-7 years</td>
<td>19</td>
<td>23</td>
<td>0.32</td>
</tr>
<tr>
<td>8-10 years</td>
<td>18</td>
<td>26</td>
<td>0.08</td>
</tr>
<tr>
<td>11-13 years</td>
<td>25</td>
<td>34</td>
<td>0.15</td>
</tr>
<tr>
<td>Gender</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>19</td>
<td>23</td>
<td>0.21</td>
</tr>
<tr>
<td>Female</td>
<td>22</td>
<td>31</td>
<td>0.04</td>
</tr>
</tbody>
</table>

**Agent Factor**

At the first observation session, a significantly higher proportion of experimental than control subjects were in the high compliance group \((p = 0.03)\) (Table 4.16). Thus, the groups lacked initial equivalence.

The increase in proportion of subjects in the high compliance group was greater for the control group \((+1, p = 0.41)\) than for the experimental group \((-4, p = 0.11)\). However, change in compliance was not statistically significant for either group (Table 4.16). This result does not support hypothesis 12, that after exposure to the *Out and About*, program experimental subjects' compliance with recommended road crossing behaviour would be significantly higher than that of control subjects.
Table 4.16  Control and experimental subjects’ level of compliance as measured on the MS before and after exposure to *Out and About* (%)

<table>
<thead>
<tr>
<th>Group</th>
<th>1st Observation Session High Compliance</th>
<th>2nd Observation Session High Compliance</th>
<th>Obs 1→Obs 2 Change</th>
<th>Obs 1→Obs 2 p =</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control</td>
<td>20</td>
<td>21</td>
<td>+1</td>
<td>0.41</td>
</tr>
<tr>
<td>Experimental</td>
<td>27</td>
<td>23</td>
<td>-4</td>
<td>0.11</td>
</tr>
<tr>
<td>Control versus</td>
<td>0.03</td>
<td>0.40</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Experimental</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Host Factors*

In this section, age group and gender are the variables associated with control and experimental subjects’ monitoring behaviour.

*Age Groups: Experimental versus Control Subjects*

At first and subsequent observation sessions, findings pertaining to 5-7 year old, 8-10 year old and 11-13 year old experimental and control subjects’ compliance are presented in this sub-section.

*5-7 Year Olds*

Exposure to the *Out and About* program had no significant effect on 5-7 year old experimental subjects’ monitoring behaviour compared to that of control subjects who were not exposed to the program (p = 0.35). The groups were initially equivalent on this variable and did not demonstrate a significant difference in
compliance level at the second observation session (Table 4.17). This result does not support hypothesis 13, that after exposure to the *Out and About* program, 5-7 year old experimental subjects' compliance with recommended road crossing behaviour would be higher than that of control subjects.

Table 4.17 5-7 year old control and experimental subjects' level of compliance as measured on the MS before and after exposure to *Out and About* (%)

<table>
<thead>
<tr>
<th>Group</th>
<th>1st Observation High Compliance %</th>
<th>2nd Observation High Compliance %</th>
<th>Obs 1→Obs 2 Change %</th>
<th>Obs 1→Obs 2 p =</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control</td>
<td>19</td>
<td>23</td>
<td>+4</td>
<td>0.35</td>
</tr>
<tr>
<td>Experimental</td>
<td>23</td>
<td>20</td>
<td>-3</td>
<td>0.33</td>
</tr>
<tr>
<td>Control versus Experimental</td>
<td>0.32</td>
<td></td>
<td>0.35</td>
<td></td>
</tr>
</tbody>
</table>

8-10 Year Olds

Exposure to the *Out and About* program had no significant effect on 8-10 year old experimental subjects' monitoring behaviour compared to that of control subjects ($p = 0.15$). The groups were initially equivalent on this variable and did not demonstrate a significant difference at the second observation session (Table 4.18). This result does not support hypothesis 14, that after exposure to the *Out and About* program, 8-10 year old experimental subjects' compliance with recommended road crossing behaviour would be higher than that of control subjects.
Table 4.18 8-10 year old control and experimental subjects’ level of compliance as measured on the MS before and after exposure to *Out and About* (%)

<table>
<thead>
<tr>
<th>Group</th>
<th>1st Observation Session</th>
<th>2nd Observation Session</th>
<th>Obs 1→Obs 2 Change</th>
<th>Obs 1→Obs 2 p =</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Compliance %</td>
<td>Compliance %</td>
<td>%</td>
<td></td>
</tr>
<tr>
<td>Control</td>
<td>18</td>
<td>21</td>
<td>+3</td>
<td>0.32</td>
</tr>
<tr>
<td>Experimental</td>
<td>26</td>
<td>27</td>
<td>+1</td>
<td>0.45</td>
</tr>
<tr>
<td>Control versus</td>
<td>0.08</td>
<td>0.15</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Experimental</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

11-13 Year Olds

Exposure to the *Out and About* program had no significant effect on 11-13 year old experimental subjects’ monitoring behaviour compared to that of control subjects (*p* = 0.44). The groups were initially equivalent on this variable and did not demonstrate a significant difference at the second observation session (Table 4.19). However, both groups’ level of compliance regressed at the second observation session: experimental 16%, control 5%. The regression of the experimental group was statistically significant (*p* = 0.02). This result does not support hypothesis 15, that after exposure to the *Out and About* program, 11-13 year old experimental subjects’ compliance with recommended road crossing behaviour would be higher than that of control subjects. No logical reason can be given for both groups compliance level regressing.

**Gender: Experimental versus Control**

At first and subsequent observation sessions, findings related to male and female experimental and control subjects’ compliance are presented in this sub-section.
Table 4.19 11-13 year old control and experimental subjects' level of compliance as measured on the MS before and after exposure to *Out and About* (%)

<table>
<thead>
<tr>
<th>Group</th>
<th>1st Observation Session High Compliance %</th>
<th>2nd Observation Session High Compliance %</th>
<th>Obs 1→Obs 2 Change %</th>
<th>Obs 1→Obs 2 p =</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control</td>
<td>25</td>
<td>20</td>
<td>-5</td>
<td>0.29</td>
</tr>
<tr>
<td>Experimental</td>
<td>34</td>
<td>18</td>
<td>-16</td>
<td>0.02</td>
</tr>
<tr>
<td>Control versus Experimental p =</td>
<td>0.15</td>
<td>0.44</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Males**

Exposure to the *Out and About* program had no significant effect on male experimental subjects' monitoring behaviour compared to that of control subjects (p = 0.30). The groups were initially equivalent on this variable and did not demonstrate a significant difference at the second observation session (Table 4.20). This result does not support hypothesis 16, that after exposure to the *Out and About* program, male experimental subjects' compliance with recommended road crossing behaviour would be higher than that of control subjects.

**Females**

At the first observation session, a significantly higher percentage of female control than experimental subjects were in the high compliance group (p = 0.04) (Table 4.21). Thus, the groups lacked initial equivalence.

Between the first and second observation session, neither the experimental nor the control group showed a statistically significant change (experimental -5, p = 0.20,
control −1, \( p = 0.49 \) (Table 4.21). This result does not support hypothesis 17, that after exposure to the *Out and About* program, female experimental subjects’ compliance with recommended road crossing behaviour would be higher than that of female control subjects.

Table 4.20  Male control and experimental subjects’ level of compliance as measured on the MS before and after exposure to *Out and About* (%)

<table>
<thead>
<tr>
<th>Group</th>
<th>1&lt;sup&gt;st&lt;/sup&gt; Observation Session High Compliance %</th>
<th>2&lt;sup&gt;nd&lt;/sup&gt; Observation Session High Compliance %</th>
<th>Obs 1→Obs 2 Change %</th>
<th>Obs 1→Obs 2 ( p = )</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control</td>
<td>19</td>
<td>22</td>
<td>+3</td>
<td>0.32</td>
</tr>
<tr>
<td>Experimental</td>
<td>23</td>
<td>19</td>
<td>-4</td>
<td>0.18</td>
</tr>
<tr>
<td>Control versus Experimental ( p = )</td>
<td>0.21</td>
<td>0.30</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Females**

At the first observation session, a significantly higher percentage of female control than experimental subjects were in the high compliance group (\( p = 0.04 \)) (Table 4.21). Thus, the groups lacked initial equivalence.

Between the first and second observation session, neither the experimental nor the control group showed a statistically significant change (experimental −5, \( p = 0.20 \), control −1, \( p = 0.49 \)) (Table 4.21). This result does not support hypothesis 17, that after exposure to the *Out and About* program, female experimental subjects’ compliance with recommended road crossing behaviour would be higher than that of female control subjects.
Table 4.21 Female control and experimental subjects' level of compliance as measured on the MS before and after exposure to *Out and About* (%)

<table>
<thead>
<tr>
<th>Group</th>
<th>1&lt;sup&gt;st&lt;/sup&gt; Observation Session High Compliance</th>
<th>2&lt;sup&gt;nd&lt;/sup&gt; Observation Session High Compliance</th>
<th>Obs 1→Obs 2 Change</th>
<th>p =</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control</td>
<td>22</td>
<td>21</td>
<td>-1</td>
<td>0.49</td>
</tr>
<tr>
<td>Experimental</td>
<td>31</td>
<td>26</td>
<td>-5</td>
<td>0.20</td>
</tr>
<tr>
<td>Control versus Experimental</td>
<td>0.04</td>
<td>0.15</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

In summary, the *Out and About* road safety program, had no demonstrable effect on experimental subjects' level of compliance to the monitoring behaviours recommended by the authorities. The results did not support any of the associated hypotheses.

Summarising Section Three on the *Out and About* Road Safety Education Program, 1827 subjects were observed crossing a road with nearly equal numbers observed at each observation session. With minor variation, between each observation session, similar percentage compliance levels were exhibited by control and experimental subjects to five of the road crossing elements (Table F2 in Appendix F). Observation sessions were undertaken once before and twice after experimental subjects had been exposed to the *Out and About* road safety education program. The *Out and About* road safety program, as measured on the CS, had a statistically significant effect on experimental subjects crossing behaviour (hypothesis 12), although the increased compliance was only 6%. However, none of the other hypotheses concerning host factors were supported, although two were borderline: hypothesis 15 – 11-13 year old experimental subjects' compliance with road crossing behaviour would be significantly higher than that of 11-13 year old control subjects; and hypothesis 16 – male experimental subjects' compliance with road crossing behaviour.
crossing behaviour would be higher than that of male control subjects. Considering the number of analyses undertaken, the borderline cases could have occurred by chance given that the significance level was \( p = < 0.05 \). However, these findings indicate that the *Out and About* program had a negligible demonstrable effect on experimental subjects' compliance to the crossing behaviours, as advocated by the authorities. The *Out and About* road safety program, program had no demonstrable effect on experimental subjects' level of compliance to the monitoring behaviours recommended by the authorities, as measured on the MS. The results did not support any of the associated hypotheses.

Section Four: Additional Information

Although the research was designed to determine the effectiveness of the *Out and About* road safety education program on primary school children's pedestrian behaviour, the researcher observed events which had the potential to positively or negatively influence their behaviour. As these observations may be acted upon by appropriate agencies or be the subject of future research, they are presented below. The following points are not presented in order of priority and for convenience have been combined into four categories: variation in children's and adults' road safety behaviours, exemplary and inappropriate adult behaviours, school initiated actions, and traffic factors.

**Variations in Children's and Adults' Road Safety Behaviours**

Whilst filming at one school the researcher observed that a small group of older children, approximately 8-13 years of age, were confronted by a particular traffic hazard when proceeding to and from school. This hazard was created by the design of the road and environs relative to the school frontage. A curved road fronts this school and continues for some distance beyond each end of the school frontage. The school is situated facing the inside curve of the road and the designated Children's Crossing is situated central to the school frontage. The approach to the school from one direction is over a very wide storm water drain with the road raised approximately two metres above the drain. For descriptive purposes this raised
section is termed a *bridge*. A footpath is provided over the bridge on the school side of the road. The opposite side of the bridge has only the kerb and approximately half a metre of grassed surface and a steel fence before the drop to the drain. Persons using this narrow ledge to cross the bridge were obliged to walk between the fence and closely passing traffic.

It was noted that this particular group of children consistently used an alternative route to travel to school. Their solution to avoid this hazard was to cross the curved section of the road prior to approaching the bridge. This enabled the children to cross the bridge by the footpath on the school side of the road. The researcher was concerned at the need for these children to cross a curved road with no pedestrian safety measures in force. This information was passed onto the school principal at the conclusion of the third observation session.

The researcher noted that there was a lack of mountable kerbing at a number of the Children Crossing sites outside schools participating in the study. It was observed that some adults who were escorting a child to school, whilst wheeling another child in a stroller, used a driveway site instead of the Children’s Crossing to cross the road, thus avoiding having to negotiate the height variation from kerbside to roadway. By using driveways, these adults were not exhibiting good role model behaviour for younger children. The researcher was concerned that when travelling to school independently, a child might be conditioned to cross at the driveway instead of at the designated crossing site. The researcher raised the issue with the Chief Engineer, Darwin City Council who although sympathetic to the situation stated that the Council did not intend to change the kerbside at these crossings. The rationale given was that the kerbside acts as a deterrent for cyclists to speed across the crossing instead of walking bicycles across the road.

At the schools where angle parking was provided, it appeared that some drivers had difficulty being certain that there were no unsighted small children at risk at the back or side of the vehicle. This was because these drivers tended to be hesitant reversing their vehicle, often stopping and starting. On some occasions when this occurred, the researcher observed small children walking between vehicles. These children
were either about to enter a vehicle adjacent to the one reversing, or cross the road. At the conclusion of the data collection phase of the study, this observation was brought to the attention of the RSCNT.

At another school, a group of children jaywalked when crossing the road at a T-Junction and used a car park driveway to gain access to the school. It would appear that these children had adopted this behaviour to avoid a section of the verge, that is the strip of land between the edge of the road and the school boundary, which had deteriorated into a dust hole. By walking up the school car park driveway, these children were at risk of being hit by a car. The researcher discussed this matter with Darwin City Council's Chief Engineer. On the afternoon of the last observation session at this particular school, Council employees commenced constructing a path across the verge to join with an existing school footpath, thereby rectifying the problem.

**Exemplary and Inappropriate Adult Behaviour**

It was not the intention to record the behaviour of adults whilst undertaking this study. However, the behaviour of two adults is worthy of comment. One adult, who accompanied a child in the 5-7 year age group, consistently appeared to reinforce the kerbside drill routine with the young child. The video camera could not record sound at zoom distances, so the researcher was unable to record the conversation between the adult and child. The following procedure was evidenced on each filming session at the particular school. At the kerbside, the adult stood a little behind the child so that his view was not obscured, after looking to the right-left-right if there was no traffic the child spoke to the adult, who nodded her head. The child walked ahead of the adult when crossing the road. He conscientiously appeared to be monitoring the traffic whilst crossing the road. Once on the footpath, as the adult and child walked together, it appeared that she was informing him that he had satisfactorily undertaken the road crossing task as she nodded and smiled at the child. This behaviour was an excellent example of how an adult can reinforce the kerbside drill as recommended by road safety authorities.
The other adult provided a poor example of road crossing behaviour. Whilst the researcher was undertaking the pilot study, she observed a young child alighting from a vehicle which was parked at kerbside closest to the school. The child proceeded to walk towards the entrance to the school grounds. The driver drove forward slightly, did a U-turn and started to drive back in the direction in which she had come. The vehicle stopped. The driver called out to gain the child’s attention, and then threw an object out through the car window in the direction of the child. The article landed on the road. Without observing for traffic, the young girl ran onto the road to retrieve the object, returning to the footpath with her head turned towards the driver of the vehicle, she smiled and waved her hand. At no time during this incident did the child appear to observe for any traffic. As it happened, there was no oncoming traffic, but the initial action of the adult had diverted the child’s attention from performing safely as a pedestrian. This behaviour was an excellent example of how an adult can put a child pedestrian at risk of being injured by an oncoming vehicle, especially as the child’s attention was on retrieving the object from the road, without ensuring that there was no approaching traffic.

The researcher became aware of actions that had been initiated at the local level by three schools. These actions were designed to promote the safety of children as pedestrians. One school is situated adjacent to a busy roadway. At this school the council has endorsed a policy that if a child is observed riding a bicycle instead of walking across a designated crossing, then in consultation with the child’s parents, the bicycle is confiscated for 24 hours. This action is an attempt to stop the children from riding along the footpath/cycle track straight onto the road and possibly into the path of oncoming traffic. A staff member advised the researcher that initially a few children objected to the policy. There is now general acceptance of the policy and it is rarely infringed.

There is limited parking for vehicles at the school previously discussed. At the time of the data being collected, the school principal was having preliminary discussions with members of the school council and the Darwin City Council about the feasibility of a designated ‘one way drop off zone’ being made adjacent to the school. The school principal indicated that he faced opposition to the proposal, as
the area designated for the 'drop off zone' would encroach on a sporting arena. The researcher observed that within six months of her conversation with the school principal, the researcher noted that a 'drop off zone' had been made about 100 metres away from the original site, and did not encroach on the sporting arena.

A bus stop was situated in front of another school. Staff at this school has developed a voluntary roster system whereby in the afternoons children are supervised as they wait for and enter the bus.

The school council and staff at another school have designated that the footpath in front of the school for an area of approximately 138 metres is a 'non-bicycle riding zone'. White lines painted on the footpath designate the zone. When a child who is riding a bicycle approaches the line, s/he is required to dismount and walk the bicycle to the designated cycle storage areas. This action was initiated because the staff found that after school many of the children were talking while walking and did not detect an approaching bicycle. Either the pedestrian or the cyclist had to take evasive action, often unsuccessfully. Teachers are rostered to reinforce this policy. Throughout the observation periods this policy was strictly adhered to by the teachers and accepted by the students as it was a rarity to see a child riding a bicycle within the restricted zone.

**Traffic Factors**

Double yellow lines indicating 'no parking', were painted parallel to the kerb, 10 metres either side of the Children's Crossing sites. Throughout the research, it was noted that outside four schools, some drivers consistently disregarded these signs. There appeared to be no plausible reason why these drivers disregarded the signs. Parking within these areas disadvantages children as it has the potential to obstruct their view when observing for approaching traffic.

Although speed restrictions applied outside fourteen of the sixteen schools participating in the study, it was observed that many drivers did not conform to the speed limits. The number of drivers who applied the car brakes when they saw the
video camera or verbally abused or used obscene gestures to the researcher evidenced this. The sight of red brake lights was a regular feature observed by the researcher. This observation reinforced the concerns of some school principals and adults that some drivers regularly disregarded speed limits.

There appears to be a need to reinforce strategies designed to modify the behaviour of drivers to ensure a safer environment for child pedestrians, for example obvious police presence near Children's Crossing sites, reducing speed limits in residential areas, monitoring speed in restricted areas and media publicity.

As reported in the Methodology Chapter, the time period in which school zone speed restrictions near schools were operational varied. This was to address the variations in time when schools started and completed their day. The time variations in speed restrictions were:

- 7:30 - 9:15 a.m. and 2:00 - 4:30 p.m.
- 7:30 - 8:30 a.m. and 11:00 - 3:00 p.m.
- 7:30 - 8:30 a.m. and 11:30 - 3:30 p.m.
- 7:30 - 8:30 a.m. and 2:00 - 3:00 p.m.

At the time of the research there was also variation in speed limits within the designated school zone speed restrictions. Speed restrictions were: 40 kilometres per hour was operational outside 13 of the participating schools; 30 kilometres per hour was set outside another school; and no speed limit in operation outside two schools. At the conclusion of the data collection phase of the study, variation in speed restriction times and speed limits was brought to the attention of the Executive Officer, RSCNT. On receipt of this information, the Executive Officer arranged for time periods when speed restrictions applied to be standardised and 40 kilometres per hour speed restrictions became operational outside all but the school where the 30 kilometres per hour speed was maintained. Although no rationale was provided for not changing the 30 kilometres per hour speed restriction outside the school concerned, the researcher had observed that it was a main thoroughfare for trucks and other heavy type vehicles. As stated in the Discussion Chapter, as from the
commencement of the 2001 school year, school zones speed restrictions are operational between 7 a.m. to 5 p.m. on school days.

Summary

The main study involved sixteen primary schools in the greater Darwin area and comprised a large number of observations of child subjects (n=3174). Nearly equal observation numbers were recorded in each session. More children were in the 8-10 year old age group, followed by the 5-7 year age group with the least number in the 11-13 year age group. Almost an equal number of male and female subjects were observed. Most of the subjects wore either light coloured clothing or a mixture of light and dark coloured clothes.

When initially observed most of the subjects were: walking, alighting from a vehicle, or talking whilst walking. Percentages for all other activities were less than four percent per activity. When first observed most of the subjects were on the footpath or verge. An adult or at least one other child accompanied approximately three-fifths of the subjects. Very few subjects’ had their hand held when initially observed. Almost all subjects appeared to be attentive to their immediate environment.

Two-thirds of the subjects were observed in the mornings and one-third in the afternoons. The greatest number of observations occurred on Tuesdays and lowest on Mondays. Slightly more subjects were observed in the Wet than the Dry season. During the Dry season slightly more subjects were observed walking to school. In the mornings during the Wet season only a few more subjects were observed alighting from a vehicle. There was a slight increase in the number of subjects who appeared to observe for and monitor traffic when crossing a road in the Wet season compared to the Dry season.

Traffic density was recorded in the observation areas at approximately two-thirds of all observation sessions. When observed, traffic density was classified as being heavy, that is, more than two vehicles per minute, on approximately two-third
occasions. Cars, including utilities and station wagons, represented the most common type of moving vehicles observed.

Less than one-third of the subjects travelled to or from school in a vehicle. Nearly equal numbers of subjects travelled in a vehicle at each observation session. The main type of vehicle in which subjects predominantly travelled to or from school were cars. Of the subjects who travelled in a vehicle, approximately three-quarters alighted from a vehicle in the mornings and slightly less than one-quarter entered a vehicle in the afternoons.

The elements of subjects' road crossing behaviour observed were:

- refrained from crossing between parked vehicles;
- crossed within designated area;
- view of approaching traffic was not obstructed by vehicle parked on left;
- view of approaching traffic was not obstructed by vehicle parked on right;
- stopped at kerbside prior to the crossing road;
- appeared to monitor traffic by moving head to the right-left-right, prior to crossing the road;
- appeared to monitor traffic whilst crossing the road;
- crossed the road at walking pace;
- and
- crossed the road at a right angle to the kerbside, that is, straight.

A majority of the subjects observed crossed a road. Over one-half of subjects crossed the road at a mid block position. Of the children who crossed the road, approximately one-quarter did so at a supervised crossing site.

At the first observation session, 597 subjects were observed crossing a road. All subjects exhibited 98-99% compliance to the road crossing elements: didn't cross between parked vehicles; view not obstructed by vehicle parked on left; and view not obstructed by vehicle parked on right. Consequently, these three elements were
eliminated from further analysis. The remaining variables were clustered into two
groups, namely: elements in which subjects attained a compliance level between 80-
90%; and elements where subjects had a compliance level of less than 55%. 
Respectively these groups were named: crossing score (CS), which specifically 
measured crossing behaviour and monitoring score (MS), which specifically 
measured monitoring behaviour.

At the first observation session, it was identified that being female, and crossing the 
road during the Wet season, in the morning and on Monday to Thursday were 
associated with higher compliance to crossing behaviour, as advocated by 
authorities. It was also found that being unaccompanied was associated with higher 
compliance to monitoring behaviour, as advocated by authorities.

Over the three observation sessions, 1827 subjects were observed crossing a road. 
Nearly equal numbers of subjects were observed at each observation session: 33%, 
35% and 32% respectively. Nearly one-half (47%) were in the control group and 
just over one-half (53%) were in the experimental group, observed crossing a road 
with nearly equal numbers observed at each observation session. First and second 
observation sessions provided the basis for data collection. This was because 
experimental subjects were not exposed to the Out and About road safety education 
program until after the first observation session. The Out and About road safety 
program, as measured on the CS, had a statistically significant effect on 
experimental subjects crossing behaviour (hypothesis 12), although the increased 
compliance was only 6%. However, none of the other hypotheses concerning host 
factors were supported, although two were borderline: hypothesis 15 – 11-13 year 
old experimental subjects’ compliance with road crossing behaviour would be 
significantly higher than that of 11-13 year old control subjects; and hypothesis 16 – 
male experimental subjects’ compliance with road crossing behaviour would be 
higher than that of male control subjects. However, these findings indicate that the 
Out and About program had a negligible demonstrable effect on experimental 
subjects’ compliance to the crossing behaviours, as advocated by the authorities. 
The Out and About road safety program, program had no demonstrable effect on 
experimental subjects’ level of compliance to the monitoring behaviours
recommended by the authorities, as measured on the MS. The results did not support any of the associated hypotheses.

The findings presented in this Chapter suggest that the *Out and About* program had minimal if any effect on the road crossing behaviour of Darwin primary school children. Furthermore, it would appear that primary school children generally disregard the critical safety elements of pedestrian road crossing behaviour.

The chapter concludes with events the researcher observed throughout the data collection phase of the study. These events pertained to four categories: variation in children and adults' road safety behaviours, exemplary and inappropriate adult behaviours, schools initiated actions, and traffic factors.
CHAPTER 5
DISCUSSION

The three main purposes of the study were to: describe the general pedestrian characteristics of Darwin primary school children; identify all subjects' level of compliance to road crossing elements; and identify what effect the *Out and About* road safety education program on experimental subjects' level of compliance. The Child Pedestrian Safety Model provided the framework for the research. The following three research questions provided the main focus for the research:

1. To what extent do child pedestrians conform to safe pedestrian behaviours:
   1.1 When first observed, what associated activities are child pedestrians undertaking?
   1.2 Are child pedestrians attentive to their environment?

2. To what extent do the following agent, environmental and host factors affect children's compliance in relation to road crossing elements:
   2.1 Agent Factors
      2.1.1 Accompanied
      2.1.2 Hand held
      2.1.3 Supervised crossing site
   2.2 Environmental Factors
      2.2.1 Time of day
      2.2.2 Day of week
      2.2.3 Season of year
      2.2.4 Traffic density
      2.2.5 Alight from vehicle parked on roadside furthest from school
2.3 Host Factors

2.3.1 Age
2.3.2 Gender
2.3.3 Attentiveness to Environment

3 To what extent does the *Out and About* program affect children's compliance to road crossing elements:

3.1 Agent Factors

3.1.1 Experimental versus Control Subjects

3.2 Host Factors

3.2.1 Experimental versus Control Subjects: Age group
3.2.2 Experimental versus Control Subjects: Gender

Consequently, 17 hypotheses were formulated to address the research questions. In addition to the research questions and related hypotheses, other specific issues addressed in this chapter include effectiveness of the Child Pedestrian Safety Model, research methodology, and limitations and significance of the study. In particular, reference is made to:

- issues pertaining to research methods, for example, benefits of unobtrusive videoing;
- constraints associated with the teaching of the *Out and About* road safety program;
- lack of equivalent compliance to road crossing elements by experimental and control subjects at the first observation session; and
- inability to monitor individual subjects at each observation session; and anomalies related to the road safety education program.
Reference will also be made to speed restrictions, traffic management devices, school initiatives and adults as role models. The chapter concludes with 19 recommendations emanating from the research findings.

The major findings associated with this study were: the relative sameness in behaviour of subjects to the majority of road crossing elements; time and resources allocated to teaching the *Out and About* program; devolution for road crossing safety by child pedestrians to others; paucity of traffic management devices in close proximity to schools; and appropriate proactive school initiatives.

**Child Pedestrian Associated Activities**

At the time of initial observation, most subjects (87%) tended to be: walking, alighting from a vehicle, or talking whilst walking. Nearly all subjects (95%) appeared to be looking for hazards in their immediate environment. The high percentage of subjects who appeared to be attentive to their immediate environment at the time was encouraging especially in their ability to transfer these skills to safe pedestrian behaviours in other situations, for example, when alighting from a vehicle parked on the roadside opposite the school the child moved to the kerbside prior to crossing the road.

**Children’s Road Crossing Behaviour**

This sub-section addresses findings pertaining to children’s level of compliance to the nine stated road crossing behavioural elements. Where relevant, overall findings and specific variables will be highlighted, for example, age group.

Subjects attained almost complete compliance (98-99%) to the following road crossing elements:

- didn’t cross between parked vehicles
- view not obstructed by vehicle parked on left;
  - and
- view not obstructed by vehicle parked on right.
Subjects’ high level of compliance to these elements implies that they have learnt and understood the need to adhere to these particular road crossing behavioural principles. Therefore, although these principles should still be taught to primary school children, they do not require the same level of attentiveness and time allocation as some other road crossing behavioural principles.

The remaining six road crossing elements divided into two distinct groups, one associated with crossing behaviour and the other with monitoring behaviour. The first group, crossing behaviour, with a compliance score of between 80-90%, addressed the following elements: walked whilst crossing; crossed straight; and crossed within designated area. This cluster of variables was named Crossing Score (CS). The second group, monitoring behaviour, with a compliance score of less than 55%, addressed the following elements: stopped at kerb; head movements; and monitored traffic whilst crossing road. This cluster of variables was named Monitoring Score (MS). There was a much higher proportion of subjects (79%) with a high compliance score for crossing behaviour than monitoring behaviour (22%).

These findings indicate that with regard to crossing behaviour, although there is some room for improvement in subjects’ level of compliance to these elements, they need not be the major focus of road safety education programs. However, appropriate intensity of instruction is required to teach these tasks, for example similar to that recommended by Molen et al. (1983): 10-15 minute duration with four sessions allocated to each task.

Within road safety education programs, children should be taught that by running, dashing, or darting across a road decreases the time available for motorists to see them and take the necessary action to avoid an accident. It is also advisable that children be taught that increasing the distance required to cross the road extends the period of time they spend on the activity. Thus, by lengthening the distance to be traversed when crossing a road, children increase the probability of colliding with an approaching vehicle.
In relation to the operation of designated road crossing sites, in particular Children's Crossings, N T Traffic Regulations (1991:32) place specific requirements on drivers. Restrictions include maximum speed limit and not driving through the crossing site if a person is about to or is crossing, when a stop banner is displayed, and not overtaking another vehicle on or near the crossing site. These legal requirements are designed to afford protection to pedestrians, thus reducing the likelihood of incurring injury. It is important that primary school children understand the purpose of designated road crossing sites, in particular Children's Crossings and to use them to cross a road when they are operational. Road safety educators need to ensure that child pedestrians realise that designated crossing sites are not 'magical areas' as found by Firth (1975 cited in Russam 1976). Rather, that they need to conform to recognised safety precautions when crossing the road at designated crossing sites. Adults need to be cognizant that for children to cross a road is a complex process. Children may not have adequately internalised the task and are therefore unaware that it is not safe to cross a road when traffic is present.

Subjects' poor compliance to monitoring behaviours was also evidenced when the researcher undertook the Pilot Study. Because subjects tended to pay the least attention to these road crossing behavioural elements, the researcher referred to them as the critical road crossing elements. This finding was reinforced in the main study, thus supporting the findings of numerous authors who argued that poor compliance to these road crossing elements was associated with: children's immaturity, lack of comprehension, inability to adequately solve problems; and failure to understand the importance of preventive strategies (Briem & Bengtsson 2000; Foot et al. 1999; Green & Hart 1998; The Child Prevention Foundation of Australia 1997; Acredolo 1989; (Vinje 1981 in Malek et al. 1980; and Coote 1976). With such a low level of compliance to these elements, especially head movements and monitored traffic whilst crossing road, it would seem that children are oblivious to the fact that their safety is in jeopardy. By not adhering to these elements, subjects increase the potential risk of being involved in a pedestrian-traffic accident.

It was reported by Connelly et al. (1998); Acredolo (1989) and Hoffmann et al. (1980) that children under 12 years of age have difficulty in judging speed of vehicles and distance between moving vehicles. Lack of compliance to these critical
road crossing elements further reinforces the view that children's immaturity and limited developmental skills should be recognised by drivers, and it also reinforces the need to exercise extra care when driving in areas frequented by young children (Ljungblom & Kohler 1991; Malek et al. 1990; Coppens 1986; Elliott 1985; OECD 1983; Sandels 1975; and Older & Grayson 1974). These findings indicate that compliance to these road crossing behaviour elements is critical to the long-term safety of child pedestrians.

According to numerous authors children do not have similar assessment skills as those developed by older children and adults, consequently they are unable to accurately assess distance and speed, or differentiate between left and right sides of the body (Foot et al. 1999; Connelly et al. 1998; Acredolo 1989; and Chapman et al. 1981). Thus it is important to regularly remind and reinforce to children how long it would take for a driver of an approaching vehicle to stop and thus avoid injuring the pedestrian.

Based on the preceding discussion, it is recommended that future education programs specifically address children's poor compliance to these three critical road crossing behavioural elements. Strategies that could be included in road safety education programs to address these critical road crossing behavioural elements include:

- increasing the time allocated for the education program, in particular these elements;
- involving classroom teachers in the education program;
- teaching children to internalise the information instead of learning information by rote;
- whilst under supervision, having children practice these skills in controlled real road traffic situations;
- involving Children's Crossing supervisors in the program, especially on-site reinforcement of the importance of complying to the critical road crossing elements; and
extending road safety into other curriculum subjects, e.g. mathematics, social studies, art, and library studies.

It is important that these findings be conveyed to adults, especially parents and motorists. This is so that they can be made aware of the potential problem and initiate strategies to address the issue, for example, parents reinforcing safe road crossing drill and motorists being more cautious when driving in areas where there are likely to be child pedestrians.

**Children's Road Crossing Behaviour: Epidemiological Factors**

Agent, environmental and host factors associated with children’s road crossing behaviour are the foci of discussion in this section. Due to the small sample size at the first observation session, the following variables were not addressed: hand held; alighting from vehicle parked on roadside furthest from school; and attentiveness to environment.

**Agent Factors**

Discussed in this sub-section are findings associated with accompaniment and supervised crossing sites, as measured on the CS and MS.

**Accompanied versus Unaccompanied**

When crossing a road, accompanied children devolve the responsibility of adhering to safe crossing behaviour to others (Downing & Spendlove 1981; Molen 1981; and Grayson 1975). It was only in relation to subjects’ monitoring behaviour, that this finding was reaffirmed in this study. Accompaniment was also the variable identified as most likely to have a detrimental effect on children’s road crossing behaviour, as measured on the MS. These findings suggest that children tend to devolve responsibility to others, especially adults, thus appearing less safety conscious (Yeaton and Bailey 1978). When with another person, or with a group of people, or when an older person is perceived to be in charge, it is not unusual for an individual to conform to group activities or defer to an adult. This social influence
on decision making is referred to as diffusion of responsibility (Latane & Darley 1970). It is as a result of diffusing responsibility for an action to others that a child’s level of independent rational thought is diminished (Latane & Darley 1970). Whilst under supervision, by delegating responsibility to others, children are not given the opportunity to develop safe road crossing techniques and have appropriate behaviours reinforced.

When accompanying children, adults are in a prime position to be agents of social reinforcement. In such situations, adults could: utilise appropriate verbal and non-verbal methods to reinforce appropriate road crossing behaviours; be exemplary role models; and gradually instill into children safe road crossing behaviours. Such actions would result in children internalising these behaviours to the point that they became a normal practice, especially when they cross a road unaccompanied. It is highly probable that young children do not understand that they can be seriously hurt if they impact with an approaching vehicle. Adults accompanying child pedestrians can guide and teach them to judge how fast a vehicle is coming towards them and if there is adequate or inadequate time to safely cross the road.

**Supervised versus Unsupervised Crossing Site**

Supervision or non-supervision of crossing site had no significant effect on subjects’ crossing and monitoring road crossing behaviours. These finding were reinforced by logistic regression analyses. These findings are contrary to those for Victorian school children (Penna 1994).

The findings of the study suggests that although supervisors of Children Crossing sites have the potential to be a positive influence on children’s road crossing behaviour; this did not occur. Although it may appear that stopping at the kerbside is enforced, it is suggested that this action was undertaken by the supervisor more to facilitate traffic flow by using the platoon system rather than for the purpose of permitting the children to check for oncoming traffic.

The RSCNT provides a voluntary education program for supervisors at Children’s Crossing sites. Guidelines on Children’s Crossings, issued by RSCNT, focus on the
design, legislation and operational aspects of these crossings and not educational strategies which supervisors could use to teach children salient road crossing behaviours at the same time as fulfilling their duty as a crossing supervisor (RSCNT 1991). Like parents and other adults, supervisors at road crossing sites can play an important part in children’s road safety education. When waiting with children gathered at the kerbside, the supervisor could go through the kerbside drill. This would reinforce the tasks associated with detecting oncoming traffic. When children are crossing the road, the supervisor can remind them to monitor for approaching vehicles. Rote learning does not accelerate the formal operational stage of a child’s cognitive development (Lefrancois 2000; and Jarvis 1987). However, it promotes the coding of information for later recall. As pedestrians, older children can then draw upon the information to make decisions on the correct pedestrian behaviour they should adopt. It is recommended that the RSCNT broaden the education program for supervisors of road crossings by actively involving them in the program and then to encourage and emphasise to children the need to adhere to the three critical road crossing behavioural elements.

Environmental Factors

As there were no statistically significant findings on environmental factors, as measured on the MS, discussion in this sub-section relates only to the CS findings. Therefore, findings associated with time of day, day of week, season of year, and traffic density, as measured on the CS are discussed in this sub-section.

Time of Day

The incidence of child pedestrian injuries occurring is higher in the afternoon than morning (Durkin et al.; 1999; Stevenson et al. 1992; and Pitt et al. 1990). It was found that at morning observations subjects’ level of compliance was significantly higher than at afternoon sessions. This finding was re-inforced by the logistic regression findings. These findings may be linked to children wanting to relax or are possibly tired at the end of the school day and as a result do not pay as much attention to the importance of adhering to safe road crossing behaviours.
Primary school pedestrians should not be expected to take full responsibility for their road crossing behaviours. In the afternoon, by having someone in authority observing their behaviour, reiterating and reinforcing safe road crossing skills, it is likely that child pedestrians would strive to conform to accepted road crossing behavioural norms. As role models these people would act as deterrents when children exhibit inappropriate road crossing behaviours and reinforcers when children conform to appropriate crossing behaviours.

**Day of Week**

Child pedestrian injuries tend to occur more frequently on a Friday than on any other school day (Stevenson et al. 1992; and Fortenberry & Brown 1982). This study found that subjects who crossed the road on Monday-Thursday had a significantly higher level of compliance to road crossing behaviour than those who crossed on a Friday. Consequently, based on this finding, the likelihood of child pedestrians incurring more injuries on a Friday than other school days, is conclusive. On a Friday afternoon after a very demanding week at work, drivers may be tired, hurrying to attend an end of week social activity and/or eager to return home to relax; therefore, may not as attentive to the presence of pedestrians, as they would on other days.

**Season of Year**

An extensive literature search failed to find any reference to children’s road crossing behaviour in tropical environments, namely *Wet* and *Dry* seasons. It was reported by Stevenson et al. (1992:236) that most child pedestrian injuries occurred in ‘... clear, light and dry conditions.’ However, as a resident in a tropical environment for over 25 years, the researcher had observed that when there was a sudden onset of rain during the *Wet* season, pedestrians moved quickly in an attempt to seek shelter. Therefore, it was postulated that children’s level of compliance to road crossing behaviours would be higher in the *Dry* season compared to the *Wet* season. This study revealed contrary findings. It was found that a higher proportion of subjects who crossed the road during the *Wet* season was in the high compliance group than subjects who crossed the road during the *Dry* season. Logistic regression also
identified season of year as a variable to have an effect on children’s road crossing behaviour. A possible explanation for this finding is that during the Dry season there is not the same urgency for children to seek shelter from the rain and therefore they tend to play, talk with friends or undertake additional activities when crossing the road. This is a very important finding and as a result road safety education programs should reinforce that irrespective of weather conditions children must adhere to safe road crossing behaviour.

**Traffic Density**

Molen (1983) found that when traffic density was classified as heavy, child pedestrians paid more heed to the task in hand, namely crossing a road. This study did not re-inforce this finding. A possible explanation for this finding is that when crossing a road, children expected to confront some degree of traffic density, therefore, they perceived that they were putting themselves at increased risk of injury and modified their behaviour accordingly. As a result, these findings did not support the view espoused by Molen (1983).

**Host Factors**

As there were no statistically significant findings on environmental factors, as measured on the MS, discussion in this sub-section relates only to the CS findings. Therefore, findings associated with age group and gender, as measured on the CS, are discussed in this sub-section.

**Age Groups**

Age group did not have a significant effect on subjects’ road crossing behaviour. This finding is contrary to that of Durkin *et al.* (1999) who found that children aged six to ten years of age were more at risk of being involved in pedestrian-traffic accidents. It was also identified that children do not have the ability to competently and appropriately apply knowledge, plus they lack the ‘commonsense reasoning’ of other pedestrians (Dunbar *et al.* 1999:398).
As a paediatric nurse with many years’ experience, the researcher has observed that older children tend to have similar beliefs and behaviours as adolescents. Adolescents give the impression that they know everything; seem to think that they are indestructible; and tend to be risk takers, whilst at the same period are still developing levels of independence and personal autonomy (Adams, McQuellin & Nagy 1996). Although these beliefs and behaviour need not be negative, older children often do not have the maturity to realise that they do not have the knowledge and skills to deal with complex situations; therefore, they are still vulnerable.

Based on children’s poor compliance to road crossing behaviours, especially monitoring behaviours, these and previous research findings indicate that it is important that motorists are informed of these childhood developmental limitations and the need to exercise greater diligence when driving in an area frequented by child pedestrians.

**Gender**

Previous studies indicated that nearly twice as many male as female primary school aged pedestrians sustain injuries (Whitebread & Neilson 2000; Stevenson et al. 1992; Rivara & Mueller 1987; Molen 1983; OECD 1983; and Routledge et al. 1974). Such findings suggest that male children have lower levels of compliance than female children to road crossing elements. This study supported this finding, furthermore, the finding was re-affirmed by the logistic regression analysis. A possible reason for this finding is that female children’s ability to detect sound direction is more acute than that of males (Eagles et al. 1970 in Sandels 1975). A lower proportion of male pedestrians were in the high compliance group for road crossing, thus indicating that these male children are at increased risk of colliding with an oncoming vehicle. Therefore, further research should be undertaken to identify factors associated with male children’s poor road crossing behaviour.

In summary, whether accompanied or at supervised crossing sites, child pedestrians tended to devolve responsibility for their road crossing behaviour to others.
Therefore, future education programs need to encourage adults to be actively involved in teaching and reinforcing safe road crossing behaviour to child pedestrians. In the mornings and during the Wet season, a higher proportion of subjects was in the high compliance group for road crossing behaviour. It is recommended that educators should incorporate these findings into future road safety education programs, for example the need for children to be very attentive to road crossing behaviours in the afternoon and during the Dry season. In addition, media campaigns should encourage drivers to be extra vigilant of child pedestrians when driving in the afternoon and during the Dry season. The research also endorsed the findings of earlier research that due to their high level of compliance to road crossing behaviours, girls are less likely than boys to sustain pedestrian injuries.

**Out and About Road Safety Education Program**

Based on experimental subjects’ level of compliance to road crossing behaviours at the second observation session, this subsection discusses findings associated with the Out and About road safety education program. Overall findings are discussed and identified limitations associated with the program are outlined.

The researcher made an assumption that experimental and control subjects’ level of compliance would not be significantly different at the first observation session. The rationale for this assumption was at the first observation session experimental subjects would not be exposed to the education program. Therefore, the effects of the Out and About road safety education program would be manifested at the second and third observation sessions, that is, a higher proportion of experimental subjects would exhibit higher levels of compliance to road crossing behaviours than control subjects. At the first observation session there was a statistically significant difference in experimental and control subjects’ level of compliance to road crossing behaviours on three CS and two MS epidemiological factors. Furthermore, with the exception of one CS variable, there was a lack of significant positive change between the first and second observation sessions for the experimental group. This finding indicates that overall the Out and About program had very little
demonstrable effect on experimental subjects' road crossing behaviour. A possible rationale for this finding is discussed under the sub-section on limitations associated with the *Out and About* program.

As a result of this finding, in which it was necessary to determine the amount of change between the first and second observation sessions as a criterion, rather than the difference between groups on the second observation session, the researcher became aware that in educational research there was a lack of a criterion to determine if a finding was of practical importance, especially if the sample was large. Therefore, within the discipline of education, research should be undertaken to determine the level of change between groups for a finding to be of practical value.

As the *Out and About* road safety education program had no significant effect on experimental subjects' monitoring behaviour, discussion of findings in the remainder of this section is restricted to crossing behaviour.

**Age Group**

Irrespective of age group, the *Out and About* education program had no demonstrable effect on the road crossing behaviour of experimental subjects, especially those in the 5-7 and 8-10 year age groups. However, between the first and second observation sessions, 11-13 year old experimental subjects' increased their compliance level by 10% \( (p = 0.08) \). This finding suggests that although the compliance level improved it was of borderline significance, consequently, the effect of the *Out and About* program was negligible. As a result of this finding it is recommended that more importance and time be given to teaching all children safe road crossing behaviours. Furthermore, by intensively reinforcing road safety principles to younger children it is highly likely that they would internalise such knowledge and behaviours and continue adhering to them as they develop and mature.
Male Subjects

Although the *Out and About* program had no significant effect on male experimental subjects' level of compliance there was evidence of some effect. At the second observation session male experimental subjects' compliance had increased by 7% ($p = 0.09$), indicating some borderline improvement. This positive finding reinforces the view that there needs to be a review of what is taught in the road safety program and the frequency with which children are exposed to the program.

Female Subjects

The *Out and About* program had no demonstrable effect on female experimental subjects' level of compliance to crossing behaviour. This finding suggests that changes need to be made either to the content, frequency and/or instructional techniques associated with the *Out and About* road safety education program. By allocating more time to road safety education, sessions can be repeated thus reinforcing salient aspects of child pedestrian behaviour. Other possible changes to the curriculum are expounded in more detail when discussing limitations associated with the *Out and About* education program and the recommendation section.

Limitations Associated with the *Out and About* Education Program

At the first observation session, on some variables there was a statistically significant difference in experimental and control subjects' level of compliance, thus making it difficult to compare control and experimental subjects at each session. Instead, the amount of change demonstrated by each group between observation sessions one and two was considered. Even so, there were few instances of significant improvement that could be attributed to *Out and About*, thus demonstrating constraints in the way in which this program was implemented in the NT. This could be explained by a number of limitations associated with and the teaching and content of the *Out and About* road safety program. These included: subjects' limited exposure to the program; lack of flow charts for use when teaching the program; process used to monitor for approaching traffic prior to crossing a road.
limited use of outdoor environment and real traffic situations to reinforce children’s road crossing skills; and failure to actively involve Children’s Crossing site supervisors in the road safety education program. These will now be explored in more detail.

**Subjects’ Limited Exposure to the Program**

A major issue that contributed to these findings was the education program offered to Darwin primary school children. At the time of the study, the road safety education program, used by the Darwin Field Officer, RSCNT, was *Out and About*. The Darwin Field Officer was the only delegated person primarily responsible for the education program within primary schools in the greater Darwin area. Even though the road safety education program conducted by the RSCNT was not a compulsory component of the school curriculum, the rate of participation by schools was high. Hence, the amount of time that this one person could allocate to teaching the subject in each class at individual schools was restricted. Consequently, one session was allocated to pedestrian safety and another pertained to bicycle safety. On average, classroom sessions were for 30 minutes duration and outdoor sessions were for approximately 60 minutes. The outdoor sessions focussed on safe bicycle behaviour. This intensity and duration of teaching sessions were not as recommended by safety experts who advocated that they be of 10-15 minute duration with four sessions allocated for each task or element in the *Out and About* program (Molen et al. 1983). In this program, nine road crossing elements were identified as essential behaviours associated with safe road crossing. Based on the recommendation of Molen et al 1983, primary school children should have a minimum of 9 hours pedestrian safety education each year. Single road safety education lessons have been shown to be ineffective (Preston 1980; Fisk & Cliffe 1975; and Lewis 1970 cited by Preston in Osborne & Levis 1980). The program offered to Darwin primary school children falls very short of the recommended level of education necessary to ensure a high level of compliance to the road safety elements.
The lack of time available to teach the program meant that road safety principles and rules were not reinforced, thus impeding cumulative learning. This results in lack of rule-governed behaviour (Lefrancois 2000; and Gagne 1985). This restriction on learning results in poor educational outcomes and in reality is false economy. In the format in which the Out and About program was taught, it is not realistic to expect it to have any significant effect on children's road crossing behaviours.

In stating the limitation placed on the Field Officer, it must be noted that he appeared to use all the time available to him to teach road safety education to as many school children as possible. However, because of the time constraints placed on him, the Field Officer was unable to teach the Out and About program in the format as recommended (Molen et al. 1983). Accordingly, it would be inappropriate to attribute the pedestrian behaviour of subjects in this study to any aspect of the Out and About program. Hence, to facilitate future evaluation of the program, it is recommended that if the road safety education program Out and About, is to continue being presented to Darwin primary school children, that the program be expanded to ensure that the time and methods used to teach the program incorporate an appropriate behavioural modification format.

It is recommended that changes be made to the road safety education program offered by RSCNT to Darwin primary schools. The program should be a compulsory topic in the school syllabi and involve more than one pedestrian and bicycle education session. Consideration should be given to utilising the following four-stage format espoused by (Molen et al. 1983:155,156):

a 'modelling' stage where the educator provides theoretical information at a level appropriate for the child's age and correctly demonstrates the task;

a joint practice session where the child explains to the teacher what pedestrian behaviour is being undertaken and the steps which are being practised, and is given positive feedback by the teacher when correct pedestrian behaviours are performed;

while observed, the child is given an opportunity to practice the task alone and receive feedback;

and

unobtrusively observing the child undertake the pedestrian task and giving appropriate feedback.
Regular follow-up teaching sessions should be incorporated into the program. The first two of these follow-up sessions would be at fortnightly intervals with another two sessions a month apart. This would enable the information to be reinforced and any additional instruction be given to the children. This teaching method is commensurate with successful behaviour modification programs (Lefrancois 2000 and Biggs & Telfer 1987). In addition, more emphasis should be placed on teaching primary school children the elements of road crossing behaviour that were identified as being least well performed, namely:

- stopped at kerb;
- head movements;
- monitored traffic whilst crossing road.

The outdoor learning environment for the early demonstration and practice sessions must be carefully chosen. This is to ensure that it appears natural to the children while at the same time being safe. This could be achieved if arrangements were made with the relevant authorities to temporarily make available a section of public road or vehicular driveway area within the school grounds for the purpose of demonstrating and supervising children's road crossing behaviour. Arrangements could then be made for parents to drive and/or park vehicles in strategic places within the area. Once children had demonstrated safe pedestrian behaviours then they could be observed and supervised practising crossing a road in real traffic situations. Use of real traffic situations for the practical component of road safety education programs has been advocated by numerous researchers (Stevenson et al. 2000; Cross et al. 1999; Ampofo-Boateng et al. 1993; Rothengatter 1984b; Molen et al. 1983; Fortenberry and Brown 1982; and Limbourg and Gerber 1981).

In the event that the RSCNT does not have the funds to employ more teaching staff to implement the revised program format, alternative strategies should be considered. One option would be for the RSCNT in conjunction with the NT Education Department and School Councils to identify a number of schools to be involved in a pilot study which would extend over two terms. Dependent on the
school population, and class sizes, it would be feasible for one teacher to be allocated to four or five schools. At each school, within each class, two groups of children would participate in the study. Children would be assigned to either a control or experimental group. Subjects in the experimental groups would be exposed to the intensive teaching of the *Out and About* program. Control subjects would be exposed to relevant health education programs similar to that described by Stevenson *et al.* (2000); and Cross *et al.* (1999). Unobtrusive observation of children’s pedestrian behaviour would be undertaken before and after completion of the respective education programs. By restricting the schools and groups in the pilot study, it is highly likely that many of the subjects would be observed at each observation session. The second option would be for the intensive education program to be taught by teachers at individual schools. It would be essential for the teachers responsible for the program to undergo an appropriate in-service program.

It is recognised that there are already many competing pressures on the school curriculum. However, many road safety researchers subscribe to the concept of incorporating road safety education programs into school syllabi (Ampofo-Boateng & Thomson 1991; Malek *et al.* 1990; Marsh & Hyde 1990; Rivara & Mueller 1987; Gardner *et al.* 1986; OECD 1986; Elliott 1985; Molen 1984; Preusser & Blomberg 1984; Molen 1983; Molen *et al.* 1983; OECD 1983; Maisey 1982; Molen *et al.* 1981; and Molen 1981). Therefore, to implement this recommendation, it would be necessary to convince primary school teachers of the importance of incorporating pedestrian safety education into the curriculum. As stated earlier, pedestrian safety need not be a stand alone subject, rather, integrated into a number of other curriculum subjects including: mathematics, social studies, art, and library studies. If young children do not adequately learn about pedestrian safety, future generations could be put at further risk.

The feasibility of increasing the frequency and duration of road safety education program to primary school children was discussed with a senior Northern Territory Government officer (Gray-Spence, E. pers. comm., 8 May 2000). While statistically the incidence of child pedestrian injuries appear to be declining,
increasing the primary school road safety education program currently is not a high priority in the N T Department of Transport and Works budgeting and planning process. This would appear to be very short-sighted especially as the current data pertaining to child pedestrian injuries tend to focus on those children who present to a hospital Accident and Emergency Department, treated by St. John Ambulance personnel, or incidents reported to the police. In reality, this is only the tip of the iceberg, as it does not address those child pedestrian injuries attended by parents, teachers, general practitioners, et cetera. This lack of statistical data about child pedestrian-traffic accidents should be no cause for complacency. Rather, it highlights the need for further research to be conducted to clarify the actual incidence of child pedestrian injuries.

Whilst child pedestrian safety is not given a high profile by the relevant government agency, it therefore becomes more urgent to educate the public about the limitations of primary school children as pedestrians.

**Lack of Flow-Charts**

An omission in the development of the Out and About program is a lack of simple flow charts suitable for use by teachers and pedestrians. The use of flow charts within instructional design is an invaluable tool for teaching concrete concepts to children has been advocated by Gagne (1985) and Molen et al. (1981). Meaningful learning occurs through a sequential approach to meaningful memorisation (Lefrancois 2000; and Jarvis 1987). Use of flow charts can be employed by educators as a tool to aid meaningful learning in that they highlight the sequence of steps taken to reach a specific outcome, in this context, safe road crossings by all primary school children. In addition, emphasis can be given to specific road crossing elements, for example, the critical road crossing elements. As a result of the research reported herein, the researcher has developed two flow charts using the steps espoused within the Out and About program. An additional step has been included in the flow charts, namely a reminder for children who cross a road at an intersection or T-Junction to turn their head and search for traffic approaching from behind (Figure G1 and G2 in Appendix G). One flow chart focuses on the steps
teachers should address when teaching children road crossing skills and the other outlines the tasks pedestrian need to concentrate on thus resulting in a safe road crossing. Within both flow charts, child pedestrians are familiarised with safe road crossing activities and appropriate strategies to be initiated if it is not safe to cross the road. Children are also made aware of situations which may interfere with safe road crossing behaviour, for example: not stopping at kerbside; parked vehicles obstructing pedestrians’ view of approaching traffic; and road crossing signals not working. Such situations are shown to have the potential to be unsafe or dangerous for pedestrians. It is recommended that these flow charts be incorporated into the instructional design of future road safety programs.

**Monitoring for Approaching Traffic**

Irrespective of where children cross a road, it is important that prior to crossing, they be aware of any traffic that may be approaching them from behind. As shown by Sandels (1975), children’s poorest hearing responses are to sounds that emanate from 3 and 9 o’clock directions. Immature peripheral vision limits what children can see out of the corner of their eyes (Moses 1989; David et al. 1986; and Sandels 1975). Children’s short stature also impedes their ability to see objects at the same height as that of the average adult (Pettit 1996; Moses 1989; OECD 1983; and Ross & Seefeldt 1978). These physical characteristics hinder children’s ability to detect advancing vehicles, especially those approaching from behind. It should be noted that when looking to detect for approaching traffic either prior to or whilst crossing the road, in the *Out and About* program children are taught to look right-left-right. It is recommended that consideration be given to changing these tasks to include looking behind especially when children cross the road at an intersection or T-Junction.

**Children’s Crossing Site Supervisors**

The researcher was surprised to observe the lack of involvement in the road safety education program by Children’s Crossing site supervisors. As stated earlier, the RSCNT provides a voluntary education program for supervisors at Children’s
Crossing sites. Because the supervisors are in an ideal situation to teach principles of road crossing behaviour to the children and reinforce these principles in a practical way, it is recommended that the RSCNT broaden and make the road safety education program for supervisors a pre-employment requirement. This initiative would be in keeping with the recommendation of Yeaton and Bailey (1978). The purpose of the education program would be to encourage Children’s Crossing site supervisors to emphasise to children the critical road crossing behavioural elements. In the education program, supervisors should be taught basic teaching principles, importance of children internalising safe road crossing behavioural skills, and how by reinforcement, especially through repetition, relevant knowledge and skills will be transferred to children’s long term memory.

In summary, the Out and About road safety education program, as taught to Darwin primary school children at the time this research was undertaken was grossly inadequate and did not demonstrate any effect on experimental subjects’ level of road crossing behaviour. Specific inadequacies associated with the program included: experimental subjects’ limited exposure to classroom and outdoor components of the program; lack of flow charts to aid teachers and pedestrians; and omission to teach children that when crossing at a T-Junction, to monitor for traffic approaching from behind.

**General Findings and Observations**

During the data collection phase of the study, the researcher became aware of various factors that could have affected the findings. These factors included: lack of sameness of control and experimental subjects at the first observation session; variation in subjects’ level of compliance; design of Children’s Crossing sites; lack of traffic management devices; societal responsibilities and road safety education; angle parking adjacent to schools; need to improve pathways adjacent to schools; commitment of School Councils and Teachers to children’s pedestrian safety; and drivers’ actions.
Significant Difference in Control and Experimental Subjects’ Road Crossing Behaviour at the First Observation Session

Due to the limitations imposed on the researcher by the N T Department of Education, it was anticipated that control and experimental subjects would have similar entry levels of pedestrian safety knowledge and behaviour. If there had been equivalence in control and experimental subjects’ levels of compliance to all of the road crossing elements at the first observation session, this would have resulted in an initial level playing field. A possible reason for this occurrence was that control subjects had directly or indirectly learnt about pedestrian safety earlier in the school year from some other source. Information may have been acquired from a range of sources including: parents acting as role models; television programs; current events; or media advertisements involving one of the road safety education icons, for example Hector the Cat.

Despite the lack of equivalence, the experimental group did not show significantly more change than the control group and therefore the program did not contribute to increased road crossing behaviour compliance.

Variation in Subjects’ Road Crossing Behaviour Level of Compliance

Why did subjects, particularly within each age group, perform so well in some elements and poorly in others, as measured on the CS and MS? A possible reason is that Children’s Crossing sites are strategically placed adjacent to schools, thus becoming optimum areas for children to cross the road. The position the researcher occupied when collecting the data was in close proximity to the schools. This may have resulted in non-observation of children who crossed the road some distance away from the school. Most drivers conformed to the traffic regulation regarding not parking within 10 metres either side of the crossing site. Thus, subjects were not forced to cross between parked vehicles, nor had vehicles parked on either or both sides of the crossing site obstructing their view. Most of the designated crossing sites provided subjects with direct access to the school grounds. This was because some of the schools did not have perimeter fencing or the crossing was in line with a
school access path. It is likely that the positioning of the crossing encouraged subjects to cross the road at right angles to the kerb.

**Design of Children’s Crossing Sites**

When pushing strollers or prams adults should not have to use a nearby driveway for easy entry to the road as an alternative to coping with the drop from the kerb at a Children’s Crossing site. The reason given to the researcher by the Chief Engineer, Darwin City Council, as to why the kerb at these crossing sites did not slope down to road level, was that it acted as a deterrent for children to cross the road without stopping, does not appear to be rational. A feature of areas in Darwin and Palmerston is that often pedestrians and bicyclists legally share the same pathway. Pathways at intersections are depressed to road level so that there is ease of access for people pushing strollers or riding bicycles. This double standard should not be allowed to continue. If adults are to be encouraged to be good role models for children, then when pushing another child in a stroller or pram, whilst escorting a child to or after school, they should have easy access to Children Crossing sites.

Children should not have to access a Children’s Crossing site over a storm water bridge, which has no footpath on that particular side of the road. It is impossible to calculate the direct and indirect costs associated with injuries incurred or the death of a child who may be hit by a vehicle whilst crossing at a bend in a road at a non-designated crossing site. At the conclusion of the research, this anomaly was brought to the attention of the NT Department of Transport of Works. The relevant personnel are to be congratulated on investigating the issue and locating a Children’s Crossing site in a safe location prior to the commencement of the bridge. This action has negated the need for children to walk across the bridge on that particular side of the road.

**Pathway Adjacent to School**

During the data collection phase of the study, the researcher advised the Chief Engineer, Darwin City Council, of the lack of a suitable pathway adjacent to a
particular school. Following data collection on the last afternoon observation session at this school, the Darwin City Council initiated extensions to the existing pathway. The Chief Engineer, Darwin City Council, is to be commended for acting so promptly on this issue and arranging for this pathway to be extended from the existing pathway to the school ground boundary. His prompt action provided children with a safe access to the school grounds, thereby eliminating the need for them to jaywalk and/or walk up a driveway.

**Paucity of Traffic Management Devices**

A range of appropriate devices designed for the purpose of slowing down traffic and thus making the road environment safer for pedestrians was advocated by Brindle (1992); and Hillman (undated). These devices included road humps, ‘sleeping policemen’, roundabouts, street enclosures, chicanes and route changes. There was a minimum of such aids in the immediate vicinity of participating schools. Traffic management devices evidenced in the research were: a chicane outside one school, narrowing of the roadway in front of four schools, and one ‘sleeping policeman’ outside another school. Therefore, other than legislated speed restrictions, there was a paucity of environmental aids used to slow down through traffic in school zone areas. Consequently, child pedestrians were more vulnerable to being involved in pedestrian-traffic accidents. This omission should be addressed as a matter of urgency, resulting in the installation of appropriate traffic management devices near Darwin primary schools.

**Angle Parking Adjacent to Schools**

In 1992/3 the researcher investigated the causes of childhood deaths in the greater Darwin region, due to unintentional injury, during the years 1983-1988. One aspect of this research involved deaths which involved motor vehicles (n=11) (unpublished). Of the eleven children who died, one was a child who was hit by a reversing vehicle. The driver of this vehicle did not see the child in the car side or rear vision mirrors. As it was observed that some drivers are hesitant when reversing a vehicle from an angle parking site outside primary schools, it is
recommended that research be undertaken to determine if angle parking of vehicles outside primary schools is an appropriate safety practice.

Commitment of School Councils and Teachers to Children’s Pedestrian Safety

Teaching staff and school councils readily agreed to participate in the study. To the researcher, this indicated that people in responsible positions within the education system were positively committed to improving child safety.

Pedestrian safety initiatives implemented at a number of schools are to be commended. As outlined in the Results Chapter, the researcher was unexpectedly given information about the positive initiatives, which have been introduced, at these schools. It is likely that child pedestrian safety initiatives that have been developed and adopted at some schools may be appropriate for implementation at other schools.

Societal Responsibilities and Road Safety Education

Children’s road safety is a societal issue and no education program should be done in isolation by a specialist road safety authority or education department. With reference to this study, other groups which could have been involved in the program include Darwin City Council, Palmerston Town Council, Department of Transport and Works, Community Policing, Health Promotion organisations, and specific organisations, for example Child Accident Prevention Foundation of Australia (Kidsafe), Youth and Children’s Services, Australian Red Cross et cetera. Child pedestrian safety may be incorporated into the charter of one or more service groups. If this were so, then it would be appropriate to invite them to contribute to the road safety education of children.

Parents have a special involvement in children’s road safety education. One role parents play is the way in which they act as an example for their and other people’s children. As pedestrians and/or vehicle drivers, parents are role models. To satisfactorily fulfill this role, parents should become actively involved in the formal
education program. It is recognised that in many families, adult members are in paid employment or have other commitments making it difficult for them to participate in the program during school hours. However, this should not stop them reinforcing correct pedestrian behaviours at every opportunity. Parents can also support teaching staff by participating in children’s allocated after school activities, for example assisting, with the completion of workbooks. The Out and About education program incorporates a Parent’s Guide booklet. A copy of this or a similar booklet should be in every child’s home so that adults can readily refer to the road safety concepts and information which is being taught in primary schools. It is recommended that strategies be developed and implemented which promote the vital role parents play in the promotion of child pedestrian safety.

Drivers’ Behaviour

Most drivers adhered to the ‘no parking’ zones either side of Children Crossing sites, however, exceptions were observed outside four schools. It is unrealistic to expect traffic authorities to constantly monitor this traffic infringement. Hence, alternative strategies should be contemplated to enforce this legislation, for example, the installation of cameras to record traffic infringements in schools zones, or authorising School Crossing site supervisors to issue traffic infringement tickets. One option would be a media campaign that focuses on why this legislation is in place. Media campaigns could also highlight road safety limitations because of children’s immaturity.

Limitations to be incorporated into such a campaign include children’s:

- visual restrictions, in particular their peripheral vision;
- inability to discriminate between the right and left side of their body;
- difficulty in gauging the gap between vehicles;
- ability to determine the approximate speed at which a vehicle is travelling; and
- variation in stages of children’s physical and psychological development.
Information about child pedestrians' capabilities and limitations could also be utilised to provide drivers with an understanding of why speed restrictions are in place in the vicinity of schools.

During the data collection phase of this study, many drivers did not appear to conform to speed limits in operation around the schools. Two possible reasons that drivers do not comply with this traffic legislation were outlined in the Results Chapter. One was that the times when school zone speed restrictions were operational varied between Darwin primary schools. The signs for these speed restrictions are on the verge adjacent to the kerbside and may be difficult for a passing driver to read the times at which the restrictions apply. To simplify the system, there should be standardisation of the times these restrictions are operational and a specific colour superimposed with the speed limit be sprayed on the road to advise a driver that they are driving in a restricted speed zone. The researcher approached the Executive Officer RSCNT regarding this matter and since completion of the data collection phase of this study, the times have been standardised. However, nothing has been done about making restricted speed zones easily recognised by drivers. Furthermore, it is suggested that the relevant authorities develop a suitable advertising slogan that reflects drivers' responsibilities within school zone areas, for example 'make certain you stay within thirty'.

Another possible reason that drivers did not appear to comply with speed restrictions near schools was non-standardisation of the speed limit. Speed limits outside schools involved in the study varied between 30 and 60 kilometres per hour. Speed limits outside all Darwin primary schools should be uniform. It is recommended that speed limits outside all Darwin schools be standardised to 30 kilometres per hour. This recommendation is based on the finding of Kries et al. (1998), namely, child pedestrian-traffic accidents were reduced by about 50% in areas were the speed limit was 30 km/h. The lower speed limit would increase the time drivers had to stop in the event that a child darted out from the kerbside and did not look prior to crossing the road. In addition, it is recommended that the speed limit near schools be extended to operate between 0700 – 1730 hours. The rationale for extending speed limit operation hours is to take cognisance of commencement and conclusion
times for all Darwin pre, primary and secondary schools plus after-school activities which operate out of many primary school premises.

It is also suggested that a broad range of strategies, which deter drivers from speeding outside schools, be adopted. These strategies could include: the use of speed surveillance cameras; and speed control devices, such as, narrowing of the road either side of a Children’s Crossing site, use of chicanes and sleeping policemen (Hillman undated; and Brindle 1992). In addition, it should be brought to drivers’ attention, through media campaigns, attributes of child behaviour including their impetuosity and inability to concentrate for any sustained period of time.

Concern is expressed for the safety of all primary school children as there was poor compliance for the elements: observing for traffic prior to crossing the road; and monitoring traffic whilst crossing the road. Irrespective of the traffic density, less than one-quarter of the subjects observed for traffic either prior to or whilst crossing the road.

Summarising the sub-section on general findings and observations, a major factor associated with this research was that at the first observation session control and experimental subjects’ level of compliance was significantly different. Consequently, subsequent comparison between control and experimental subjects on the second observation session was not meaningful. Other negative aspects associated with the research included: non-standardisation of speed limits and operating times in school speed zones; paucity of traffic management devices designed to slow down traffic near schools; design of some Children’s Crossing sites; and the need to improve pathways adjacent to some schools. School Councils and teachers are to be commended on the initiation of proactive strategies designed to promote child pedestrian safety.

**Evaluation of the Child Pedestrian Safety Model**

This sub-section addresses the effectiveness of the Child Pedestrian Safety Model, strengths, weaknesses and limitations of the methodology used in this study, significance of the study and future research based on study findings.
The child pedestrian model was developed utilising central concepts of the epidemiological triad, namely agent, environment and host. The rationale behind the development of the model was to address the salient aspects associated with child pedestrian safety. The relationship between the concepts was simple, clear and congruent. The diagram of the model also provided the researcher with a clear and logical representation of epidemiological theory. For the researcher the model proved to be extremely valuable as a research tool. It provided a sound scientific framework and coherent frame of reference on which to explore and evaluate child pedestrian behaviour and various factors that impinged on their safety. The structure facilitated the development of research questions and hypotheses, and provided direction for the clustering and definition of variables, thus making the research more rigorous and the researcher accountable. As a result, it served to establish indicators as to children's level of compliance to road crossing behaviours. The model was also used as a tool on which the researcher reflected on the appropriateness, efficacy, inadequacy, and ineffectualness of various initiatives designed and implemented by government and non-government agencies, to safeguard child pedestrians, for example, speed restrictions, traffic calming devices, and role of supervisors. By incorporating other research findings, for example, accompaniment, time of day, day of week, season of year and traffic density, the model also served as a tool to analyse the pedestrian behaviour of children. The design of the model enabled the researcher to conclude that the road safety education program, as taught at the time of the research, was ineffectual and enabled her to identify likely explanations for this problem. Overall, the model was found to be all encompassing, pertinent and relevant for use across a range of age groups and gender.

The model is suitable for use by a range of service providers including: government, non-government organisations, and the community at large. Politicians, administrators, planners, legislators and educators associated with Northern Territory Government Departments of Education, Police, Transport and Works, Law, Darwin City Council and Palmerston Town Council, et cetera can use the model as a template for describing child pedestrians' needs by identifying the various factors and their relationships plus evaluating any initiatives implemented.
The RSCNT, primary school councils, Child Accident Prevention Foundation of Australia, journalists, parents and other concerned community members can also employ the model to evaluate the appropriateness and effectiveness of strategies implemented to promote and maintain child pedestrian safety.

Due to its generalisation, the model should serve as a useful tool for future research into child pedestrian behaviour. Furthermore, because it addresses the learner, environmental and agent factors, the model should also assist and guide road safety educators and primary school teachers to design, implement and evaluate education programs which address cognitive, affective and psychomotor aspects associated with children's safe pedestrian behaviour.

**Reflection on Research Design and Methodology**

This sub-section focuses on the strengths, weaknesses and limitations of the design and methodology associated with this study.

**Strengths associated with the Study**

A major strength of this study was the decision to use a video camera to unobtrusively observe the pedestrian behaviour of primary school children. As evidenced by Kellehear (1993); Sapsford and Abbott (1992); Marshall and Rossman (1989); Roberts and Burke (1989); and Michon (1981), the advantages of using a zoom lens video camera to unobtrusively observe children's pedestrian behaviour were numerous. These advantages included: limiting footage to only children who appeared to be unaware of being videoed; gaining a realistic view of how subjects behave in their normal environment; the ability to preserve subjects behaviour thus facilitating regular view of the footage to confirm or correct recorded details; and being able to revisit the footage as the need arose. The use of a 10-magnification zoom lens further enhanced the unobtrusive process.

Suggestion by School Councils and or Principals to use their Newsletter to parents/guardians to publicise the research was another positive aspect of the
research. This initiative ensured that all responsible adults had the opportunity to be informed of the research and mechanism for lodging any disagreement about the data process. Throughout filming, no child and only one adult raised any concerns about the method used to collect data. In the latter situation, the woman was assured that all footage depicting the accompanied child would be excluded from the study, thus complying with recognised ethical considerations. With this one exception, when coming into close proximity to where the researcher was with the video camera, adults verbally expressed support for the initiative and indicated they were in general, are concerned about children’s pedestrian safety.

Due to the research design, namely use of Crosstabs and paired t-tests, when at the first observation session there was a lack of equivalence in control and experimental subjects’ level of compliance, it was possible to analyse the amount of change each group demonstrated at and between each observation session.

Another strength of this study was that it uncovered a lack of a criterion to determine if a statistically significant finding in educational research was of practical importance. This lack of information indicates that within the discipline of education, research be undertaken to determine the level of change between groups for a finding to be of impractical importance.

**Weaknesses associated with the Study**

Specific weaknesses of the research pertained to: subjects and schools not randomly selected; the inability to access information regarding socioeconomic factors related to individual subjects and follow-up of individual subjects; initial differences between control and experimental groups; use of videoing being very labour and time intensive; and the Expert Panel’s failure to discriminate importance of road crossing elements.

All schools approached about the research indicated that they would prefer to be within the experimental group. It was only as a result of the Darwin Field Officer, RSCNT, assuring School Council Chairpersons’ and Principals that their school
would receive road safety education programs in the Term immediately after data completion, that control groups were identified. Because of this commitment by the Field Officer, it was not possible to utilise a random sampling process to allocate subjects to control and experimental groups.

When the researcher approached the relevant person within the N T Department of Education to discuss the study, it was indicated that the application for ethics clearance would not be considered unless she guaranteed that no individual student would be identified in the study. Notes made at the time indicate reasons given for this condition were primary: children's rights may be endangered; and Hawthorne Effect likely to be detrimental to the study findings, that is people perform better at a task knowing they are being observed (Ausubel & Robinson 1969). Initially it was planned to link subjects' socioeconomic factors with their pedestrian behaviour. The researcher was advised that in the N T children did not have to attend the primary school near their place of residence. Therefore, it was not unusual for a child to attend a school some 20 or more kilometres from their residential address. The researcher was also denied access to subjects' residential postal code. Although at the time of implementing the research, the researcher accepted these restrictions, in hindsight they proved to be a weakness of the study. By ensuring no individual subject was identified, data analysis was severely restricted, in particular, the use of multiple regression statistics and comparison of the road crossing behaviour of individual subjects across observation sessions.

At the first observation session, control and experimental subjects' lack of equivalence in compliance to all of the road crossing elements meant that comparison between groups at subsequent observation sessions had limited value in the assessment of the Out and About education program. This was directly attributable to the researcher having to work with pre-determined groups and inability to assign subjects or schools to either an experimental or control group.

Although the benefits of unobtrusive videoing outweigh the negative aspects, it is important to make reference to the labour and time intensity of the method as it related to this study. Because of the restrictions the N T Department of Education
imposed on the study, it was necessary for the researcher to compile video cameo sequences so that subjects' age group could be identified. This process was extremely time-consuming, as the researcher had to ensure that neutral child pedestrian behaviours were depicted on each cameo sequence. Through the imposition of this additional step, the researcher had to develop a form that indicated the cameo number and specific student attributes, for example, colour of school bag, clothing, or hairstyle. This video and information sheet was then hand delivered to the school where one or more teacher(s) viewed the footage, recorded the subject's age group on the form and notified the researcher that the video and form were ready for collection. If individual control and experimental subjects had been identified prior to the research commencing, these additional steps would have been unnecessary.

Validity of the Research

Two aspects of validity need to be addressed in relation to the research: external and internal. External validity is associated with subjects being chosen at random from a population (Roberts & Taylor 1998). In this research the researcher had no control over who would be subjects. Stipulations placed on the researcher by the NT Department of Education restricted her control over subject selection. Stipulations included: no direct contract was to be made with subjects, especially to assess their knowledge of road safety; plus subjects were not to be identified by name, only age group. In addition, the need to negate the Hawthorne Effect on children’s pedestrian behaviour was an important consideration. It is acknowledged that the sample size was not based on statistical power calculations because there were no reports of similar studies available from which to estimate variances and analyses involved in this study made power calculations excessively complex. Internal validity relates to the findings being linked with ‘...manipulation of the independent variable.’ (Roberts & Taylor 1998:82). Factors that can threaten the internal validity of research include: experimental mortality; history; maturation; testing effect; selection effect and placebo effect (Roberts & Taylor 1998). As the data was collected within a six-month period subject maturation was unlikely to have had any affect on the study. None of the remaining factors appeared to have had any affect
on the study. In this study the major independent variable was experimental subjects' exposure to the road safety education program *Out and About*. Although experimental subjects were exposed to the specialised education program, the duration and frequency of the exposure was extremely limited. As a result of the limited exposure to *Out and About* is highly unlikely to have contributed in any way at the second observation session to experimental subjects having higher levels of compliance to all road crossing elements.

**Limitations associated with the Study**

Limitations of the study have been discussed in the sub-sections pertaining to weaknesses associated with the study and validity of the research. A summary of these perceived limitations include:

- the research was restricted to primary school age children; the
- *the Out and About* program was the only road safety education program analysed;
- subjects were not randomly selected;
- there was no matching of subjects observed in the first and subsequent observation sessions;
- only pedestrian behaviour was analysed;
- analysis of pedestrian behaviours were restricted to those captured on video tape;
- non-intensive teaching of the education program *Out and About* to children in the experimental group;
- at the time of undertaking the study, the researcher had not internalised the fact that the RSCNT Darwin Field Officer did not have enough time to allocate more than one teaching session per group on pedestrian behaviour. Furthermore, any RSCNT or NT Department of Education staff members ever conveyed this information to the researcher. Therefore, subjects' poor compliance to the three critical road crossing behaviours cannot be attributed to the *Out and About* program;
Expert Panel’s inability to discriminate importance of specific road crossing elements.

Initially, the involvement of an Expert Panel to provide weightings for each of the road crossing behaviours was perceived to be a strength of the study. Prior to the initial meeting, each panel member was given a copy of the Out and About program and informed that the panel was required to allocate weightings for each of the tasks associated with the road crossing behaviours. Inviting the Expert Panel to participate in the study provided the researcher with numerical information which could be used to undertake statistical analysis at a higher level rather than the yes/no option associated with the Out and About program. Although theoretically beneficial, this initiative proved to be counter-productive. With the exception of one element, the Expert Panel allocated the same weighting to all of the road crossing elements. This lack of discrimination meant that each road crossing element was considered to be equally important. The researcher challenges this equality concept. To the researcher elements such as: stopped at kerb; head movements and monitored traffic whilst crossing road have more relevance to children’s pedestrian safety than the elements: didn’t cross between parked vehicles; view not obstructed by vehicle parked on left; or view not obstructed by vehicle parked on right. Of the nine road crossing elements, subjects attained a high level of compliance to three, a satisfactory level to another three and poor compliance to the remaining three. These results further reinforce the need for the elements to be weighted individually.

Significance of the Study

This study has resulted in numerous positive outcomes including:

- highlighting the paucity of exposure Darwin primary school children had to the road safety education program;
- development of flow charts depicting safe road crossing behaviour steps. These flowcharts are perceived by the researcher to be an important teaching tool especially for use by teachers, parents, concerned adults and child pedestrians.
• identifying that Darwin primary school children are at risk of being injured because of their low level of compliance to the critical road crossing elements;
• need for future road safety education programs to focus on the critical road crossing elements;
• confirmation that when traffic density is classified as heavy, child pedestrians pay more attention to road crossing elements;
• need to standardise operating times of Children's Crossing sites;
• need to incorporate traffic management devices in close proximity to Children's Crossing sites;
• need to standardise speed restrictions at Children's Crossing sites;
• when Children's Crossing sites are operational, need to increase police presence to deter speeding motorists;
• importance of educating public on primary school aged children's limitations as pedestrians;
• identified reasons why adults and children do not always use designated road crossing sites;
• recognition of the need to actively involve Children's Crossing site supervisors in children's road safety education program;
• improving injury surveillance programs resulting in a comprehensive data base of child pedestrian injury;

and

• need to determine a criterion that identifies the level of positive change required for a result to be of practical importance in educational research.

Future Research

As previously indicated, this study has highlighted a number of areas worthy of future research. This sub-section provides additional information associated with the need for future research.

Overall, this study found that irrespective of age group, all children's level of compliance to recommended road crossing behaviours, especially monitoring behaviours, should be a major concern to all parties involved in children's road
safety. A possible reason as to why 11-13 year old children’s compliance level was higher than that of the younger children is that they had already developed skills designed to assess early traffic conditions in relation to road crossing safety. Such an action would reinforce Piaget’s formal operations phase where older children have developed proficiency in synthesising and organising information whilst simultaneously undertaking more than one task (Lefrancois 2000; Dunbar et al. 1999; Biggs & Telfer 1987, and Smart & Smart 1977). It has already been suggested that when accompanied or at supervised crossing sites children devolve responsibility for their safety when crossing a crossing. Devolution of responsibility may also be a reason why 5-7 year old children’s level of compliance to road crossing behaviour was lower than that for older children.

The use of flow charts depicting specific tasks child pedestrians undertake when crossing a road should be incorporated into future road safety education programs. Once such flow charts have been adopted, appropriate research involving both teachers and pedestrians could be undertaken to ascertain the efficacy of these instructional tools.

To identify the pedestrian behaviour of pre and secondary school aged children, further research should be undertaken.

To clarify the actual incidence of child pedestrian injury, further research should be undertaken to identify the number of injured child pedestrians not treated at a hospital or by St John ambulance personnel or the injury reported to the police.

Wiersma (2000) and Roberts and Taylor (1998) stated that a large sample may contribute to analyses identifying small differences being reported as statistically significant. However, such results may not to be of practical significance. Furthermore, in clinical research, for findings to be of practical value, a positive change of greater than 20% between groups is required (Dawson-Saunders & Trapp 2001). Research should be undertaken, in the discipline of education, to determine an appropriate level of difference between groups for findings to be of practical value.
Recommendations

This subsection provides brief qualifying information justifying the 19 recommendations. The recommendations pertain to: the teaching of pedestrian road safety; research; changes to road and kerbside design; traffic matters; public education; and the wider dissemination of information. As some of these recommendations were formulated at the conclusion of the data collection phase, relevant government and non-government agencies were informed of the recommendations. This section will also indicate which of these recommendations have already been acted upon. A summary of the nineteen recommendations is presented in Table 5.1.

Table 5.1 Summary of Recommendations

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<thead>
<tr>
<th>Number</th>
<th>Recommendation</th>
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<tr>
<td>1</td>
<td>Teaching of the Out and About program to Children.</td>
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<td>2</td>
<td>Road Safety Education in Darwin Primary Schools.</td>
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<td>3</td>
<td>Traffic Observance at Intersections and T Junctions.</td>
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<td>4</td>
<td>Primary School Teachers’ Road Safety Education In-service.</td>
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<td>5</td>
<td>Parents’ and ‘Social Others’ Involvement in Children’s Pedestrian Safety.</td>
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<td>6</td>
<td>Utilisation of Flow Charts in Pedestrian Safety Education Programs.</td>
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<td>7</td>
<td>Expansion of Children’s Crossing Supervisors’ Education and Role.</td>
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<td>8</td>
<td>Non-Compliance to Critical Road Crossing Behavioural Elements.</td>
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<td>9</td>
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<tr>
<td>10</td>
<td>Relationship between Size of Change and Practical Value in Educational Research.</td>
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<td>11</td>
<td>Modification of Kerbs at Children’s Crossing Sites.</td>
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<td>12</td>
<td>Potential Pedestrian Hazard caused by Road Design.</td>
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<tr>
<td>13</td>
<td>Standardisation of School Zone Speed Limits.</td>
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<tr>
<td>14</td>
<td>Reduction in School Zone Speed Limits and Extension of Operational Period.</td>
</tr>
<tr>
<td>15</td>
<td>Traffic Management Devices.</td>
</tr>
<tr>
<td>16</td>
<td>Infringement of Traffic Regulations.</td>
</tr>
</tbody>
</table>
Recommendation 1: Teaching of the Out and About program to Children

The road safety education program Out and About, as presented to Darwin primary school children at the time this research was undertaken, should be expanded to incorporate appropriate behavioural modification format and techniques.

A typical behavioural modification program consists of: providing verbal information about the skill to be learnt, including rationale; instructor demonstrating the skill; participants practising the skill in a simulated or real environment; praising and/or rewarding positive behaviours; and explaining why some behaviours are inappropriate. Terminology should be suitable for the learner(s) and easy to understand. To be successful, teaching sessions should be of a short duration and repeated frequently (Molen et al. 1983). If a child’s pedestrian behaviour is to be changed, then the relevant education program should utilise appropriate behavioural modification format and techniques. It is further advocated that under supervision and in controlled real traffic situations, children are taught safe road crossing skills (Stevenson et al. 2000; Cross et al. 1999; Foot et al. 1999; Ampofo-Boateng et al. 1993; Rothengatter 1984b; Molen et al. 1983; Fortenberry & Brown 1982; and Limbourg & Gerber 1981). The incorporation of the two flow charts: Teacher’s and Pedestrian’s Versions of Children’s Road Behaviour at Kerbside and Crossing Sites, is also advocated. These flow charts are designed to identify each step that needs to be met thus ensuring the child pedestrian safely crosses a road.

The time available for teaching the Out and About program was inadequate. This was because the RSCNT could only provide one person to teach at all primary schools in the greater Darwin area. There has been no major increase in child pedestrian injuries within the greater Darwin area (Gray-Spence, May 2000, pers. comm.). However, it is important that people in positions of authority do not become complacent regarding the importance of suitable road safety education programs for primary school children.
Recommendation 2: Road Safety Education in Darwin Primary Schools

Road safety programs, as offered by the Road Safety Council of the NT, to primary schools in the Darwin area are made a compulsory subject within the school syllabi.

Children’s road safety education is a societal issue and should not be left solely to one or two groups, such as an education authority or specialist road safety organisation. However, if children are to learn the concepts of safe pedestrian behaviour and to have them regularly reiterated and reinforced, then road safety education should be incorporated into the education system. This is especially important for primary school children, as their cognitive development is incomplete and they have not acquired the ability to organise and reflect on the interrelationship of different situations. There is a general consensus that road safety education programs should be incorporated into school syllabi (Stevenson et al. 2000; Cross et al. 1999; Ampofo-Boateng & Thomson 1991; Malek et al. 1990; Marsh & Hyde 1990; Rivara & Mueller 1987; Gardner et al. 1986; OECD 1986; Elliott 1985; Molen 1984; Preusser & Blomberg 1984; Molen 1983; Molen et al. 1983; OECD 1983; Maisey 1982; Molen et al. 1981; and Molen 1981). At the time that this study was undertaken the children’s road safety education program conducted by the RSCNT was not a compulsory component of the school syllabi.

Recommendation 3: Traffic Observance at Intersections and T Junctions

Kerbside drill be broadened to include teaching children to look behind prior to and whilst crossing the road at an intersection or T-junction.

The road safety education program teaches children to look right-left-right when observing for and monitoring traffic. This sequence of actions is taught to ensure that children learn to fully appraise the traffic situation and finally check that there are no approaching vehicles on their right-hand side before they cross the road. In this study, although only 18% of the subjects crossed the road at an intersection or T-junction, the researcher noted that it was a rarity for children to observe if there was any moving traffic approaching from behind. This omission creates a potential
problem if the driver of such a vehicle is intending to turn in the direction of the child. The instruction for child pedestrians to look behind when crossing the road at an intersection or T-junction has been incorporated into the Teacher’s and Pedestrian’s version of *Children’s Road-Crossing Decisions*.

**Recommendation 4: Primary School Teachers’ Road Safety Education In-service**

In collaboration with the Road Safety Council of the NT, in-service programs are designed and conducted for selected teachers who would teach the road safety curriculum within Darwin primary schools.

If the road safety education program is made a compulsory topic within the school syllabus, it may be necessary for schoolteachers to be involved in the education program. To assist them in teaching the road safety program, it would be necessary for suitable in-service programs to be made available to these teachers.

Currently the NT Department of Transport and Works are in the process of developing a new road safety education program for pre-school, primary and high school children (Kirwin, J. 2000, pers. comm., August). Teacher and parent education packages are being developed with anticipated completion date being within the 2001 school year. When available, the revised education program will be introduced into the primary schools over two terms: initially with students aged 5-8 years of age and then 8-10 and 11-13 year old students (Kirwin, J. 2000, pers. comm., August).

Furthermore, a new action plan is in the process of formulation and is due to be implemented between first January and thirty first of December 2001 (Kirwin, 2000, pers. comm., August). In the new plan, RSCNT Field Officers would assist teachers in delivering road safety education programs and act in a supporting role for pre-school, primary and high school teachers. It is proposed that by involving teachers

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10 Manager, Commercial Compliance, NT Department of Transport and Works
in the education program, RSCNT Field Officers would be able to more efficiently convey the ‘road safety message’ to specific target groups.

An intersectoral involvement is advocated for effective health education programs (Pless & Arsenault 1987). For such an initiative to be effective there must be continuing intersectoral involvement. In the current fiscal climate, cost benefit audits of intervention programs are the norm. When the new program is evaluated it is important that costs do not outweigh children’s safety, well being and possibly life. The proposed initiative by the NT Department of Transport and Works is positive and must be commended. Furthermore, it is in line with Recommendation 4.

**Recommendation 5: Parents’ and ‘Social Others’ Involvement in Children’s Pedestrian Safety**

Strategies be developed and implemented which promote the vital role parents and ‘social others’ play in the promotion of child pedestrian safety.

The term ‘social others’ has been advocated by Valsiner in Garling and Valsiner (1985:16) and describes people who ‘... constantly intervene in the children’s individual relationships with their environments.’ In addition to parents and teachers, Valsiner identifies grandparents, peers and siblings as groups that can purposefully guide and influence children’s knowledge, skills and behaviour.

Any measures aimed at promoting the safe pedestrian behaviour of children cannot be undertaken in isolation. Parents are the primary teachers and role models for children. Covertly and overtly they teach their children the norms of society. This may be by: explaining a situation, event, or action to a child(ren); reinforcing information and skills which children have learnt at school; and through their own actions. When parents were actively involved in road safety education programs, then it was demonstrated that more children comply with safe road crossing tasks (Molen 1983; Sandels 1975). Parental involvement in the road safety education program may take one of many forms. Parents can promote safe pedestrian
behaviours by assisting with teaching children appropriate road crossing behavioural skills in the classroom and at road crossing sites. Parents could be invited to participate in the Children’s Crossing Supervisors’ education program, thus providing them with contemporary road safety knowledge and skills. In addition, parents could be involved in road safety activities at after-school education programs. They could also be good role models for children, especially when crossing a road or driving a vehicle. These contributions and positive parental attitudes should be recognised and encouraged.

The proposed changes to the road safety education program offered to pre, primary and secondary school students addresses this recommendation from the perspective of parents but should be broadened to include ‘social others’.

**Recommendation 6: Utilisation of Flow Charts in Pedestrian Safety Education Programs**

At the time this research was undertaken, flow charts outlining salient steps associated with safe road crossing behaviour as outlined in the *Out and About* program, for use by teachers and children were unavailable. As discussed earlier in this chapter, the researcher has developed such flow charts (Appendix G). It is recommended that these flow charts be incorporated into the revised education program and be evaluated as part of the formative and summative evaluation process.

**Recommendation 7: Expansion of Children’s Crossing Supervisors’ Education and Role**

The Road Safety Council of the N T Children’s Crossing supervisors’ education program to include teaching children critical road crossing behaviours.

The study found that children crossing the road at a supervised crossing site gave little or no attention to the need to search for and monitor traffic prior to and whilst crossing the road. Approximately one-fifth of subjects complied with monitoring behaviours at supervised and unsupervised crossing sites. Supervisors could be
involved in the teaching of these crucial elements of road crossing behaviour to children. The reinforcement of these skills by supervisors at Children's Crossing, site encourages children to practice the tasks in real traffic conditions. It is more likely that these learnt skills would be applied when children are required to function independently in traffic, especially when crossing a road at an unsupervised site.

**Recommendation 8: Non-Compliance to Critical Road Crossing Behavioural Elements**

Research efforts should be directed towards identifying why there was such low compliance to the road crossing elements: stopping at kerbside; observing and monitoring for traffic prior to and whilst crossing the road.

Factors which contribute to child pedestrian injury are children: failing to detect approaching traffic; and *darting* and *dashing out* onto the road (Harborview Injury Prevention and Research Center 1997; Kraus *et al.* 1996; Roberts *et al.* 1992; Malek *et al.* 1990; Pitt *et al.* 1990; Elliott 1985; Preusser & Blomberg 1984; OECD 1983; Molen *et al.* 1981; Molen 1981; and Ross & Seefeldt 1978). This study found that when crossing the road at an unsupervised site: less than one-half of the subjects stopped at the kerbside; observed for the presence of traffic prior to crossing the road; and monitored traffic while crossing the road. These behavioural elements have been shown to be essential components of road crossing and are incorporated into pedestrian education programs including *Out and About*. The road safety education program *Out and About*, developed in 1986, has been used widely throughout Australia to teach children road safety education (Castor & Rush 1988). It is of concern that in this study so many subjects did not adhere to the recommended road crossing behavioural elements.

**Recommendation 9: Reversing from Angle Parking Outside Schools**

Research should be undertaken to determine if angle parking of vehicles outside primary schools is an appropriate and safe practice.
The researcher was concerned about vehicles reversing from an angle park outside some of the schools participating in the study. It is possible that the drivers had difficulty seeing if there were small children behind or adjacent to the vehicle.

**Recommendation 10: Relationship between Size of Change and Practical Value in Educational Research**

Research be undertaken to determine the level of positive change required in educational research for findings to be of practical importance, especially when the sample size is large.

Wiersma (2000) and Roberts and Taylor (1998) indicated that large samples may contribute to analyses identifying small differences as being statistically significant, however, such results need not be of practical significance. To avoid misinterpretation of the importance of statistical significance, in clinical research a difference of 20% between groups is used as the criterion for the findings to be of practical value (Dawson-Saunders & Trapp 2001). A search of the literature failed to find a similar criterion for educational research. Therefore, it is timely that research be undertaken to identify the level of positive change that reflects the practical value of statistically significant research results, especially when the sample size is large.

**Recommendation 11: Modification of Kerbs at Children’s Crossing Sites**

Kerbs at Children’s Crossing sites are modified to road level thus facilitating ease of access for the users.

The researcher became aware of a problem which arises when adults are escorting a child to school whilst wheeling a younger child in a stroller. The problem occurs when these adults arrive at a designated Children’s Crossing site that is not sloped from the footpath height to the road level. They subsequently had difficulty negotiating a stroller from the kerbside onto the road. Most of these adults tended to use a driveway to gain access to the road surface level. If adults are to be
encouraged to act as good role models for children, then kerbsides at Children's Crossing sites should be sloped from the footpath height to the road level. This would facilitate ease of access to the crossing site for adults who are wheeling a younger child in a stroller whilst accompanying another child to school.

**Recommendation 12: Potential Pedestrian Hazard caused by Road Design**

Design changes are made to the section of road or bridge to provide safe road crossing conditions for children living in the area.

In order to cross at the designated Children's Crossing site, children living in an area on the opposite side of the road to one school were required to use a narrow verge adjacent to the kerb when crossing a storm drain bridge. As an alternative to using the Children's Crossing, it was observed that some children crossed at a curved section of road. It would appear that these children considered this to be a safer option than crossing the bridge where there was no footpath.

Since the researcher advised the RSCNT of the actual location of this road section and the information passed on to the appropriate authority, a Children's Crossing Site has been located prior to the storm water drain bridge.

**Recommendation 13: Standardisation of School Zone Speed Limits**

Speed limits outside all schools in the greater Darwin area are standardised.

At the time when data was collected for this study, there was variation in the speed limits in force outside individual schools. This speed variation could cause confusion for drivers, especially if their journey involved them traversing streets adjacent to more than one primary school.

This anomaly was conveyed to an Engineer, NT Department of Transport and Works. Since the conclusion of this research, speed limits outside schools in the greater Darwin area have been standardised to 40 Km/h.
Recommendation 14: Reduction in School Zone Speed Limits and Extension of Operational Period

Speed limits outside all schools in the greater Darwin area be reduced to 30 Km/h and operational period extend from 0700-1730 hours.

Numerous studies indicate that many adults do not fully comprehend that young children are at a major disadvantage in traffic due to their physical, behavioural and intellectual development and lack of experience (Briem & Bengtsson 2000; Whitebread & Neilson 2000; Durkin et al. 1999; Foot et al. 1999; Green & Hart 1998; Harborview Injury Prevention and Research Center 1997; Kraus et al. 1996; Daniel & Lee 1990; Malek et al. 1990; Pearson and Lane 1990; Pitt et al. 1990; Acredolo 1989; Enns and Brodeur 1989; Moses 1989; Coppens 1986; David et al. 1986; Molen 1983; OECD 1983; Molen 1981; Molen et al. 1981; Hoffmann et al. 1980; Ross & Seefeldt 1978; Cohen & Haith 1977; and Sandels 1975). Children's immature development is evidenced by their:

- inability to concentrate on more than one task at a time;
- poor concentration span, therefore they are not always as attentive as they should be to the task in hand;
- underdeveloped problem solving skills;
- limited peripheral vision;
- difficulty in accurately identifying the direction from which sounds emanate;
- small stature;
- impulsiveness,

*et cetera*

Children *darting out, and/or, dashing onto* or running across a road have been identified as causes of child pedestrian injuries (Harborview Injury Prevention and Research Center 1997; Kraus et al. 1996; Pitt et al 1990; Preusser & Blomberg 1984; and Synder & Knoblauch 1971 in Malek et al. 1990).
As a result of these factors, drivers need to exercise a high level of safety when driving in an area frequented by young children. In addition, even though a higher proportion of children complied with road crossing behaviours during the Dry compared to the Wet season, drivers should not become complacent. During the Wet season, roads can be slippery and hazardous resulting in a driver having difficulty quickly stopping the vehicle. By reducing the speed limit within school zone areas would afford drivers with more time to stop and attempt to avoid colliding with a child who darts out or dashes onto a road.

At the time this study was undertaken, in Australia, there was variation in maximum vehicular speed limits within school zone areas, for example 40 Km/h in the NT and ACT, whereas 25 Km/h in SA. In Germany, there was approximately a 50% reduction in child pedestrian-traffic accidents in areas where the speed limit was restricted to 30 Km/h (Kries et al. 1998). This finding was comparable to that of Mclean et al. (1994) who stated that a reduction in vehicular speed limits in close proximity to schools would result in less child pedestrian injury. A compromise speed limit of 30 Km/h within school zone areas is recommended.

Although this study focussed on the pedestrian behaviour of primary school children, there are still two potentially vulnerable groups of children not addressed. These are children who attend pre and secondary schools. At the time this study was undertaken commencement and conclusion times for these schools varied. Observation of child pedestrian commenced 30 minutes prior to the commencement of the school day. At the commencement of observation sessions, the researcher observed that some children were already in the school grounds. To address the early arrival at school of some children, it is recommended that speed limits in school zones be operational from 0700 hours. By extending the operation time of speed limits in school zone areas would serve to avoid confusion for drivers, especially those whose journey involves them driving in areas that include pre, primary and secondary schools and schools that offer after school child care programs.
Therefore, it is recommended that speed limits outside all schools in the greater Darwin area be reduced to 30 Km/h and operational period to extend from 0700-1730 hours.

From the commencement of the 2001 school year, speed limits outside all schools in the greater Darwin area have been standardised to 40 Km/h and on school days are operational between 0700-1700 hours. A possible reason for the decision to extend the restrictions to 1700 hours is to cater for after-school activities that operate out of a number of primary school premises. However, from personal experience the researcher is aware that the majority of after-school activity programs operate until 1730 hours.

**Recommendation 15: Traffic Management Devices**

Install appropriate traffic management devices in close proximity to Children’s Crossings and implement appropriate strategies designed to discourage drivers from parking illegally near Children’s Crossings.

When collecting data, the researcher became aware that very few traffic management devices were in place near Children’s Crossing sites. In addition, the fact that some drivers braked once they became aware of the researcher and her video camera, and some obscene hand gestures and language directed at her suggests these drivers were not conforming to the speed restrictions. Hence, child pedestrians are more vulnerable and likely to be involved in a pedestrian-traffic accident. Therefore, it is recommended that appropriate traffic slowing devices, for example chicanes, speed restrictions, speed cameras _et cetera_ be installed near Children’s Crossing sites.

**Recommendation 16: Infringement of Traffic Regulations**

When collecting data, the researcher observed numerous vehicles passing through marked School Crossings at speeds estimated to be well above the set speed limit for that area. The researcher’s perception that drivers were travelling at speeds higher
than permitted was reinforced by the number of brake lights she observed when the
driver of the vehicle became aware that someone was recording the event on a video
camera. These speeding infringements occurred when the Children’s Crossing flags
were in place to indicate speed restrictions were in force.

The researcher brought this issue to the Community Relations Division of the N T
Police. As a result of this action, at the commencement of each school Term there is
a very obvious police presence in close proximity to primary schools in the greater
Darwin area (Northern Territory News, 25 July 2000, p3; Northern Territory News,
02 February 2000, p3; Northern Territory News, 15 October 1999, p3; Northern
Territory News, 16 February 1999, p3; Northern Territory News, 02 February 1999,
p4; Northern Territory News, 21 October 1998, p3; Sunday Territorian, 19 July
News, 08 August 1998, p3; Northern Territory News, 07 August 1998, p3; and

Although it was not a common occurrence, the researcher observed drivers outside
four schools parking on double yellow lines within ten metres either side of a
Children’s Crossing. These parking restrictions have been put in place so that child
pedestrians have a clear view of approaching traffic when they are assessing if it is
safe to cross a road. In such situations road crossing supervisors should be
authorised to issue traffic infringement tickets.

**Recommendation 17: Schools’ Pedestrian Safety Initiatives**

Positive pedestrian initiatives developed and implemented by some Darwin primary
schools should be disseminated to other schools and the Road Safety Council of the
NT, for their information and if appropriate, adoption.

Every school is unique and in trying to maintain and promote a safe pedestrian
environment, problems may arise. Whilst undertaking this study, the researcher
became aware of some pedestrian safety initiatives individual schools had
implemented. Other schools may have similar child pedestrian safety problems.
Recommendation 18: Publicity regarding Children’s Limitations as Pedestrians

Media campaigns should focus on the physical and cognitive limitations confronting child pedestrians.

It is reiterated that children do not have the physical skills or the cognitive ability to function as a pedestrian in the same way as an adult. Research has shown that children have not developed the same level of problem solving skills as adults. Their stature, hearing and visual limitations, lack of memory and concentration span and impetuosity increases their risk of pedestrian injury. Community members should be advised of what capabilities child pedestrians have and the limitations which impinge on their ability to function safely in traffic situations.

Recommendation 19: Child Pedestrian Injury Data

In the greater Darwin area, current data on child pedestrian injuries pertains to those children who present to the Accident and Emergency Department of the two hospitals, St John Ambulance and police statistics. So that a clearer picture of the incidence of child pedestrian injuries can be developed, consideration should also be given of the injuries incurred by child pedestrians who are treated by people or other agencies, for example, general practitioners, teachers, and responsible adults. It is recommended that further research be undertaken to rectify the incompleteness of current child pedestrian injury data.

Summary

The epidemiological triad, namely agent, environmental and host factors, provided the framework for the Child Pedestrian Safety Model. This model served as the structure for identifying the behaviour of Darwin primary school child pedestrians and determining the effectiveness of the road safety education program Out and About. Variables assessed in the study were: agent - accompanyement and supervised crossing sites; environmental - time of day, day of week, season of year, and traffic density; host – age group and gender. Due to insufficient numbers for at least one
component of the variable at the first observation session, the following variables were not assessed: hand held; alighting from vehicle parked on roadside furthest from school; and attentiveness to environment. The researcher has addressed aspects in this chapter that emanate from the research findings including: at the first observation session, lack of sameness in experimental and control subjects’ level of compliance; experimental subjects’ limited exposure to the Out and About program, making it impossible to adequately assess the program’s effectiveness; adults as role models; pedestrian safety initiatives adopted by some schools; drivers’ infringement of some NT Traffic Act regulations and possible reasons why the legislation is breached; and additional road safety behaviours the researcher observed whilst undertaking the study. This study reinforced earlier findings, namely, that primary school aged children do not have the ability to consistently make appropriate judgements regarding the critical road crossing behaviours. Consequently, it is important that adults, including drivers, are made aware of children’s limitations as pedestrians. Strengths, weaknesses, validity and significance of this research and future research initiatives have been outlined in this chapter. Nineteen recommendations emanate from this research. These are designed to improve children’s pedestrian behaviour, in particular road crossing behaviour, resource development, and partnerships establishment in an attempt to minimise child pedestrian injuries. Acknowledgements are made of recommendations already addressed by and appropriate strategies implemented by relevant Northern Territory Government and Quasi-Government and Local Government Departments.
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APPENDIX A

DATA COLLECTION INSTRUMENT
Data Collection Instrument

(Not Applicable values either 8 or 88)
(Missing Values either 9,99,999, 9999 or 99999)

Subject Number (ID) (0000)

Subject Observed Previously
(Repeatid : Round number then ID number)

Date (000000)

Subject Age Group

(Agegroup: 1=5-7 years, 2=8-10 years, 3=11-13 years)

School Code (Schcode : 01=Acacia, 02=Adonsonia, 03=Banksia,
04=Calytrix, 05=Cycus, 06=Eucalyptus, 07=Ficus, 08=Grevillea,
09=Gronophyllum, 10=Heliotropium, 11=Hibbertia, 12=Ipomoea,
13=Leucaena, 14=Livistonia, 15=Melaleuca, 16=Pandanus,
17=Polycarpsia, 18=Sesbania)

School Population (Schpop : 1< 350, 2 > 350)

Site Observations Recorded (Sitecode : 1= By crosswalk,
2=By Carpark, 3=By Shop, 4=Adjacent Park, 5=Roadside,
6=Vacant block)

Observation Round (Round: 1,2,3)

Group Type (Group : 1=Control, 2=Subject)

Time (Time 1 = am, 2 = pm)

Day of Week (Day : 1=Monday, 2=Tuesday, 3=Wednesday,
4=Thursday, 5=Friday)

Season of Year (Season: 1 = Wet, 2 = Dry)

Climatic Conditions (Climate: 1=Sunny, 2=Humid, 3=Overcast
4=Build-up, 5=Raining, 6=Thunderstorms)

Observation Environment in relation to observed subject

(Observenvir : 01=Left Residential, 02=Right Residential
03=Left & Right Residential, 04=Front Residential
05=Rear Residential, 06=Left Park, 07=Right Park,
08=Left & Right Park, 09=Front Park, 10=Rear Park, 11=Left Shop
12=Right Shop, 13=Left & Right Shop, 14=Front Shop,
15=Rear Shop, 16=Left Road, 17=Right Road, 18=Left & Right Road,
19=Front Road, 20=Rear Road, 21=Left School, 22=Right School,
23=Left & Right School, 24=Front School, 25=Rear School,
26=Left Carpark, 27=Right Carpark, 28=Left & Right Carpark,
29=Front Carpark, 30=Rear Carpark, 31=Vacant block)
<table>
<thead>
<tr>
<th>Relationship of School to Observer</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>(Schposit : 1= Front, 2= Back, 3= Left, 4= Right)</td>
<td></td>
</tr>
<tr>
<td>Relationship of School to Road</td>
<td></td>
</tr>
<tr>
<td>(Schsit : 1= Corner, 2= Mid Block, 3= Full Block)</td>
<td></td>
</tr>
<tr>
<td>Road Type within Observation Area</td>
<td></td>
</tr>
<tr>
<td>(Roadtype : 1= Arterial, 2= Sub-Arterial, 3= Local, 8= Not applicable)</td>
<td></td>
</tr>
<tr>
<td>Number of Road Entries Within Observation Area</td>
<td></td>
</tr>
<tr>
<td>(Entries : 1= 1 only, 2= 2, 3= more than 2, 4= None)</td>
<td></td>
</tr>
<tr>
<td>Types of Traffic Observed Near Child</td>
<td></td>
</tr>
<tr>
<td>(Traffic : 1= Car, 2= Truck, 3= Bus, 4= Motor Cycle, 5= Push Bike, 6= Mixed, 7= None, 8= Not Applicable)</td>
<td></td>
</tr>
<tr>
<td>Amount of Traffic</td>
<td></td>
</tr>
<tr>
<td>(Amounta : 1= Heavy, 2= Moderate, 3= Light, 4= None, 8= Not Applicable)</td>
<td></td>
</tr>
<tr>
<td>Designated Street Crossing</td>
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</tr>
<tr>
<td>(Crossing : 1= Yes, 2= No)</td>
<td></td>
</tr>
<tr>
<td>Crossing Controlled by Traffic Light Device</td>
<td></td>
</tr>
<tr>
<td>(Xtrafdev : 1= Yes, 2= No, 8= Not Applicable)</td>
<td></td>
</tr>
<tr>
<td>Crossing Supervised</td>
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<tr>
<td>(Xsuper : 1= Yes, 2= No, 8= Not Applicable)</td>
<td></td>
</tr>
<tr>
<td>Sex of Subject</td>
<td></td>
</tr>
<tr>
<td>(Sex : 1= Male, 2= Female)</td>
<td></td>
</tr>
<tr>
<td>Colour of Subject's Clothing</td>
<td></td>
</tr>
<tr>
<td>(Clothing : 1= Light, 2= Dark, 3= Mixed)</td>
<td></td>
</tr>
<tr>
<td>Subject Accompanied</td>
<td></td>
</tr>
<tr>
<td>(Company : 1= No, 2= Adult, 3= Child, 4= Kids, 5= Adult &amp; child, 6= Adult &amp; kids)</td>
<td></td>
</tr>
<tr>
<td>Subject's Hand Held</td>
<td></td>
</tr>
<tr>
<td>(Hand : 1= Adult Yes, 2= Child Yes, 3= No)</td>
<td></td>
</tr>
<tr>
<td>Child's Activity at Time of Observation</td>
<td></td>
</tr>
<tr>
<td>(Activity : 01= Walking, 02= Running, 03= Skipping, 04= Playing, 05= Reading, 06= Talking, 07= Chasing/retrieving object on road, 08= Eating, 09= Drinking, 10= Walking &amp; wheeling bicycle, 11= Walking &amp; drinking, 12= Walking &amp; eating, 13= Walking &amp; bouncing ball, 14= Walking &amp; talking, 15= Walking &amp; playing, 16= Walking &amp; reading, 17= Sitting, 18= Alighting from vehicle, 19= Walking, talking &amp; eating, 20= Standing, 21= Bending over, 22= Cycling, 88= Not Applicable)</td>
<td></td>
</tr>
<tr>
<td>Subject Appears to be Looking for Hazards</td>
<td></td>
</tr>
<tr>
<td>(Hazlook : 1= Yes, 2= No, 3= Intermittently)</td>
<td></td>
</tr>
<tr>
<td>Area Where Subject is Observed</td>
<td></td>
</tr>
<tr>
<td>(Precinct : 1= Footpath, 2= Verge, 3= Road, 4= Park, 5= School ground, 6= Outside shop, 7= Driveway, 8= Vacant block)</td>
<td></td>
</tr>
<tr>
<td>Did Subject Cross Road</td>
<td></td>
</tr>
<tr>
<td>(Xroad : 1= Yes, 2= No)</td>
<td></td>
</tr>
<tr>
<td>Road Entry Site Where Subject Crosses</td>
<td></td>
</tr>
<tr>
<td>(RoadX : 1= Intersection, 2= Mid-block, 3= T Junction, 8= Not Applicable)</td>
<td></td>
</tr>
</tbody>
</table>
Subject Stopped At Kerbside Prior To Crossing Road
(Kerbstop : 1=Yes, 2=No, 3=Unsighted, 8=Not Applicable)

Parked Vehicle(s) On Left Of Subject, Obstructing View
(Parkvehl : 1=Yes, 2=No, 8=Not Applicable)

Parked Vehicle(s) On Right Of Subject, Obstructing View
(Parkvehr : 1=Yes, 2=No, 8=Not Applicable)

Subject Crossed Between Parked Vehicles
(Xparkveh : 1=Yes, 2=No, 8=Not Applicable)

Subject Appears to Observe Traffic
(Seektraf : 1=Yes, 2=No, 3=Unsighted, 8=Not Applicable)

Subject's Head Movement(s) If Observing Traffic
(Headmove : 01=Right Only, 02=Left Only, 03=Right & Left,
04=Left & Right, 05=Right, Left, Right,
06=Left, Right, Left, 07=None, 08=Unsighted,
88=Not applicable)

Subject Used Traffic Control Device
(Trafdev : 1=Yes, 2=No, 8=Not Applicable)

Subject Appeared To Monitor Traffic Whilst Crossing
(Trafmonx : 1=Yes, 2=No, 3=Initially only,
4=Towards completion of crossing, 5=Intermittently,
6=Unsighted, 8=Not Applicable)

Subject's Pace Whist Crossing Road
(PaceX : 1=Walked, 2=Ran, 3=Walked & ran, 4=Skipped,
5=Cycled, 6=Unsighted, 8=Not Applicable)

Subject Crossed Within Designated Area
(Xdesarea : 1=Yes, 2=No, 8=Not Applicable)

Angle Subject Crossed Road
(Anglex : 1=Straight, 2=Angled, 8=Not Applicable)

Subject's Activity Post Crossing Road
(PostX : 01=Continued Walking, 02=Walking Looking Ahead,
03=Walking Not Looking, 04=Walking & Waving,
05=Running, 06=Skipping, 07=Cycling, 08=Running & walking,
09=Walking in gutter, 10=Playing, 11=Running & waving,
12=Sitting, 13=Stopped & talked, 14= Walking & reading,
15=Walking & talking, 16=Walking & bouncing ball,
88=Not Applicable)

Did Subject Travel in Vehicle (Travveh : 1=Yes, 2=No)

Subject Alighted From Vehicle
(Outveh : 01=Left Front, 02=Right Front 03=Left Rear,
04=Right Rear, 05=Right Side, 06=Left Side, 07=Back,
08=Not Sighted, 88=Not Applicable)
Subject Entered Vehicle

(Inveh : 01=Left Front, 02=Right Front, 03=Left Rear, 04=Right Rear, 05=Right Side, 06=Left Side, 07=Back, 08=Not Sighted, 88=Not Applicable)

Type of Vehicle Subject Alighted From

(Vehitype : 1=Car, 2=Van, 3=Utility, 4=Bus, 5=Motor Cycle, 6=Not Sighted, 7=4 Wheel Drive, 8=Not Applicable)

Did Subject Cross Road After Alighting From Vehicle

(PostvehX : 1=Yes, 2=No, 8=Not Applicable)

Type of Vehicle Subject Entered

(Vehypin : 1=Car, 2=Van, 3=Utility, 4=Bus, 5=Motor Cycle, 6=Not Sighted, 7=4 Wheel Drive, 8=Not Applicable)

Position of Stopped Vehicle When Subject Alighted

(Vehstout : 1=Car Park, 2=Roadside Closest Side To School, 3=Roadside Furtherest Side From School, 8=Not Applicable)

Subject Moved To Kerbside After Alighting From Vehicle

(Movekerb : 1=Yes, 2=No, 3=Unsighted, 8=Not Applicable)

Subject's Activity After Alighting From Vehicle

(Subact : 01=Walking, 02=Running, 03=Skipping, 04=Playing, 05=Reading, 06=Talking, 07=Chasing/retrieving object on road, 08=Eating, 09=Drinking, 10=Walking & wheeling bicycle, 11=Walking & drinking, 12=Walking & eating, 13=Walking & bouncing ball, 14=Walking & talking, 15=Walking & playing, 16=Walking & reading, 17=Standing & grooming, 18=Walking & waving, 19=Standing & adjusting back pack or similar, 20=Standing & adjusting back pack or similar, 21=Retrieving object from back of vehicle, 22=Standing waiting, 23=Walking & adjusting back pack, 88=Not Applicable)

Position of Stopped Vehicle When Subject Entered

(Vehstout : 1=Car Park, 2=Roadside Closest Side To School, 3=Roadside Furtherest Side From School, 8=Not Applicable)

Comment 1
APPENDIX B

DATA COLLECTION SCHEDULE
# Appendix B

## Data Collection Schedule

<table>
<thead>
<tr>
<th>School Pseudonym</th>
<th>Observation Session 1</th>
<th>Observation Session 2</th>
<th>Observation Session 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acacia</td>
<td>26/27:07:94</td>
<td>02/03:08:94</td>
<td>01/02:09:94</td>
</tr>
<tr>
<td>Adansonia</td>
<td>28/29:07:94</td>
<td>16/17:08:94</td>
<td>05/06:09:94</td>
</tr>
<tr>
<td>Banksia</td>
<td>04/05:08:94</td>
<td>22/23:08:94</td>
<td>19/20:09:94</td>
</tr>
<tr>
<td>Calytrix</td>
<td>08/09:08:94</td>
<td>24/25:08:94</td>
<td>15/16:09:94</td>
</tr>
<tr>
<td>Ipomoea</td>
<td>12:10:94</td>
<td>03:11:94</td>
<td>07:12:94</td>
</tr>
<tr>
<td>Melaleuca</td>
<td>01/02:11:94</td>
<td>29/30:11:94</td>
<td>05/06:12:94</td>
</tr>
<tr>
<td>Pandanus</td>
<td>25/26:10:94</td>
<td>07/08:11:94</td>
<td>01/02:12:94</td>
</tr>
</tbody>
</table>
APPENDIX C

ROAD SAFETY COUNCIL OF THE NORTHERN TERRITORY AUTHORITY TO CONDUCT RESEARCH
Mrs Cecilia Batterham
PO Box 42945
CASUARINA NT 0811

Dear Cecilia

This is to advise you that the Council met on 14 September and discussed your proposal to evaluate child pedestrian behaviour before and after receiving road safety education.

Your research proposal has been approved by the Council. It is noted that you will be working in conjunction with the Executive Officer, Research Officer and the Darwin Field Officer of the Road Safety Council.

Yours sincerely

ALEX RAE
Executive Officer

24 September 1993
APPENDIX D

NORTHERN TERRITORY UNIVERSITY HUMAN ETHICS CLEARANCE
HUMAN ETHICS COMMITTEE REPORT

PROJECT APPROVAL CODE: 10/93/16

NEW PROPOSAL

PROJECT TITLE: The Behaviour of Child Pedestrians Travelling to and from Darwin Primary Schools

CHIEF INVESTIGATOR(S): Ms Cecilia Batterham

The abovementioned project has been considered by the Human Ethics Committee of the Northern Territory.

The Committee is satisfied that the proposed experiments involved in this project conform with the general principles set out in the current National Health and Medical Research Council regulations on experimentation, and with the policy of the Northern Territory University.

Expiry date: 10 November 1994

APPROVED

Chair, NTU Human Ethics Committee

Date: 30.11.93

273
HUMAN ETHICS COMMITTEE REPORT

PROJECT APPROVAL CODE: 10/93/16

RENEWAL

PROJECT TITLE: The Behaviour of Child Pedestrians Travelling to and from Darwin Primary Schools

CHIEF INVESTIGATOR(S): Ms Cecilia Batterham

The abovementioned project has been considered by the Human Ethics Committee of the Northern Territory.

The Committee is satisfied that the proposed experiments involved in this project conform with the general principles set out in the current National Health and Medical Research Council regulations on experimentation, and with the policy of the Northern Territory University.

Expiry date: 10 November 1995

APPROVED

Chair, NTU Human Ethics Committee

Date: 14 November, 1994
Re: Application for Renewal of Ethics Clearance, Reference No. 109316.

Dear Ms Batterham

The Northern Territory University Human Ethics Committee has approved your application for renewal of ethics clearance for your project titled *The behaviour of child pedestrians travelling to and from Darwin primary schools*. Please find attached a notice of clearance.

The expiry date of ethics approval for your project is 10 March, 2000. It is the responsibility of the researcher to ensure that ethics approval is renewed prior to the expiry date. If further renewal is necessary, you will need to submit a progress report including a statement of compliance with ethical requirements, and detailing any proposed or actual changes to the project which may affect its ethical acceptability. Renewal/Final Report forms may be downloaded from the Web at: [www.ntu.edu.au](http://www.ntu.edu.au/admin/research/) or obtained from the Research Branch.

If any significant alterations to your project are contemplated, or if any matters arise which may conceivably affect the continued ethical acceptability of the project, you are required to immediately notify the Human Ethics Committee.

Yours sincerely

Elizabeth Jacob
Executive Officer

for Associate Professor Charles Webb
Chair, NTU Human Ethics Committee
20 March, 2000

Ms Cecilia Batterham
PO Box 42945
CASUARINA NT 0811

Dear Ms Batterham

APPLICATION FOR RENEWAL OF ETHICS CLEARANCE, REF. NO. 109316.

The Northern Territory University Human Ethics Committee has approved your application for renewal of ethics clearance for your project titled The behaviour of child pedestrians travelling to and from Darwin primary schools. Please find attached a notice of clearance.

The expiry date of ethics approval for your project is 08/03/01. It is the responsibility of the researcher to ensure that ethics approval is renewed prior to the expiry date. If further renewal is necessary, you will need to submit a progress report including a statement of compliance with ethical requirements, and detailing any proposed or actual changes to the project, which may affect its ethical acceptability. Renewal/Final Report forms may be downloaded from the Web at: www.ntu.edu.au/admin/research/ or obtained from the Higher Education & Research Branch.

If any significant alterations to your project are contemplated, or if any matters arise which may conceivably affect the continued ethical acceptability of the project, you are required to immediately notify the Human Ethics Committee.

Yours sincerely

Hemali Seneviratne
Executive Officer

for Associate Professor Charles Webb
Chair, NTU Human Ethics Committee
APPLICATION FOR RENEWAL OF ETHICS CLEARANCE, REF. NO. 109316.

The Northern Territory University Human Ethics Committee has approved your application for renewal of ethics clearance for your project titled *The behaviour of child pedestrians travelling to and from Darwin primary schools*. Please find attached a notice of clearance.

The expiry date of ethics approval for your project is 18/04/02. It is the responsibility of the researcher to ensure that ethics approval is renewed prior to the expiry date. If further renewal is necessary, you will need to submit a progress report including a statement of compliance with ethical requirements, and detailing any proposed or actual changes to the project, which may affect its ethical acceptability. Renewal/Final Report forms may be downloaded from the Web at: www.ntu.edu.au/corporate/research/ or obtained from the Higher Education & Research Branch.

If any significant alterations to your project are contemplated, or if any matters arise which may conceivably affect the continued ethical acceptability of the project, you are required to immediately notify the Human Ethics Committee.

Yours sincerely,

Hemali Seneviratne
Executive Officer

for Associate Professor Charles Webb
Chair, NTU Human Ethics Committee
APPENDIX E

NORTHERN TERRITORY DEPARTMENT OF EDUCATION
AUTHORISATION TO CONDUCT RESEARCH
Ms Cecilia Batterham
PO Box 42945
CASUARINA NT 0811

Dear Cecilia

Thank you for your application to conduct research involving NT schools.

I am pleased to inform you that subject to your complying with the conditions stated below, the Department has approved your application to carry out the following study:

'Behaviour of Child Pedestrians Travelling to and from Darwin Primary Schools'.

I note from your proposal that you intend to videotape a number of students travelling to and from Darwin primary schools. In this regard, I need to receive a written statement from you that the confidentiality of participants is protected.

The guidelines which we share with the NT University in relation to videotaping for research purposes are as follows:

'No names of actual schools or people are to be used. Pseudonyms or codes must be used in field notes, audio or videotapes, etc. The tapes are then only to be viewed by agreed upon audiences, and this is agreed upon and specified within a written contract. If any tapes are to be used for any other purpose, prior consent must be given by the teacher or persons videotaped'.

Your written statement should confirm that the above guidelines will be followed. Please note that you will also need to approach each of the schools concerned to obtain permission to carry out the study and to make any necessary arrangements for observation and videotaping.

Regards and best wishes

Cliff Fowler

CLIFF FOWLER
Chief Assessor

24 December 1993

copy to: Superintendents, Darwin Primary Schools
APPENDIX F

TABLES
<table>
<thead>
<tr>
<th>Table No:</th>
<th>Table Title</th>
<th>Page No:</th>
</tr>
</thead>
<tbody>
<tr>
<td>F1</td>
<td>Control and experimental subjects’ compliance % and significance levels to road crossing elements, based on Out and About program, at first observation session</td>
<td>281</td>
</tr>
<tr>
<td>F2</td>
<td>Road crossing behavioural elements: compliance rates for control and experimental groups at each observation session (%)</td>
<td>282</td>
</tr>
<tr>
<td>F3</td>
<td>Control and experimental subjects’ level of compliance on the CS at second and third observation sessions (%)</td>
<td>283</td>
</tr>
<tr>
<td>F4</td>
<td>5-7 year old control and experimental subjects’ level of compliance on the CS at second and third observation sessions (%)</td>
<td>283</td>
</tr>
<tr>
<td>F5</td>
<td>8-10 year control and experimental subjects’ level of compliance on the CS at second and third observation sessions (%)</td>
<td>283</td>
</tr>
<tr>
<td>F6</td>
<td>11-13 year old control and experimental subjects’ level of compliance on the CS at second and third observation sessions (%)</td>
<td>284</td>
</tr>
<tr>
<td>F7</td>
<td>Male control and experimental subjects’ level of compliance on the CS at second and third observation sessions (%)</td>
<td>284</td>
</tr>
<tr>
<td>F8</td>
<td>Female control and experimental subjects’ level of compliance on the CS at second and third observation sessions (%)</td>
<td>284</td>
</tr>
<tr>
<td>No:</td>
<td>Table Title</td>
<td>Page</td>
</tr>
<tr>
<td>-----</td>
<td>------------------------------------------------------------------------------</td>
<td>------</td>
</tr>
<tr>
<td>F9</td>
<td>Control and experimental subjects’ level of compliance on the MS at second and third observation sessions (%)</td>
<td>285</td>
</tr>
<tr>
<td>F10</td>
<td>5-7 year old control and experimental subjects’ level of compliance for MS at second and third observation sessions (%)</td>
<td>285</td>
</tr>
<tr>
<td>F11</td>
<td>8-10 year old control and experimental subjects’ level of compliance on the MS at second and third observation sessions (%)</td>
<td>285</td>
</tr>
<tr>
<td>F12</td>
<td>11-13 year old control and experimental subjects’ level of compliance on the MS at second and third observation sessions (%)</td>
<td>286</td>
</tr>
<tr>
<td>F13</td>
<td>Male control and experimental subjects’ level of compliance on the MS at second and third observation sessions (%)</td>
<td>286</td>
</tr>
<tr>
<td>F14</td>
<td>Female control and experimental subjects’ level of compliance on the MS at second and third observation sessions (%)</td>
<td>286</td>
</tr>
</tbody>
</table>
Table F1  Control and experimental subjects’ compliance % and significance levels to road crossing elements, based on *Out and About* program, at first observation session

<table>
<thead>
<tr>
<th>Road Crossing Element</th>
<th>Obs. 1</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>Didn’t cross between parked vehicles:</em></td>
<td></td>
</tr>
<tr>
<td>Control</td>
<td>99</td>
</tr>
<tr>
<td>Experimental</td>
<td>98</td>
</tr>
<tr>
<td><em>p</em> = 0.26</td>
<td></td>
</tr>
<tr>
<td><em>Crossed within designated area:</em></td>
<td></td>
</tr>
<tr>
<td>Control</td>
<td>83</td>
</tr>
<tr>
<td>Experimental</td>
<td>78</td>
</tr>
<tr>
<td><em>p</em> = 0.14</td>
<td></td>
</tr>
<tr>
<td><em>View not obstructed by vehicle parked on left:</em></td>
<td></td>
</tr>
<tr>
<td>Control</td>
<td>98</td>
</tr>
<tr>
<td>Experimental</td>
<td>97</td>
</tr>
<tr>
<td><em>p</em> = 0.26</td>
<td></td>
</tr>
<tr>
<td><em>View not obstructed by vehicle parked on right:</em></td>
<td></td>
</tr>
<tr>
<td>Control</td>
<td>99</td>
</tr>
<tr>
<td>Experimental</td>
<td>97</td>
</tr>
<tr>
<td><em>p</em> = 0.07</td>
<td></td>
</tr>
<tr>
<td><em>Stopped at kerb:</em></td>
<td></td>
</tr>
<tr>
<td>Control</td>
<td>48</td>
</tr>
<tr>
<td>Experimental</td>
<td>54</td>
</tr>
<tr>
<td><em>p</em> = 0.11</td>
<td></td>
</tr>
<tr>
<td><em>Head movements:</em></td>
<td></td>
</tr>
<tr>
<td>Control</td>
<td>16</td>
</tr>
<tr>
<td>Experimental</td>
<td>24</td>
</tr>
<tr>
<td><em>p</em> = 0.03</td>
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<tr>
<td><em>Monitored traffic whilst crossing road:</em></td>
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</tr>
<tr>
<td>Control</td>
<td>11</td>
</tr>
<tr>
<td>Experimental</td>
<td>26</td>
</tr>
<tr>
<td><em>p</em> = 0.00</td>
<td></td>
</tr>
<tr>
<td><em>Walked whilst crossing:</em></td>
<td></td>
</tr>
<tr>
<td>Control</td>
<td>86</td>
</tr>
<tr>
<td>Experimental</td>
<td>88</td>
</tr>
<tr>
<td><em>p</em> = 0.28</td>
<td></td>
</tr>
<tr>
<td><em>Crossed straight:</em></td>
<td></td>
</tr>
<tr>
<td>Control</td>
<td>86</td>
</tr>
<tr>
<td>Experimental</td>
<td>79</td>
</tr>
<tr>
<td><em>p</em> = 0.02</td>
<td></td>
</tr>
</tbody>
</table>
Table F2  
Road crossing behavioural elements: compliance rates for control and experimental groups at each observation session (%)

<table>
<thead>
<tr>
<th>Element Description</th>
<th>Observation 1 Compliance %</th>
<th>Observation 2 Compliance %</th>
<th>Observation 3 Compliance %</th>
</tr>
</thead>
<tbody>
<tr>
<td>Refrained from crossing between parked vehicles:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Control</td>
<td>99</td>
<td>99</td>
<td>100</td>
</tr>
<tr>
<td>Experimental</td>
<td>98</td>
<td>99</td>
<td>100</td>
</tr>
<tr>
<td>Crossed in designated area:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Control</td>
<td>83</td>
<td>84</td>
<td>84</td>
</tr>
<tr>
<td>Experimental</td>
<td>78</td>
<td>82</td>
<td>78</td>
</tr>
<tr>
<td>View not obstructed by vehicle parked on left:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Control</td>
<td>98</td>
<td>99</td>
<td>99</td>
</tr>
<tr>
<td>Experimental</td>
<td>97</td>
<td>99</td>
<td>98</td>
</tr>
<tr>
<td>View not obstructed by vehicle parked on right:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Control</td>
<td>99</td>
<td>99</td>
<td>100</td>
</tr>
<tr>
<td>Experimental</td>
<td>97</td>
<td>99</td>
<td>98</td>
</tr>
<tr>
<td>Stopped at kerb:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Control</td>
<td>48</td>
<td>44</td>
<td>51</td>
</tr>
<tr>
<td>Experimental</td>
<td>54</td>
<td>55</td>
<td>52</td>
</tr>
<tr>
<td>Head movements:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Control</td>
<td>16</td>
<td>17</td>
<td>23</td>
</tr>
<tr>
<td>Experimental</td>
<td>24</td>
<td>19</td>
<td>20</td>
</tr>
<tr>
<td>Monitored traffic whilst crossing road:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Control</td>
<td>11</td>
<td>17</td>
<td>13</td>
</tr>
<tr>
<td>Experimental</td>
<td>26</td>
<td>19</td>
<td>22</td>
</tr>
<tr>
<td>Walked whilst crossing</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Control</td>
<td>86</td>
<td>89</td>
<td>92</td>
</tr>
<tr>
<td>Experimental</td>
<td>88</td>
<td>90</td>
<td>89</td>
</tr>
<tr>
<td>Crossed straight:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Control</td>
<td>86</td>
<td>89</td>
<td>85</td>
</tr>
<tr>
<td>Experimental</td>
<td>79</td>
<td>82</td>
<td>78</td>
</tr>
</tbody>
</table>
Table F3  Control and experimental subjects' level of compliance on the CS at second and third observation sessions (%)

<table>
<thead>
<tr>
<th>Group</th>
<th>2nd Observation Session High Compliance %</th>
<th>p =</th>
<th>3rd Observation Session High Compliance %</th>
<th>Change %</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control</td>
<td>84</td>
<td>0.30</td>
<td>82</td>
<td>-2</td>
</tr>
<tr>
<td></td>
<td></td>
<td>p = 0.049</td>
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<td>p = 0.01</td>
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<tr>
<td>Experimental</td>
<td>79</td>
<td>0.09</td>
<td>74</td>
<td>-5</td>
</tr>
</tbody>
</table>

Table F4  5-7 year old control and experimental subjects' level of compliance on the CS at second and third observation sessions (%)

<table>
<thead>
<tr>
<th>Group</th>
<th>2nd Observation Session High Compliance %</th>
<th>p =</th>
<th>3rd Observation Session High Compliance %</th>
<th>Change %</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control</td>
<td>84</td>
<td>0.14</td>
<td>76</td>
<td>-8</td>
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<tr>
<td></td>
<td></td>
<td>p = 0.41</td>
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<td>p = 0.46</td>
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<tr>
<td>Experimental</td>
<td>81</td>
<td>0.32</td>
<td>78</td>
<td>+3</td>
</tr>
</tbody>
</table>

Table F5  8-10 year control and experimental subjects' level of compliance on the CS at second and third observation sessions (%)

<table>
<thead>
<tr>
<th>Group</th>
<th>2nd Observation Session High Compliance %</th>
<th>p =</th>
<th>3rd Observation Session High Compliance %</th>
<th>Change %</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control</td>
<td>85</td>
<td>0.36</td>
<td>83</td>
<td>-2</td>
</tr>
<tr>
<td></td>
<td></td>
<td>p = 0.06</td>
<td></td>
<td>p = 0.07</td>
</tr>
<tr>
<td>Experimental</td>
<td>77</td>
<td>0.36</td>
<td>75</td>
<td>-2</td>
</tr>
</tbody>
</table>
Table F6  11-13 year old control and experimental subjects’ level of compliance on the CS at second and third observation sessions (%)

<table>
<thead>
<tr>
<th>Group</th>
<th>2nd Observation Session High Compliance %</th>
<th>p =</th>
<th>3rd Observation Session High Compliance %</th>
<th>Change %</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control</td>
<td>High</td>
<td>84</td>
<td>0.27</td>
<td>High</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>p = 0.28</td>
</tr>
<tr>
<td>Experimental</td>
<td>High</td>
<td>79</td>
<td>0.11</td>
<td>High</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>p = 0.00</td>
</tr>
</tbody>
</table>

Table F7  Male control and experimental subjects’ level of compliance on the CS at second and third observation sessions (%)

<table>
<thead>
<tr>
<th>Group</th>
<th>2nd Observation Session High Compliance %</th>
<th>p =</th>
<th>3rd Observation Session High Compliance %</th>
<th>Change %</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control</td>
<td>80</td>
<td>0.28</td>
<td>76</td>
<td>-4</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>p = 0.30</td>
</tr>
<tr>
<td>Experimental</td>
<td>77</td>
<td>0.52</td>
<td>77</td>
<td>+0</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>p = 0.48</td>
</tr>
</tbody>
</table>

Table F8  Female control and experimental subjects’ level of compliance on the CS at second and third observation sessions (%)

<table>
<thead>
<tr>
<th>Group</th>
<th>2nd Observation Session High Compliance %</th>
<th>p =</th>
<th>3rd Observation Session High Compliance %</th>
<th>Change %</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control</td>
<td>88</td>
<td>0.49</td>
<td>88</td>
<td>+0</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>p = 0.05</td>
</tr>
<tr>
<td>Experimental</td>
<td>81</td>
<td>0.03</td>
<td>71</td>
<td>-10</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>p = 0.00</td>
</tr>
</tbody>
</table>
Table F9  Control and experimental subjects' level of compliance on the MS at second and third observation sessions (%)

<table>
<thead>
<tr>
<th>Group</th>
<th>2nd Observation Session High Compliance</th>
<th>$p$</th>
<th>3rd Observation Session High Compliance</th>
<th>Change %</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control</td>
<td>High</td>
<td>0.38</td>
<td>High</td>
<td>20</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Experimental</td>
<td>High</td>
<td>0.48</td>
<td>High</td>
<td>22</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table F10  5-7 year old control and experimental subjects' level of compliance for MS at second and third observation sessions (%)

<table>
<thead>
<tr>
<th>Group</th>
<th>1st Observation Session High %</th>
<th>$p$</th>
<th>2nd Observation Session High %</th>
<th>Change %</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control</td>
<td>23</td>
<td>0.12</td>
<td>14</td>
<td>-9</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Experimental</td>
<td>20</td>
<td>0.32</td>
<td>16</td>
<td>-4</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table F11  8-10 year old control and experimental subjects' level of compliance on the MS at second and third observation sessions (%)

<table>
<thead>
<tr>
<th>Group</th>
<th>2nd Observation Session High Compliance</th>
<th>$p$</th>
<th>3rd Observation Session High Compliance</th>
<th>Change %</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control</td>
<td>21</td>
<td>0.41</td>
<td>19</td>
<td>-2</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Experimental</td>
<td>27</td>
<td>0.18</td>
<td>24</td>
<td>-3</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
### Table F12  
11-13 year old control and experimental subjects’ level of compliance on the MS at second and third observation sessions (%)

<table>
<thead>
<tr>
<th>Group</th>
<th>2(^{nd}) Observation Session High Compliance</th>
<th>(p)</th>
<th>3(^{rd}) Observation Session High Compliance</th>
<th>Change %</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control</td>
<td>20</td>
<td>0.21</td>
<td>27</td>
<td>+7</td>
</tr>
<tr>
<td></td>
<td>(p = 0.44)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Experimental</td>
<td>18</td>
<td>0.18</td>
<td>25</td>
<td>+7</td>
</tr>
</tbody>
</table>

### Table F13  
Male control and experimental subjects’ level of compliance on the MS at second and third observation sessions (%)

<table>
<thead>
<tr>
<th>Group</th>
<th>2(^{nd}) Observation Session High Compliance</th>
<th>(p)</th>
<th>3(^{rd}) Observation Session High Compliance</th>
<th>Change %</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control</td>
<td>22</td>
<td>0.36</td>
<td>19</td>
<td>-3</td>
</tr>
<tr>
<td></td>
<td>(p = 0.30)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Experimental</td>
<td>19</td>
<td>0.11</td>
<td>25</td>
<td>+6</td>
</tr>
</tbody>
</table>

### Table F14  
Female control and experimental subjects’ level of compliance on the MS at second and third observation sessions (%)

<table>
<thead>
<tr>
<th>Group</th>
<th>2(^{nd}) Observation Session High Compliance</th>
<th>(p)</th>
<th>3(^{rd}) Observation Session High Compliance</th>
<th>Change %</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control</td>
<td>21</td>
<td>0.52</td>
<td>20</td>
<td>-1</td>
</tr>
<tr>
<td></td>
<td>(p = 0.15)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Experimental</td>
<td>26</td>
<td>0.08</td>
<td>19</td>
<td>-7</td>
</tr>
</tbody>
</table>
APPENDIX G

FLOWCHARTS
Pedestrian looks for a designated crossing site.

Is there a designated road crossing site close by?

Yes

Pedestrian moves to crossing site

No

Is this a designated road crossing site?

Yes

Pedestrian selects and moves to kerbside area where there is a clear view of approaching traffic.

No

Has pedestrian stopped at kerbside?

Yes

Are parked vehicles obstructing the pedestrian view either side of crossing site?

No

Are there any signals lights at the crossing site?

Yes

Are the signal lights working?

Yes

Pedestrian: Presses traffic control button

Waits for Walk signal

No

Pedestrian: Looks to the right

Looks to the left

Looks to the right again

No

Is the crossing at an intersection?

Yes

Pedestrian: Looks to the right

Looks to the left

Looks behind, around the corner

Looks to the right again

No

Pedestrian: Presses traffic control button

Waits for Walk signal

Are any vehicles moving toward the crossing site?

Yes

Pedestrian crosses:

a) straight across road

b) walks quickly, NOT running

c) watches for oncoming traffic

d) goes to the opposite kerbside

e) does not turn back when part way across road

No

Are the road clear of traffic?

Yes

Pedestrian: Presses traffic control button

Waits for Walk signal

No

DANGER UNSAFE ZONE

END

Figure 5.1 Teacher's Version of Children's Road-Crossing Behaviour at Kerbside & Crossing Sites
Select and move to kerbside area where there is a clear view of approaching traffic.

• Go to centre line of crossing at kerbside
• Stop
• While looking to the right, walk forward until you have a clear view of approaching traffic.
• Stop
• While looking to the right step out as far as the outside edge of parked vehicles
• Stop

DANGER
UNSAFE
ZONE

Figure 5.2 Pedestrian’s Version: Children’s Road-Crossing Decisions

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