CHILDREN'S PERCEPTION OF SAFETY AND DANGER ON THE ROAD

by

KWAME AMPOFO-BOATENG B.A.(Hons.) LEGON (GHANA)

A thesis submitted in accordance with the regulations governing the award of the Degree of Doctor of Philosophy in Psychology

Department of Psychology
University of Strathclyde
Glasgow

September, 1987

D E C L A R A T I O N

I certify that the work reported in this thesis is my own.

KWAME AMPOFO-BOATENG

DEDICATION

My parents James Kwabena Ampofo and Susanna Ama Bema for the things they did for me while I was growing up.

Kwadwo Asante, Kwame Kyere, Kwame Boateng, Adwoa Manu, Akwasi Kuma, Abena Amakyewaa and Kofi Asare for the fight against the 'Northern Saga'.

'It appears that the onus of responsibility for children in traffic must be laid equally on town planners, drivers, and other responsible adults, as well as on the parents, because children themselves are innocent victims of our lack of knowledge concerning how they behave in traffic situations'
(Sandels S. (1975) Children in traffic, p.3)

ACKNOWLEDGEMENTS

The work reported in this thesis would not have been completed without the kind help and co-operation of the following people:-

Dr James A. Thomson who supervised the project, for his constructive criticisms, suggestions and encouragement;

Dr Bill Cheyne for discussions and additional statistical help;

Prof. Anthony Chapman and Dr. Noel Sheehy for providing extra reading materials;

George Gillespie, Gerald Cummings, Wendy Hoyle and Susan Sutherland for evaluating the task-situations, contacting the schools, providing materials for constructing the table-top models, and making available the Road Accident Statistics of the Strathclyde Region;

The teachers for organising the children, and the children for participating in the experiments;

Dr Gabriel Boakye-Ansah for helping to draw the graphs;

Janice Brownlee (student advisor) for helping in many ways;

Prof. Gustav Jahoda and family, Mr Charles A. Addo and family, Kom Amfoh, Bernee Tewari and Kelvin, Dr. Gabriel Boakye-Ansah and family, and the Smiths of Edinburgh for making the three years away from home less difficult to bear;

Ama Asor, Joseph Allen Kwabena Amponsah, Ama Akoko-Sakyiwaa, Yaw Anhwere-Bekoe and Kwasi Obiri-Yeboah 'menim se mo te ase a anka mo ani begye se m'asua adee abedu ha';

Jean Thomson for typing the thesis.

ABSTRACT

This thesis examines aspects of children's road safety awareness in relation to road crossing. The principal concern is with children's ability to discriminate safe from dangerous road crossing sites and their ability to select safe routes to cross the road. The influence of age, sex and specific road environmental features (hedges, bends, junctions, parked cars and zebra crossings) on safety judgements are explored. Children's judgements were obtained in a variety of experimental situations including table-top models, photographic posters and the real-world traffic environment. The results showed no sex differences in children's understanding of road dangers, but very significant age differences. Five and seven year olds used as their main referent the presence or absence of cars on the road to determine whether a situation was safe or dangerous. Other dangers, for example, an obscured view, were ignored. They were also inclined to select the shortest and most direct route as the safest. Nine and eleven year olds by contrast reasoned that even without cars on the road some crossing sites and routes were potentially dangerous because they did not permit an adequate view of the roadway. They also noted more varied and relevant road features in estimating safety and danger. On the basis of the findings, a preliminary training scheme was designed using a large table-top model to see if the younger children's skills could be improved. The results of the training were encouraging; the implications of the findings for child pedestrian research and training are discussed. Other psychological factors which may facilitate or hinder child pedestrians ability to identify safety and danger in traffic are also considered.

TABLE OF CONTENTS

CHAPTER 9: GENERAL DISCUSSION

APPENDICES

CHAPTER 1

INTRODUCTION

1.1 CHILDHOOD ACCIDENTS

Not long ago, the major cause of death to children was diseases. The decline in the frequency of diseases is attributable to their current effective preventive and curative control. Accidents to children, however, continue to increase (Baker, O'Neil and Kapf, 1984). And whether 'measured in terms of mortality or morbidity, accidents are one of the most important problems of child health today' (Jackson, 1978, p.807).

In the United Kingdom accidents are responsible for 15 to 40% of paediatric admissions of children (Child Accident Prevention Centre, 1981; Jackson, 1978; Illingworth, 1977); 26.3% of deaths in children aged over 1 year (Watson, 1982); and 19.8% of all children admitted to hospital annually (Sibert, Maddocks and Brown, 1981). The pattern is the same in the United States of America where O'Shea, Collins and Butler (1982) saw accidents as the main cause of death of children over the age of 1. In developing countries the importance of childhood accidents is often overshadowed by the problems of infection and malnutrition. However, where valid statistics are available accidents are at least as numerous (Marcusson and Oehmisch, 1977). This was confirmed by Simmons (1985) who in a two-month period in Malawi, a developing country, found accidents as being the cause of hospital admission of seventy seven children.

The trend of childhood accidents in terms of severity and specific cause, however, varies with age. Kravitz (1973), for example, reported that 91% of all injuries and more than one half of the fatalities to children under 5 years of age occur at home (see also Mitchell, 1972). Reporting on the death rates associated with fires, Marcusson and Oehmisch (1977) also observed their occurrence in the 1-4 year olds to be three times higher than in the age group 5-14 years. However, increasing age brings the child into a widening environment which introduces fresh dangers not previously encountered. Traffic death rates are therefore far higher among the 5-14 year olds than the 1-4 year olds (Marcusson and Oehmisch, 1977) the former being more exposed to the road traffic environment.

Overall also, the risk of traffic accidents to children as pedestrians is high, not only by comparison to other age groups but to other threats such as poisoning and drowning (Rothengatter, 1981a). Extensive statistical information has, therefore, been gathered from a variety of sources on these trends. We will begin by examining this literature in the hope that informative patterns and trends can be identified. We will also note some of the problems of analysing and evaluating such information.

Though variances exist in the definition of the term 'children' in accident statistics our analysis, consistent with the age classifications of O'Shea *et al*., 1982; Foot, Chapman and Wade, 1982; and the Scottish Health Statistics, 1984; will define children as those under 15 years of age.

1.1.1 Problems of accident statistics

Before reviewing the literature on accident statistics, it is important to bring to the reader's attention a number of points which must be kept in mind when evaluating this literature. An initial problem with accident statistics is that the seriousness of childhood accidents is typically under-estimated through a variety of factors. Inaccurate compilation, for example, is not uncommon (Sheehy and Chapman, 1984; O'Shea *et al*., 1982; Morris, 1972). Moreover, whilst most fatal and very serious accidents are almost reported, accidents which result in minor injuries are probably under-reported. This is because serious accidents are more likely to attract the attention of the police, road safety officers and the media due to the large number of people and vehicles involved, the seriousness of the injuries usually sustained and the attendant legal implications (Morris, 1972). Official accident statistics should therefore be seen to under-estimate rather than over-estimate childhood accidents. This is concurred by O'Shea et al., (1982) conclusion that 'most of the information available about childhood accidents concerns those resulting in death or a visit to a privately practicing health-care provider. Most minor injuries go unreported by parents and uncounted by statisticians'(p.290).

Data on accidents have also been found to be problematic in several ways, due mainly to incompleteness of records, insufficient descriptions of accident characteristics and doubtful classification systems (Noordzij and Muhlrad, 1979). Accident statistics in most cases also tabulate the number of people involved in general categories of accidents (for example, pedestrians versus cyclists) without explaining in detail how the accidents happened. This prompted Sheehy and Chapman (1984) to conclude that accident statistics on their own do not explain anything: there is a need for a set of alternative causal models if statistics are to be interpreted and put to use. We will return to this again below.

1.1.2 Pedestrian accident statistics of children and the child pedestrian accident problem.

Pedestrian accident statistics are normally reported in one of two ways; a numerical count of casualties classified by age and sex of the pedestrian and by injury severity; or a casualty rate presented in terms of casualties per 100,000 population (Foot et al., 1982). While the former statistics present accidents by absolute figures the latter allows a detail comparison between age and sex in relation to trends within the entire national population.

Getting an accurate picture of children involved in pedestrian accidents is, however, not easy, as the official statistics pertaining to these are often inadequate.

It is, for example, not always possible to compare the incidence of pedestrian accidents and other types of accidents. This is because the accident statistics do not always include such comparisons though some investigators have, however, been able to achieve such comparisons to some extent. O'Shea et al., (1982) in a review of childhood accidental deaths in the United States of America in 1978, shown in Table 1.1, were able to compare moving vehicle accidents with other childhood accidents. They found that in order of decreasing frequency, serious accidents included moving-vehicle accidents, water related accidents, burns, falls and poisoning. Their analysis, however, did not allow a proper comparison between child pedestrian accidents and other childhood accidents, because their moving-vehicle accident figures were a combined total of children's accidents as automobile or school bus passengers, cyclists, bicycle passengers, pedestrians, skateboard drivers, and lawnmower victims. The Scottish Health Statistics (1983) confirmed the trend that children in the 1-4 and 5-14 age groups suffered the majority of mortalities through home and traffic accidents respectively (see Table 1.2). However, here also, it was not possible to calculate the proportion of deaths caused by pedestrian accidents since the statistics did not include this (Scottish Health Statistics, 1983).

Table 1.1: Childhood accident deaths in the United States in 1978.

Ages	Total	Moving Vehicle	Water-Related	Burns	Falls	Poisonings
<1 year	1,262	264	66	154	71	24
1-4	3,504	1,287	636	742	121	108
5-14	6,118	3,130	1,028	586	124	113

Where official statistics are available, however, there is no doubt that accidents in road traffic are seen as the leading single cause of death of children in highly motorised countries. A recent W.H.O. report gave credence to this when it concluded that accidents cause between a quarter and half the deaths in Europe in the 1-4 age group; traffic accidents represent one third and half of this total and are the most common cause of accidental deaths (Deschamps, 1981).

Where a breakdown is possible, pedestrian accidents do constitute the bulk of road traffic accidents of children. England and Wales statistics on road accidents to children aged 1-14 years (see Table 1.3) included such a breakdown, showing clearly that the vast majority of traffic accidents involved children as pedestrians.

Table 1.2: Childhood mortality for selected causes in Scotland, 1983.

Type of Accidents	Age Groups (Years)		
	Under 1	1 - 4	5 - 14
Traffic Accidents	1	3	60
Home Accidents	11	17	11

Table 1.3: Statistics on road accidents to children in England and Wales, 1976 (Registrar General, 1976).

Type of Road Accident	Killed	Seriously injured	Slightly injured
Pedestrians	405	7,461	21,072
Cyclists	102	2,022	7,939
Passengers in vehicles	100	1,759	10,209
Drivers or passengers on motor bicycle	2	94	266

Concerning children also, when age groups are included in accident statistics, the incidence of pedestrian accidents is highest in the 5-9 year age group followed by the 0-4 and lastly 10-14. Table 1.4, showing the proportion of child pedestrian fatalities (expressed as an average of the total number of fatalities in the 0-14 year age group) in the 16 member countries of the Organisation for Economic Co-operation and Development (O.E.C.D.) in 1979 confirms these age differences (O.E.C.D., 1983).

The incidence of pedestrian accidents is highest in the 5-9 year olds not only in terms of comparisons within the 0-14 year age group but by comparison with other age groups outside this range. Foot, Chapman and Wade (1982) confirmed this when they concluded after a thorough assessment of road accidents in Great Britain (1975-1978) that children aged 5-9 years were the most involved in pedestrian accidents. In fact, the casualty rates of the 5-9 year olds for the period under consideration were 5 times that of adults aged 20-59 years.

Table 1.4: Child pedestrian fatalities by age groups in O.E.C.D. member countries, 1979 (O.E.C.D., 1983).

Age Groups (Years)	Mean
0 - 4	33.6
5 - 9	46.4
10 - 14	20.0

The 2,700 child pedestrians who were killed on British roads in 1982 were also 4 times the casualty rate (per 100,000 population) for 20-59 year old adults (Road Accidents Great Britain, 1982). In 1985 also, the number of child pedestrians within the 5-9 age group killed were more than all the other age classifications within both the 0-14 and the 20-59 age groups (Road Accidents Great Britain, 1985). Since 1972 also, 5-9 year olds have always topped the list of pedestrians killed or seriously injured per 100,000 population in Great Britain (see Figure 1.1) (Road Accidents Great Britain, 1985).

There is also a striking sex difference in the child pedestrian casualty rates, showing that boys are twice as likely to be involved in pedestrian accidents as girls. Foot et al., (1982) in an indepth breakdown of road accident statistics of Britain found this sex difference to be the most dominant feature in the number of casualties (of all severities) sustained by children under the age of 10 years. The importance of this sex difference will be discussed in more detail below.

As our investigation took place in the Strathclyde Region of West Central Scotland, it is important to examine the accident pattern here.

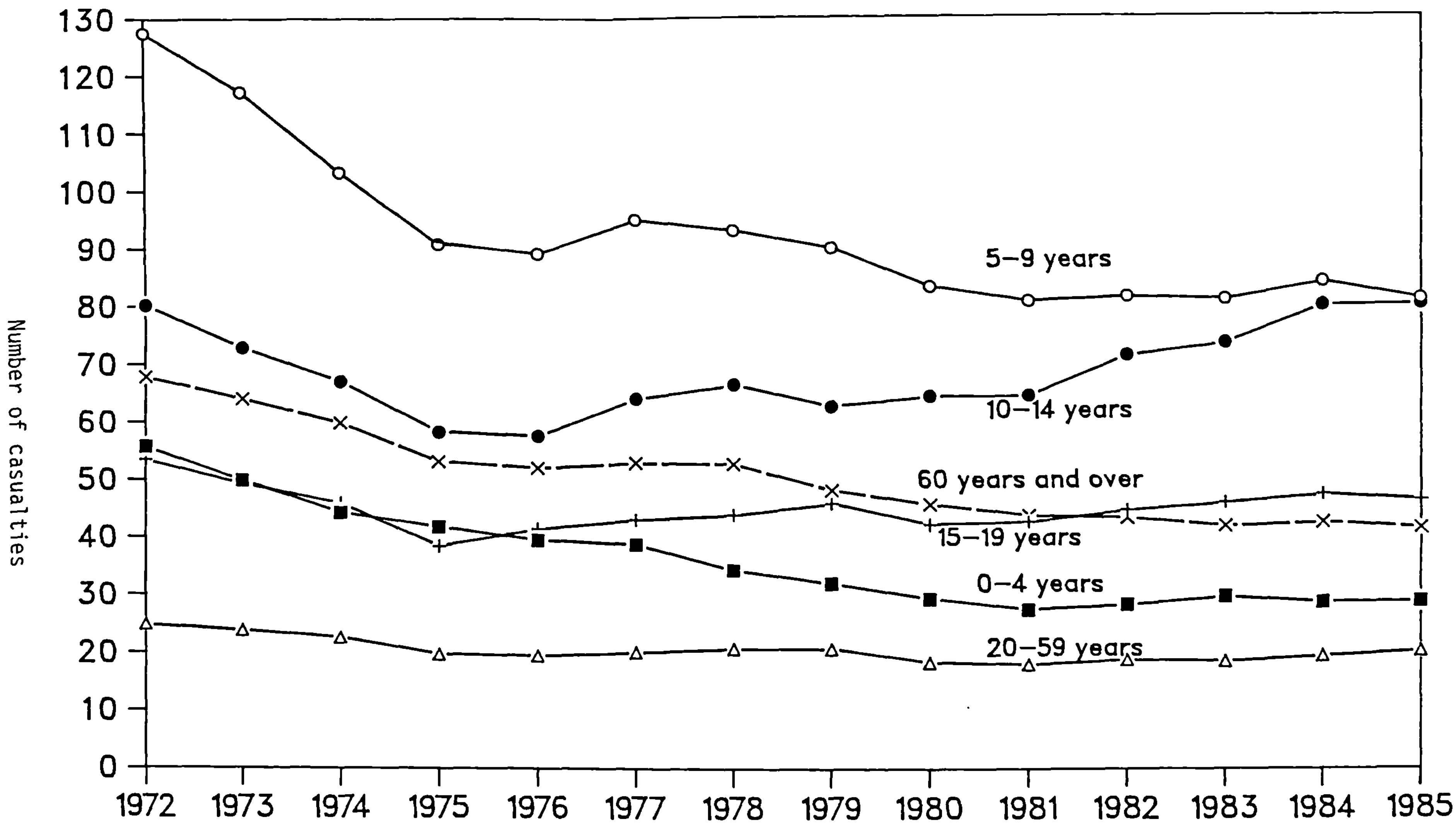

Figure 1.1. Pedestrians killed or seriously injured per 100,000 population; 1972-1985
(Source; Road Accidents Great Britain, 1985)

1.1.3 Child pedestrian accident statistics of the Strathclyde Region of Scotland.

The pattern of pedestrian accidents of children showing a breakdown by age and sex in the Strathclyde Region was not readily available. In most cases, however, the details could be extracted from the raw records maintained by Strathclyde Region's Glasgow Road Safety Division. An analysis of these records was therefore undertaken by the author with the help of road safety officers of Strathclyde Region's Glasgow Safety Division.

The rate of child pedestrian casualties in the region is very high. And though by 1983 the child pedestrian casualties in the region had fallen from 1,780 in 1979 to 1,634 (a drop of 8.2%), this was attributed to a reduction in child population (Strathclyde Police and Department of Roads, 1983). When the figures were considered in terms of population of children then the casualty rate in 1983 was slightly worse than 1979. In 1984, the child pedestrian casualties were 1,599 (a drop of 10.2% compared to the 1979 casualty rate), but again, the 1984 reduction was due to a decrease in child population. (Strathclyde Police and Department of Roads, 1984). Moreover, in 1985, there was an increase of 12.7% in the number of child pedestrian casualties in the region despite a decline in child population of 2.7% (Strathclyde Police and Department of Roads, 1985).

Table 1.5: Pedestrian casualties in the Strathclyde Region in 1983, 1984 and 1985 (Strathclyde Police and Department of Roads, 1983; 1984; and 1985).

Age Groups	Number of Casualties	Percentage of Casualties
1983		
Children (age 0-15 years)	1,634	46.5
Adults (age 16-65 years)	1,439	41.0
Senior citizens (age 66 years and over	438	12.5
1984		
Children(age 0-15 years)	1,599	45.3
Adults (age 16-65 years)	1,498	42.4
Senior citizens (age 66 years and over	435	12.3
1985		
Children (age 0-15 years)	1,738	47.4
Adults (age 16-65 years)	1,532	41.3
Senior citizens (age 66 years and over)	417	11.3

Compared with other age groups, children aged less than 16 had more pedestrian casualties in the Strathclyde Region in 1983, 1984 and 1985 (see Table 1.5). This shows an important age trend especially since the under-16 age group is much smaller than the other age classifications.

The exceptionally high incidence of child pedestrian accidents in the Strathclyde Region (Table 1.5) prompted accident investigations to be carried out in the worst hit areas in Glasgow. Table 1.6 shows the total number of child pedestrian accidents in the worst hit areas of Glasgow during the course of the investigation.

Table 1.6: Pattern of child pedestrian casualties in some worst hit areas of Glasgow.

Area of Glasgow Studied	Period of Study	Total No. of pedestrian accidents	Total No. of child pedestrian accidents	Pedestrian accidents - boys	Pedestrian accidents - girls
Arden	1979-1982	24	21	n.a.	n.a.
Carnwadric	1979-1982	n.a.	25	n.a.	n.a.
Castlemilk	1979-1981	80	56	40	16
Drumchapel	1980-1982	144	117	74	43
Garthamlock	1979-1982	39	34	22	12
Govanhill	1980-1983	n.a.	47	n.a.	n.a.
(n.a. = not available)					

Where it was possible to work out the incidence of child pedestrian accidents by sex, boys were found to be twice as involved (see Table 1.6) confirming the wider population sex trends. These sex differences were also seen in the child pedestrian casualty statistics in the Strathclyde Region in 1985 (see Figure 1.2). From Figure 1.2, it comes out clearly that boys are overall at greater risk than girls. There is also a pronounced peak at age 5 and 6. The risk for girls also varies much less than for boys.

In areas where age groupings were possible the 5-9 year olds were the most vulnerable (see Table 1.7) confirming the trend observed in most countries.

Table 1.7: Child pedestrian casualties in some areas of Glasgow (1979-1982).

Area of Glasgow	0 - 4	Age Groups 5 - 9	10 - 15
Castlemilk	11	27	18
Drumchapel	22	61	34
Garthamlock	9	13	12
Total	42	101	64

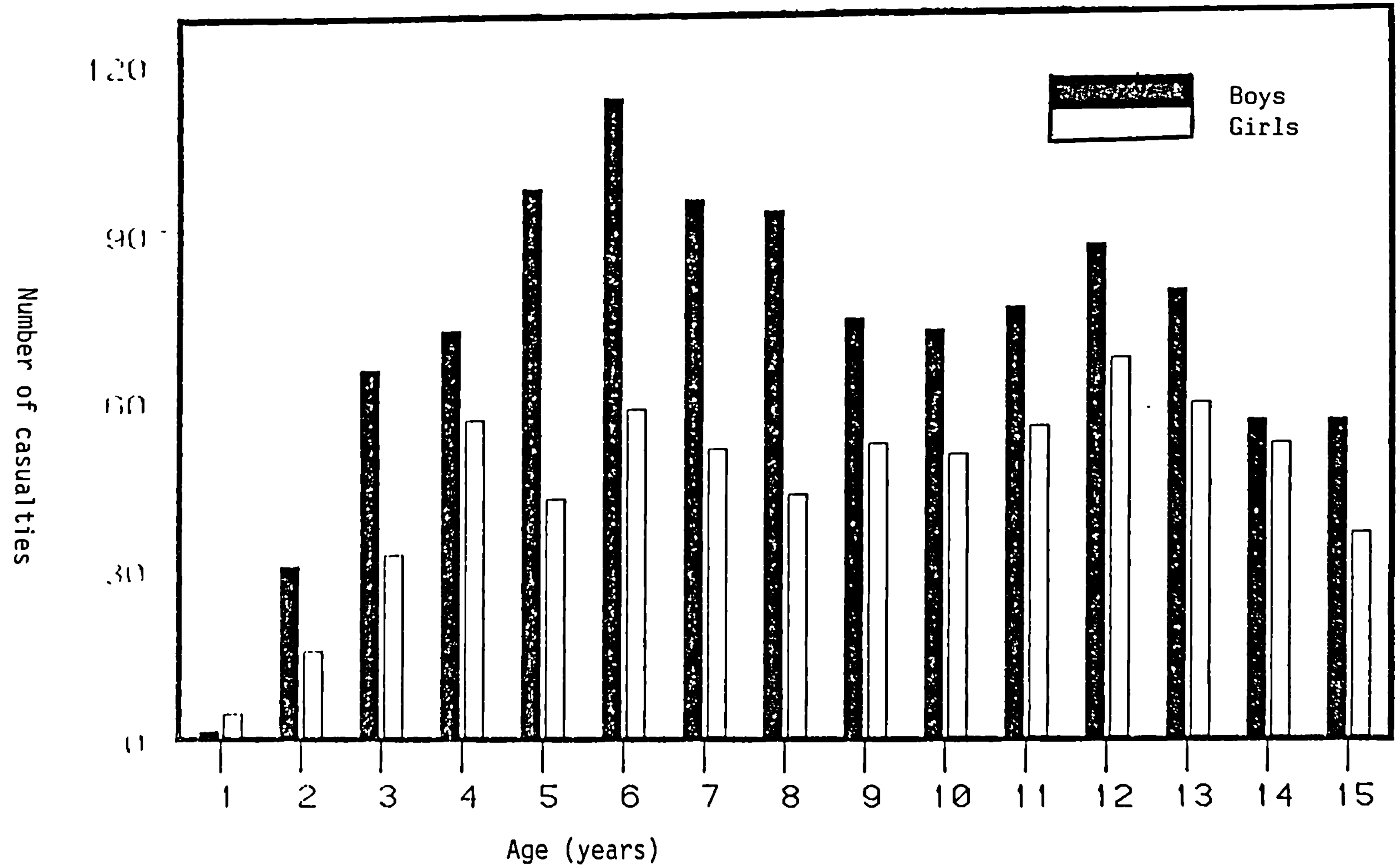

Figure 1.2. Sex differences in child pedestrian casualties in the Strathclyde Region (Scotland), 1985. (Source: Strathclyde Police and Department of Roads, 1985).

The accident statistics of the Strathclyde Region also allowed us to look more specifically at road locations where accidents were more likely to occur. An analysis of such locations might help us identify factors which lead to an increased understanding of accidents. Such an analysis is undertaken under the objectives of the present series of experiments below.

1.1.4 Pedestrian accident statistics and their limitations.

Pedestrian accident statistics are, unfortunately, limited in several important ways, making it difficult for one to get an accurate picture of children's involvement. This assertion gains support in the well known fact that adults at times fail to report an accident because the victim is a child. This is especially the case when the child is alone and is involved in an accident as a pedestrian or cyclist rather than as a car passenger (O.E.C.D., 1983). This situation is not helped either by the anomalies in the international recording of accident statistics (Nummenmaa and Syvanen, 1974; Lightburn and Howarth, 1981), making international comparisons difficult to undertake. Fatal traffic accidents have, for example, been accorded varying definitions in different countries (Sheehy and Chapman, 1984; Lightburn and Howarth, 1981). Most of the European Economic Community member countries, for example, define a fatal traffic accident as one resulting in death within a 30-day period, while it is 7, 6 and 3 days in Italy, France and Greece respectively.

Absent from many accident statistics is also a description of events which preceded and led up to the collision (Lightburn and Howarth, 1981; Firth, 1982). 'Attempts to discover what happened are often not profitable because the participants are frequently concerned with proving their own innocence or are inhibited in their evidence due to the possibility of legal action. Some are so confused and shocked by the whole affair that they are themselves not certain of exactly what happened' (Lightburn and Howarth, 1981, p.2549).

Most countries, also, do not keep up-to-date pedestrian accident statistics. This compels researchers to use very old data in providing causal explanations for current trends in pedestrian accidents (Older and Grayson, 1976). This has the disadvantage of yielding conclusions which may no longer be accurate.

Pedestrian accident statistics are also limited because they do not consider the influence of <u>exposure</u> on accidents. Russam (1977) stressed this when he explained that pedestrian accident statistics do not include the relative risk to children of a particular age group. This is because accident statistics in most cases do not include the number of road crossings made by children within a particular age group. This renders analytical studies of accident statistics less useful since they fail to relate measures of exposure to the conditions in which the accidents occurred (Jacobs, 1961). Thus, though, typically, official accident reports record many details surrounding an accident, yet few of these can provide helpful information for prevention, either as propaganda or planning, unless appropriate measures of exposure are available (Routledge, Repetto-Wright and Howarth, 1976a, p.781).

Children's exposure to traffic as pedestrians can be measured through interviews with children and parents (Routledge, Repetto-Wright and Howarth, 1974b), by discreetly following children home from school (Routledge, Repetto-Wright and Howarth, 1974d) or by random site study which involves counting the number of pedestrians in different age and sex groups crossing the road or going into the carriageway at the selected sites (Howarth, Routledge and Repetto-Wright, 1974b). Though these methods vary significantly from each other there is considerable agreement among all of them in their major findings. They showed, for example, that between the ages of 5-11 years, there is a marked increase in exposure. This implies that young children are very much more at risk whenever they cross a road than would appear from the raw accident statistics. Also, there is little difference in exposure between boys and girls, especially between the ages 5-7 years when the difference in accident statistics is so obvious (Routledge et al., 1976a). From these observations one can conclude that the present considerable financial resources devoted to pedestrian safety programmes and urban planning schemes can only be successful through an understanding of where the major problems lie. This can only be achieved through the identification of the high risk situations, and the subsequent concentration of resources where they are most needed (Routledge et al., 1976a).

Despite the usefulness of exposure in giving reasons for the extreme vulnerability of child-pedestrians, we are yet to obtain the full impact of exposure on traffic accidents (Firth, 1980). This may be due to the absence of theoretical guidance for the selection of the most appropriate means of measuring exposure for pedestrians. A variety of alternatives is possible; the number of pedestrians on the streets, the distance they travel, the time they spend on the roads, the number of roads they cross, their degree of accompaniment, the traffic they encounter and so on. The task remains how best to evaluate these measures and distinguish between them' (O.E.C.D., 1983, p.27).

1.1.4.1 Behavioural studies undertaken to improve pedestrian accident statistics

Fortunately, however, some researchers have carried out investigations to throw more light on pedestrian behaviour prior to the accident than is possible from the general statistics.

Grayson (1975b) in a study involving 474 child pedestrian accidents observed that looking behaviour immediately before the road crossing was a significant factor. It was found that 90% of the children had either not looked, or looked but did not recognise the striking vehicle. Firth (1980) also stressed that areas and locations with high proportions of accident, and also the age groups of pedestrians with high casualty rates in these areas must be included in the statistics. She also called for a comparative study to find out if accident groups differ from accident-free groups; and also, whether pedestrian behaviour prior to an accident differs from pedestrian behaviour which does not result in accident. The problem envisaged in the later study is that researchers hardly witness accidents (Sheehy, 1981; Grayson and Howarth, 1982). Details about behaviour resulting in an accident will have to be extracted from the accident statistics which are inadequate. One other way to assess behaviour of pedestrians is through real traffic studies (Routledge *et al.*, 1976a). This can yield meaningful measures if the observers do not concentrate only on age and sex, but also, observable behavioural features of child pedestrians such as route taken, social activities, walking characteristics, stopping, delay, head movements and gap acceptance (Van der Molen, 1977).

Information about how and why an accident happened can also be obtained from the pedestrian accident victims themselves (Sheehy and

Chapman, 1982; Sheehy and Chapman, 1985b). This assessment, however, has its problems. For example, it may be traumatic to question accident victims to re-live these experiences. In most cases also, they manage only a distorted recall of what actually happened especially when the impact is brutal (Firth, 1980) (see also page 13). With caution and discreet prompting however, interviewers may be able to obtain details about the occurrence of an accident from victims without jeopardizing the evidence (Sheehy and Chapman, 1982).

The above survey indicates that with careful additional investigations the understanding of accidents can be substantially increased.

1.1.4.2 Usefulness of valid pedestrian accident statistics

Valid pedestrian accident statistics, however, play a key role in pedestrian behavioural researches. This was exemplified by Nummenmaa and Syvanen, (1974) when they emphasised that analysis based on official statistics are relevant to work in road safety in that they show the general significance of the problem and the importance of the development of some new measures. Accident statistics have shown, for example, that children are the most involved in pedestrian accidents (England, 1976; Firth, 1982; Strathclyde Police and Department of Roads, 1985; Foot, Chapman and Wade, 1982). This has resulted in numerous studies being conducted (David, Chapman, Foot and Sheehy, 1986b; Sandels, 1975; Sheehy and Chapman, 1985a; Martin and Heimstra, 1973), to explain the over-involvement of children in pedestrian accidents.

Accident statistics also form one of the bases for the evaluation of countermeasures designed to reduce pedestrian accidents. The number of individuals involved in pedestrian accidents prior to the implementation of a training scheme are compared with those who had accidents after it within the same target population. A statistically significant reduction in the rate of pedestrian accidents is then used as a measure of the success of the countermeasure and vice versa (Morris, 1972; Firth, 1982).

From the review of the accident statistics it can be clearly seen that a large number of children are involved in pedestrian accidents in most countries. The pattern was the same in the critical review of the child pedestrian accident statistics in the Strathclyde Region.

In the next section the literature will be reviewed to discover why children are so vulnerable to pedestrian accidents.

CHAPTER 2

THE CHILD PEDESTRIAN

2.1 WHY ARE CHILDREN SO VULNERABLE TO PEDESTRIAN ACCIDENTS?

The work of Sandels (1975) stands out as one of the most thorough studies of children's vulnerability in traffic. She delineated several developmental abilities which separated adult from child pedestrian behaviour, and which probably accounted for the large numbers of child pedestrian accidents. She, for example, found children to be relatively poor at judging the direction of oncoming sound, such as the horn of a car. Children she also observed are significantly poor in detecting movement and processing information in the periphery and are subsequently disadvantaged when negotiating the roads. Children would, for example, not have the same ability to see traffic out of the corners of their eyes as would adults. Recent evidence, however, shows that children are not as inferior in their expectations for peripheral events as Sandels observed (David *et al*., 1986a; b). But just how these essentially laboratory findings relate to children's actual behaviour in traffic was not tackled by both Sandels and David *et al*.,.

Sandels also found children to be playful with spontaneous behaviour making them unpredictable pedestrians. Children are also more inclined to use the street as recreation site, cross the road at an inappropriate location because his mother or friend is standing at the opposite side of the road and tend to get caught up in accidents. Vinje (1981) confirmed this when she stressed that children and especially those under the age of 6 years, cannot be trusted to look for traffic in an adequate way, in the presence of more attractive objects like an ice cream van or a dog. Children's tendency to use the roadside for games and their occasional dashing onto the roads after their friends or to retrieve lost toys was a contributory factor in their accidents as pedestrians (Strathclyde Department of Roads, 1984).

Sandels also contended that the small stature of the child made him a vulnerable pedestrian. First he would have to negotiate the roads at a faster pace to obtain margins of safety of an adult. Secondly, the child will experience difficulties detecting oncoming cars and similarly drivers will find it difficult to see the child.

One should, however, be cautious in generalising from Sandels' laboratory based findings to explain everyday driver-child pedestrian interactions (Sheehy, 1982). This necessity was acknowledged by Sandels herself when she invited experiments similar to her peripheral vision study to be conducted in the real traffic situation.

The road crossing task also requires the pedestrian to wait for a suitable gap between vehicles. 'One strategy is to wait until the first vehicle has passed before judging whether it is possible to cross before the next arrives. However, this means wasting some of the gap. A more efficient strategy is to determine ahead of time whether a gap is long enough and, if so, make optimal use of it by stepping out smartly as the first vehicle passes' (Lee, Young and McLaughlin, 1984, p.1272). Observational studies of real traffic behaviour of children (Routledge, Repetto-Wright and Howarth, 1976b; Grayson, 1975a) indicates that children are more inclined to use the first strategy and consequently squander as much as 3 seconds of a gap. Children also do not look ahead as adults do for upcoming gaps, but rather consider the vehicles one by one. This inadequate utilisation of safety gaps may be a contributory factor to children's high pedestrian casualty rates. Similarly, children aged 6-13 years have been found to lack the consistency of adults in making distance judgements. This predisposes them to accidents as pedestrians especially in situations in which accurate distance judgement of oncoming car is an absolute prerequisite for successful road crossing (Zwahlen, 1974).

Adults also, exhibit bad examples to children in traffic by frequently crossing the road against red pedestrian lights. To utilise gaps between vehicles adults usually start crossing the road while a vehicle is passing or is about to pass. They often employ complicated strategy to cross a congested road. This involves two or more stages often in a zig-zag manner, and occasionally when traffic is dense but is still moving they walk a short distance down the middle of the road, thus treating the middle of the road as a kerb (Chapman, Sheehy, Foot and Wade, 1981). Adults also do not avoid crossing the road behind parked cars and also do not walk at right angles across the road. 'Children are, therefore, caught between the exhortations of teachers, parents and road safety officers and the Green Cross Code on the one hand, and what adults actually do on the other hand. Since they learn as much by example as by what they are told, it is perhaps not surprising they are often in conflict about what to do' (Foot, 1985, p.8). Children who get attracted to copy this complicated adult road crossing strategies are likely to be unable to successfully cope with them and subsequently endanger themselves.

Children's increasing involvement in pedestrian accidents may also be partly attributable to the way they perceive other road users especially drivers. Sandels (1970), for example, pointed out that children take it for granted that adults mean well towards them and are capable of stopping their vehicle instantaneously. Children may therefore, think that if the drivers have seen them, then, they can cross the road safely without harm. Research findings, however, indicate a different picture. Howarth and Lightburn (1980) in observational studies of children found, for example, that drivers under normal circumstances rely upon pedestrians to initiate measures that may be necessary to avert collision. Even for the 0-4 and 5-7 year age groups 86% of the effective avoiding action was initiated by them and not the drivers in close encounters. They also observed that no driver was seen to anticipate an accident with a child until it was almost certainly too late for him to prevent it.

Children's motor skill may also be a factor in their high accident rates. The evidence on this is, however, inconclusive so far. Children who perform poorly on motor skills test may be assumed to be at risk of injury because they are unable to extricate themselves quickly from harm. Conversely, it has been suggested that children with highly developed motor skills are more likely to indulge in physical activities that expose them to hazards. The researches conducted on these two hypotheses have, however, either had methodological flaws or the reported associations were so minimal to be of practical significance and as such do not permit any firm conclusions (Langley, Silva and Williams, 1980). Also, it is yet to be established just how these two assumptions correlate with the high incidence of child pedestrian accidents. Research is needed on this.

Boys have also been involved in auto-pedestrian collisions at a significantly higher rate than girls (see also page 7). The explanation given for this has, however, been fragmentary and inconclusive. Originally, it was thought that boys had more pedestrian accidents because they were found on the roads more frequently than girls. And Chapman, Foot and Wade (1980) after more than 7,000 observations of 4-17 year-olds in the streets before and during the summer holidays, found that both age and sex differences in children's accidents were partly due to variations in exposure to risk. Boys more than girls in the 5-10 year-olds used the streets for recreational purposes; were more exposed to traffic and subsequently explained the high involvement of boys in pedestrian accidents. Contradictory results have, however, been recorded by Howarth and Lightburn (1980) when they observed no significant differences in the exposure of boys and girls to traffic on their journey home from school. This was found with 5-9 year age group; the period when sex differences in pedestrian accidents is so conspicuous. Howarth (1980) reconciling these two conflicting results explained that it might be that boys are more exposed when playing in the streets (Chapman _et al._, 1980) but not during journey from school (Howarth and Lightburn, 1980). Howarth (1980), however, made it clear that, despite the discrepancies in the results of the two observational studies, the sex differences in the pedestrian accidents rates were still approximately the same in both situations.

Routledge, Repetto-Wright and Howarth (1976a), also observed that exposure did not explain the sex differences in child pedestrian accident rates. When boys and girls had equal exposure to risk measured by the number of roads crossed and traffic density, boys nonetheless had the highest rates of pedestrian accidents.

Is it the case that girls have fewer pedestrian accidents because they are more skilful in traffic than boys? Researchers such as Howarth and Lightburn (1980) and Routledge, Repetto-Wright and Howarth 1974a; b) have all conjectured that boys are less skilful or cope less well in extricating themselves from difficult encounters in traffic than girls. More research is, however, required to ascertain the extent to which differential skills in the actual roadway may hold the key to the real observed sex differences in child pedestrian casualty rates. Such research becomes even more important when one considers that evidence from Chapman et al., (1980) observational studies was not supportive of the commonly expressed view that boys are more active and heedless in street play than girls. And also, Sandels' (1975) documentation that, though Swedish road safety educational programmes have improved the road safety knowledge and attitude of boys more than girls, young male pedestrians were still twice as vulnerable as their female counterparts.

We have so far been considering some of the research conclusions on children's extreme vulnerability as pedestrians. We believe, however, that what children need for "putting up" safe pedestrian behaviour is the acquisition of the requisite skills. This has been given support by Jolly (1977d) when he stated that the range of human skills essential for road users safe movement in traffic are by no means innate. Neither is the subsequent acquisition of such skills automatic or inevitable. They are beyond doubt an example of learned behaviour. It is, therefore, necessary that road users reach their acquired standard of performance as a result of some form of education or training, however informal and however unsatisfactory this may appear to be.

Children can indeed be educated to develop such skills through carefully designed road safety intervention programmes. Lee, Young and McLaughlin (1984) were, for example, able to use an innovative roadside pretend road method to train children aged 5-10 years the skills of road crossing. Their pretend road - a miniature road was laid on the pavement, which the child crossed, as if crossing the adjacent real road in the face of coming vehicles. The children understood and performed the task, with some of the 5 year-olds even performing close to adult level.

The training of the child pedestrian to acquire these skills needed 'for his daily interaction with vehicular traffic' will be evaluated in the next section.

2.2 A brief review of the main bodies involved in road safety education in Britain.

The first major body established in 1916 is the Royal Society for the Prevention of Accidents (ROSPA). Its main concern is with road safety, though it also conducts researches into other accidents. The Green Cross Code was devised under its initiative. Next is the Transport and Road Research Laboratory (TRRL) set-up in 1946. It initiates and supports research on road safety. It also evaluates learning aids aimed at preventing pedestrian accidents.

Internationally also, there is the Organisation for Economic Co-operation and Development (O.E.C.D.) Special Research Group on Pedestrian Safety, established in 1975 after discussions involving the European Conference of Ministers of Transport. It identifies research objectives and co-ordinates pedestrian researches among member countries.

Apart from these three principal bodies, there are also the road safety officers and the police who periodically visit schools to talk to children about road safety. The Schools Traffic Education Programme also provides teachers with materials and advice on how to teach their children road safety. The Royal Automobile Club and the Automobile Association also concentrate on motor cycle and driver education schemes in schools.

Unfortunately, however, there appear to be no co-ordination in the activities of these organisations. Cawkell (1976) realising the muddled situation has called for a conference to co-ordinate their functions. Since then, however, no such conference has been convened leaving road safety researches and campaigns in the hands of 'too many cooks'.

2.2.1 Road safety educational countermeasures for children

The countermeasures designed to prevent or reduce pedestrian accidents are grouped into education, engineering and enforcement (Howarth and Lightburn, 1981). The one that specifically focuses on the child pedestrian is educational countermeasure. Most of them, however, have in-built flaws which limit their effectiveness in equipping children with skills for safe pedestrian behaviour. We will now review some of them.

Training children in safe pedestrian skills in the real road traffic situation is one such method. Rothengatter (1984) used mothers and kindergarten teachers to achieve improvements in the road crossing behaviour of children aged 5-6 years, through real traffic training. Training in real traffic has many advantages. Besides being effective training situations, it also has a number of practical advantages; it is freely and generally available and there is no need to invest or maintain anything (Rothengatter, 1981b). Real traffic training is, however, discouraged because it exposes children to the actual traffic, and the least error can lead to injury or death. Teachers, in most countries, are therefore dissuaded from taking children outdoors for in situ traffic training, on either legal, time or class size grounds (Rothengatter, 1981b). The cold European weather for most part of the year also discourages such outdoor real road safety training of children (Boyle, 1973). It can also only be successful if the training programmes are selected to suit the ages of the children. In due course, our present series of experiments will make recommendations on how careful background assessments are needed to select feasible objectives for traffic training of young children.

Simulations are also employed in instructing children in safe pedestrian skills. These may be test-tracks, traffic training parks or gardens, which usually comprise of small scale imitations of streets and traffic signs. Simulations bearing only a very abstract resemblance to the actual traffic situation may also be constructed in the school yard or gym (Rothengatter, 1981c). A basic problem with simulation is the extent to which the skills learned from them will be transferable to the real traffic situation. And most of them are never evaluated to determine whether they help children cope with the real traffic situation .

Printed materials have been extensively used in the traffic education of children. These may vary from published books with illustrated stories about road safety for classroom use under the teachers supervision (Jolly, 1977 a, b, c), to articles on how to teach children road safety for parents, the police and road safety officers (McGivern, 1977); Northern, 1975). The merits of most of these printed materials have not been demonstrated because they were not evaluated to ascertain their influence on the children (Singh, 1982). From the little evidence available it seems that whereas printed materials may increase children's traffic knowledge, they do not necessarily affect behaviour in the real traffic environment (Schioldborg, 1976). Their effects are also very much dependent on other factors such as classroom processes and teachers activities and attitudes during the presentation (Rothengatter, 1981c).

Television and radio are also utilised in the road safety training of children. The problems with them are that the durations of the programmes are normally very short and there is little control over who will see or hear them. There is also very little opportunity for feedback or clarifications (Preusser and Blomberg, 1984).

Slides are used in children's road safety training but their value has so far not been conclusively demonstrated (Rothengatter, 1981c). For example, presentation of slides concerning crossing behaviour appeared to have an effect on some behaviour of 7 and 8 year-old children, after testing in a traffic garden (Colborne, 1971). On the other hand, Nummenmaa and Syvanen (1970) have indicated that slide presentations increased traffic knowledge of 5-7 year-old children, while having no influence on behaviour in the real traffic environment. Singh (1982) confirmed this when he concluded that there was no evidence to show that training by films and slides affects everyday crossing behaviour of children.

Films have also been observed to have positive effect on children's traffic knowledge (Nummenmaa and Syvanen, 1974) and not their behaviour in real traffic (Singh, 1982). Dueker (1975a, b) has, however, shown that film presentations may be effective in changing behaviour when social learning principles are incorporated in the film. The present studies will, therefore, assess the role of social learning principles in children's road safety training.

Video is currently gaining popularity in schools as road safety training device. The possibility of presenting local traffic situations in the video is seen as a vital advantage in the use of videos. Video systems also allow repeated recording and immediate playback of the recorded material. It also enables the children to have a direct visual feedback on their own traffic behaviour (Rothengatter, 1981c). Cyster (1980) in a pilot study, demonstrated that children were able to recount vividly after 2-3 weeks time span, a video recording that featured their friends and themselves in traffic. It is, however, yet to be demonstrated if video can be used to train children in safe pedestrian skills which will be transferable to the real traffic situation. And though, Collingridge (1979) reported that video can be successfully used to introduce children to changes in the traffic environment, there seems to be no available supporting information (Rothengatter, 1981c). Children aged 5 and 6 years have also been observed to be incapable of gaining from video tape recordings (Cawkell, 1982).

Road safety at the preschool level is organised through traffic clubs, known as Tufty Club, founded by ROSPA in 1961. The principal character in all the materials for the Tufty Club is Tufty - a squirrel. Originally, the club included only children less than 5 years of age, but recently it has attracted primary school children. The Tufty is featured as setting safe examples, when he and his friends are involved in dangerous situations in traffic. Firth (1973b) found that children did learn from the Tufty books, when they were read to them individually over a 2-week period. The fantasy element did not have any influence on the children. It is, however, doubtful if the scheme is effective in instilling skills for safe pedestrian behaviour in children. And Firth (1973b) provided a supportive evidence when she observed no significant difference between children in the Tufty Club and non-members after an assessment involving a behavioural test of road crossing.

Recent findings from Antaki, Morris and Flude (1986) showed that children trained with Tufty materials did not demonstrate superior road safety knowledge than their peers who received no such training after testing on video and picture cards.

The most popular educational countermeasures for children are, the 'verbalised ones'. The next sub-section, therefore, reviewed the relevant literature concerning the Green Cross Code the most popular verbalised educational countermeasure for children's road safety education in Britain (Grayson, 1981). Before the Green Cross Code is described, however, the first verbalised countermeasure - The Kerb Drill will be addressed. The Kerb Drill was in operation between 1942-1969. However, it was eventually found to be ineffective in helping children acquire the skills needed for safe use of the roads as pedestrians. It for example, contained some outdated military style commands such as 'halt' and 'quick march' (Dean, 1981) which were not suitable for children's safe behaviour as pedestrians. Preston (1980b) also concluded that children aged 5-6 years did not understand the full import of the kerb drill and just recited it as a talisman to ward off the dangers posed by cars. The widespread concern about the ineffectiveness of the drill resulted in the design and introduction of the Green Cross Code.

2.2.2 The Green Cross Code

The Green Cross Code was devised by Sargent and Sheppard (1974) in a research involving 432 mothers, 227 road safety officers and 177 teachers. The mothers, road safety officers and teachers were instructed to state the relative importance regarding safety they would attribute to each of 20 items concerned with crossing the road. A great deal of agreement was found, and these served as the basis for the design of the new code.

To test children's comprehension of the items in the code, 294 children aged 5-7 years were questioned by the roadside. The questions involved concepts of traffic and terms relating to road crossing which were to be included in the code. The combined results from these two investigations provided the framework for the drafting of the final version of the code. The code itself consisted of a set of six carefully phrased injunctions for road crossing;

1. First find a safe place to cross, then stop.
2. Stand on the pavement near the kerb.
3. Look all round for traffic and listen.
4. If traffic is coming, let it pass, look all round again.
5. When there is no traffic near; walk straight across the road.
6. Keep looking and listening for traffic while you cross.

The code was tested with 170 children aged 7 and 8 years who were instructed to carry out the Green Cross Code as it was read to them by the roadside. Their ability to read the code was also investigated. The study concluded that given guidance and instruction, children between 7 and 8 years of age would be able to follow the items within the code, and would be able to read it without much difficulty (Sargent and Sheppard, 1974).

The code was officially launched amidst a well orchestrated road safety publicity campaign in Britain in April 1971. The campaign had three major objectives (Morris, 1972) and these were;

1. To reduce the incidence of pedestrian accidents to children, and particularly in the highly vulnerable 5-9 year age group;
2. To encourage parents in training children to avoid accidents;
3. To introduce the new code - the Green Cross Code - as an essential safety system for coping with traffic conditions.

Since its design and launching the code has been the underlying basis of most teaching programmes and child road safety campaigns in Britain (Singh, 1982; Grayson, 1981). The code was also initially viewed as being very effective. Morris (1972) saw it as achieving four great feats. And these were;

(1) A reduction of 11% in child pedestrian casualties during the first three months period of the campaign. This was significantly below the expected total and was attributed to the publicity about the new code.

(2) 5,000 observations of real road behaviour of children conducted just before and in the first few days of the campaign showed significant improvement in the number of children who stopped at the kerb, and those who looked both ways before crossing the road.

(3) Interview survey among 5-9 year-olds showed an improved knowledge of the code, and finally,

(4) A cost benefit analysis calculated on the basis of casualties saved in the first three months of the campaign showed a positive return, indicating that the campaign paid for itself over the period of its operation.

Viewed uncritically, therefore, the Green Cross Code appeared to have been a greater success than its predecessor the Kerb Drill. A later indepth assessment, however, revealed that the observed reduction in child pedestrian casualties could have been equally attributed to other pertinent factors which operated during that period. Sheehy and Chapman (1984) have, for example, challenged the success attributed to the Green Cross Code on the grounds that the energy crisis (with its petrol shortages, price increases and the reduction of the national speed limit to 50 m.p.h.) and the large-scale pedestrian campaign launched at the period of the introduction of the code must have all contributed significantly to the observed reductions in child pedestrian casualties.

Grayson and Howarth (1982) also maintained that the cut in the number of child pedestrian accidents during the period could have been due to temporary changes in driver behaviour or in child pedestrian behaviour which might have resulted from the launching of the new code, rather than its subject matter. Methodologically also, the absence of a control group made it impossible to conclude that the reduction in the 'number of casualties occurred as a result of the publicity campaign; it might, for example, be attributed to cyclical variations in the long term distribution of casualties' (p.123).

The review has, so far, concentrated on other important factors which compete with the code in explaining the decrease in the incidence of child pedestrian casualties. We now turn our attention to studies dealing with children's understanding of the concepts and terms in the code and the very structure of the code. Fisk and Cliffe (1975) assessed the effects of the teaching of the Green Cross Code to 86 children aged 5-8 years. They found that verbal presentation of the code did not result in significant improvements in behaviour in the younger age group of 5½-7 years. They, therefore, suggested that practical methods of teaching on the basis of the code need to be developed to reach this young age group. They also observed that the concepts 'safe', 'near', 'all round' and 'straight' were relatively devoid of significance to children of infant school age. These concepts they suggested needed to be built up steadily before children can appreciate their meaning in the context of a line in the Green Cross Code.

Preston (1980a;b) also observed a very important pitfall in the Green Cross Code as compared with the Kerb Drill. The principle that one must always stop, before going onto the road is vital to the road crossing task. But, rather unfortunately, the first injunction of the code views the idea of stopping as secondary to the desire to cross the road. This is a serious loophole in the code, especially if one considers the fact that 'many accidents occur when the child inadvertently steps or runs into the road, without any intention of crossing the road' (Preston, 1980a, p.4).

Another problem with the code concerns its length. Sheppard (1982) for example, asserted that during the design of the Green Cross Code, it was necessary to break down the action of road crossing into its components. The items were all judged to be of such importance that all the items were included in the code except those that were inconsistent. As a result the code was rather too long and probably too long to be easily memorised by children.

From the evidence we have been considering, it becomes certain that the purported effectiveness of the Green Cross Code has not gone unchallenged, and there are a number of other problems within it. We will return to them when discussing the objectives of the present series of experiments.

Educational countermeasures designed and implemented to reduce or prevent child pedestrian accidents need to be evaluated to determine their effectiveness. The next section reviews some of the methods developed for such purposes.

2.3 Evaluating children's understanding of safety and danger in traffic - methodological issues.

Unobtrusive observation of the behaviour of children is one such method. It has the advantage of yielding results that are reflective of children's notions of danger and safety in the normal traffic situation. It is, however, limited because of a lack of explanation on the part of the children to justify their behaviour. This is because any attempt to question children about their behaviour will make them aware of being observed and this will significantly influence their subsequent behaviour. And there is evidence indicating that children exhibit more safe behaviour when they are aware of being observed (Rothengatter, 1981c). There is also the danger of the observation being concentrated on specific sites, especially if bulky cameras and video recorders are used. This invariably will yield results which do not cover all the areas that confront the child pedestrian.

With the selection of careful methodology and relevant behavioural categories for observational studies, however, (Rennie and Wilson, 1980) one may be able to gain an insight into what goes on in children's minds as they interact with vehicular traffic.

Interviews are also used in such assessments. Cattell and Lewis (1973) and Sandels (1975) used interview to examine children's comprehension of words commonly used in road safety campaigns. And, Ampofo-Boateng (1986) also employed interviews to explore children aged 5, 7, 9 and 11 years' safe traffic knowledge, their degree of exposure to traffic and current trends in their road safety training. Interviews, however, do not permit the presentation of the 'real situations' children encounter in the normal traffic environment.

This makes it doubtful whether performance on such a method could be representative of children's ideas about real safe behaviour in traffic. If the questions and instructions are not carefully phrased children may not understand and answer them correctly or they may be compelled to give responses suggestive of the questions (see for example Sheehy and Chapman, 1982; Sheehy, 1981).

Martin and Heimstra (1973) also designed a perception of hazard test to examine children's awareness of danger. The test required the children to rate a large number of photographs which showed hazardous situations and varying degrees of hazard. The rating was done on a 5-point scale ranging from 'no danger to very dangerous'. A major flaw with their method was that the children were not asked to give reasons for their answers. Such explanations could have helped reveal age trends in the way the children perceived and described the hazards shown in the photographic scenes. It will be seen from the present experiments that an analysis of children's reasoning greatly affects the interpretation that may be given to their judgements. The method will also not be feasible with preschoolers and first graders since it is doubtful if they will understand the full import of rating hazardous scenes on an arbitrary 5-point scale. The study was also inadequate in assessing children's ideas about safety and danger in the road traffic situation, since it included only one traffic related photograph.

Gunther and Limbourg (1976) also studied children's perception of safety and danger as they moved dolls across a model street with moving toy cars present. The results failed to establish a significant relation between pulse frequency and the risk involved in the situations. They observed, however, that the pulse frequency was rather related to the number of crossings made during the experiment. They concluded that for children pulse frequency might be more a measure of activity level than of risk perception. It was also a crude way of assessing children's perception of safety and danger in traffic, since their pulse rate could have equally been a function of physiological factors.

Films have also been employed in studying the nature of children's awareness of safety and danger in traffic. Finlayson (1972) used a film to investigate children and adults' reaction to a boy knocked down by a car while playing football in the street. The galvanic skin response (GSR) of the subjects were recorded as they watched the accidents occur in the film. He concluded that adults, 9 and 10 year-olds had significant increases in their GSR during the period immediately before the accident. The younger children, however, did not experience any rise in GSR. Again, the recorded age variations in GSR levels could be interpreted in several ways. It may be suggestive, for example, that young children do not exhibit emotive reactions to the occurrence of accidents, and not a reflection of their perception of potential collisions in traffic.

Sheehy and Chapman (1985a) used video recordings to study adults and children's perception of hazards in familiar environments. It consisted of two studies and the first study assessed adults, 7 and 11 year-olds perception of traffic hazards. The problem with video recordings is that if not done by 'experts' it can grossly over-or-under estimate the situations which confront children in the real traffic situation.

It also precludes active participation on the part of the children which is always essential to sustain interest. Sheehy and Chapman faced this problem in their pilot study when they realised that the younger children were not relaxed and forthcoming in the absence of peer companions. They circumvented this problem by testing the children in pairs in the main study. Each pair of children were chosen from the same classroom. There is, however, a problem in such an arrangement, since it cannot be denied, for example, that interactions between pairs of children familiar with each other, however discreet, may have an influence on their responses. The fear of appearing 'stupid' in the presence of a peer-companion may prevent children tested in pairs for asking further questions for clarification of the experimental procedure. If they are not of the same intellectual ability, the less intelligent may be inhibited and just repeat the responses of his more bright companion.

All the methods reviewed showed a number of promising approaches but are also accompanied by attendant problems. A further look will be made on how best these different approaches can be drawn upon to devise a more effective method in our discussion of the objectives of our present series of experiments.

2.4 Objectives of the present series of experiments

The experiments reported in this thesis were a direct result of the critical issues which were observed in the earlier survey of child pedestrian accidents. It was realised from the review that not much had been achieved in the design and implementation of an effective countermeasure to educate children in skills for safe pedestrian behaviour. Children's accidents as pedestrians are, therefore, still alarmingly high.

Two aspects of children's road safety behaviour crucial to the successful completion of the road crossing task, but which have not been given adequate coverage in children's road safety training, are the ability to discriminate between dangerous and safe locations to cross the road. The overall neglect in educating children on how to choose safe places and routes to cross the road, and also position themselves at these sites to guarantee an adequate view of traffic must therefore be seen as contributing to their high vulnerability as pedestrians. And as we shall presently see, this appears to be the case.

For example, the Green Cross Code, the main theme for road safety training of children in Britain (Grayson, 1981; Singh, 1982) also does not sufficiently cover this. In its introductory injunction, it instructs the child to 'first find a safe place to cross then, stop'. This, of course, fails to teach the child how to select those safe road crossing sites. The attendant most stressed safe road crossing sites prescribed as teaching notes for the first injunction; subways, footbridges, zebra and pelican crossings, traffic lights, police, lollipop and traffic warden may also not be available in areas where children have majority of their accidents as pedestrians. And evidence we will be considering below, indeed shows that in many, perhaps most, circumstances children are compelled to choose a site where these purpose-built safe road crossing facilities are not available. The fact that where accident statistics are available child pedestrian accidents tend to be congregated in specific locations in the roadway not covered by these officially designated safe road crossing locations (see Table 1.8) confirms this assumption. Howarth and Lightburn (1980) also supported this argument when they found in observational studies that the risk per road crossing for children was greater on major roads, whereas the risk per interaction with a car was greater on minor roads. They additionally emphasised that most interactions and most accidents of child pedestrians occur on minor roads. This observation provides a linkage with the statistics which shows that most accidents occur on minor roads, and that 60% occur within ¼-mile of the child's home (Grayson, 1975b). Children are therefore at the greatest risk as pedestrians in their own neighbourhood (Jones, 1980; Foot, Chapman and Wade, 1982). Incidentally, the child's immediate neighbourhood is often the very area where the purpose-built safe road crossing sites may not be available. Richard (1974; cited in Rothengatter, 1981c) concurred this when he asserted that light regulated crossings are only installed when traffic intensities are high, in any case higher than the intensities of traffic in which young children participate. There is also evidence to suggest that children aged 5 and 7 years may not be knowledgeable about the existence of these officially designated safe road crossing sites (Ampofo-Boateng, 1986).

A detailed examination of charts and research reports of accidents in the Strathclyde Region conducted by the author with the help of road safety officers (of the region) also showed that children's accidents as pedestrians were at locations where there were no safe road crossing facilities. Such details were not immediately obvious from the statistics but had to be extracted from the raw accident data with the legends accompanying each chart of accident report as the main referent used in achieving this (see Table 1.8). The data for Table 1.8 also included examples quoted from other places where such data had been reported. From Table 1.8, it can be clearly seen that children's accidents tended to occur in zones where they did not have adequate view of the roadway.

Our present series of experiments will therefore study how children discriminate between safe and danger sites; and their identification of safe routes to cross the road at junctions, bends, parked cars, hedges and zebra crossing, in an attempt to find out whether the high accident rates at these locations result from children's inability to perceive them as potentially dangerous crossing zones. With the exception of the zebra crossing all the other features selected for the experiments are particularly dangerous to young children. (see Table 1.8). The zebra crossing was, however, included because misinterpretation of its purpose has been observed to result in accidents (Vinje, 1981; Van der Molen, 1981; Grayson and Howarth, 1982). The zebra crossing's inclusion is further reinforced by accidents occurring at other officially designated safe road crossing locations. In 1982, for instance, figures revealed that 54 people were killed and 549 seriously injured on pelican crossings which were first introduced in 1969 (Williams, 1984). Pelican and zebra crossings also do not provide any barrier between the pedestrian and vehicular traffic. In the event of their not being used appropriately therefore, an

Table 1.8 Specific areas where child pedestrian accidents are concentrated.

Number or percentage of children	Specific locations (or activities)	Source of statistics
21%	Bends on the roads	Arden-Carnwadric areas of Glasgow (1979-1982) Strathclyde Department of Roads (S.D.R.), (1983)
68%	Intersections on the roads.	Drumchapel area of Glasgow (1980-1982) S.D.R., (1983)
67%		Castlemilk area of Glasgow (1979-1981) S.D.R., (1983)
65%		Garthamlock area of Glasgow (1979-1982) S.D.R., (1983)
78%		Govanhill area of Glasgow (1980-1983) S.D.R., (1983)
32%	Near obstacles restricting visibility	O.N.S.E.R., (1982) cited in O.E.C.D. (1983)
29%	Zones where visual exploration was difficult at or near intersections.	
26%	Intersections where visibility was in addition limited by obstacles like hedges and parked cars	
21	Crossing while masked by stationary vehicle	S.D.R., (1984)
22	Crossing the road carelessly	
403	Going into the road near parked cars	Downing (1981)

accident can occur as readily as other parts of the road (Firth, 1979).

The danger posed by bends, junctions, hedges and parked cars is also seldom emphasised in the road safety training of children, which in most cases rather dwells on such topics as zebra crossings and light-regulated crossings than on crossings near parked cars (Rothengatter, 1981c). And only 11% of mothers of children in the 5-9 year-old range interviewed said they had taught their children not to cross between parked cars (Morris, 1972).

The literature survey also indicated that the methods employed to investigate children's understanding of safety and danger in traffic are all beset with problems. Most of these earlier methods, for example, stories (Firth, 1975); drawings (David et al., 1986a; b; Grieve and Williams, 1985); questionnaire (Fisk and Cliffe, 1975); video recordings (Sheehy and Chapman, 1985; Antaki et al., 1986) and photographs (Martin and Heimstra, 1973) (see also 2.3; chapter 2), did not allow for the active involvement of the children in registering their responses. With children, however, this is essential to sustain their interest in the tasks. Some of the above methods are also entirely different from what confronts children in traffic casting doubts on the relevance of their responses to their real road traffic awareness. The passivity of the above methods required that we adopt a more interactive method in our experiments. This is even more important if one considers the fact that learning is known to be better where children are active. Hence the potential advantage of the table-top model approach.

Our present experiments, therefore, evolved around a table-top model of traffic situations which had a dual advantage of permitting children to be active in recording their responses, and also in a realistic but safe way. The design and implementation of the table-top model additionally attempted to take into account other relevant methodological pitfalls associated with its use in children's road safety researches. We had to gain an insight into the exact nature of children's understanding of the table-top model, since we also had the intention of introducing it as a potential training tool for their road safety training. Our series of interrelated experiments, will tackle this by progressively examining the feasibility of the table-top model in studying children's traffic sense. Each experiment will, subsequently, build on the potential methodological issues which emerge out of the experiment preceding it.

CHAPTER 3

GENERAL METHODOLOGY

OF

EXPERIMENTS

3.1 Stimulus materials

We employed a number of methodological approaches in this thesis. These included photographic tasks (based on a table-top model, and the real traffic situation), real world traffic settings and a table-top model of road traffic situations. The table-top model, however, formed an important methodological theme in our research and we will describe it in detail here.

The table-top model was constructed with a traffic mat measuring 119 x 102 centimetres. The traffic mat was pasted on hard cardboard to make it durable. Houses constructed from plasticine materials, artificial hedges, trees, toy cars and dolls were placed on the traffic mat to create as far as possible road situations similar to those encountered in real traffic environments (see Fig. 3.1). The table-top simulation of road traffic situations was used for the two tasks of recognition and construction in the experiments. These two tasks, which are explained below, were used in all the experiments. Any variations in the tasks are explained under the individual experiments.

3.2 The experimental tasks

3.2.1 Recognition task

The rationale behind this was to set up situations on the traffic mat to investigate children's understanding of safe and dangerous places or sites to cross the road. A doll was placed at a position which was either very safe or very dangerous. The task of each subject was to state whether it was safe or dangerous for a doll-pedestrian to cross the road from where it was standing. They were also asked to state the reasons behind their answers. The recognition task involved

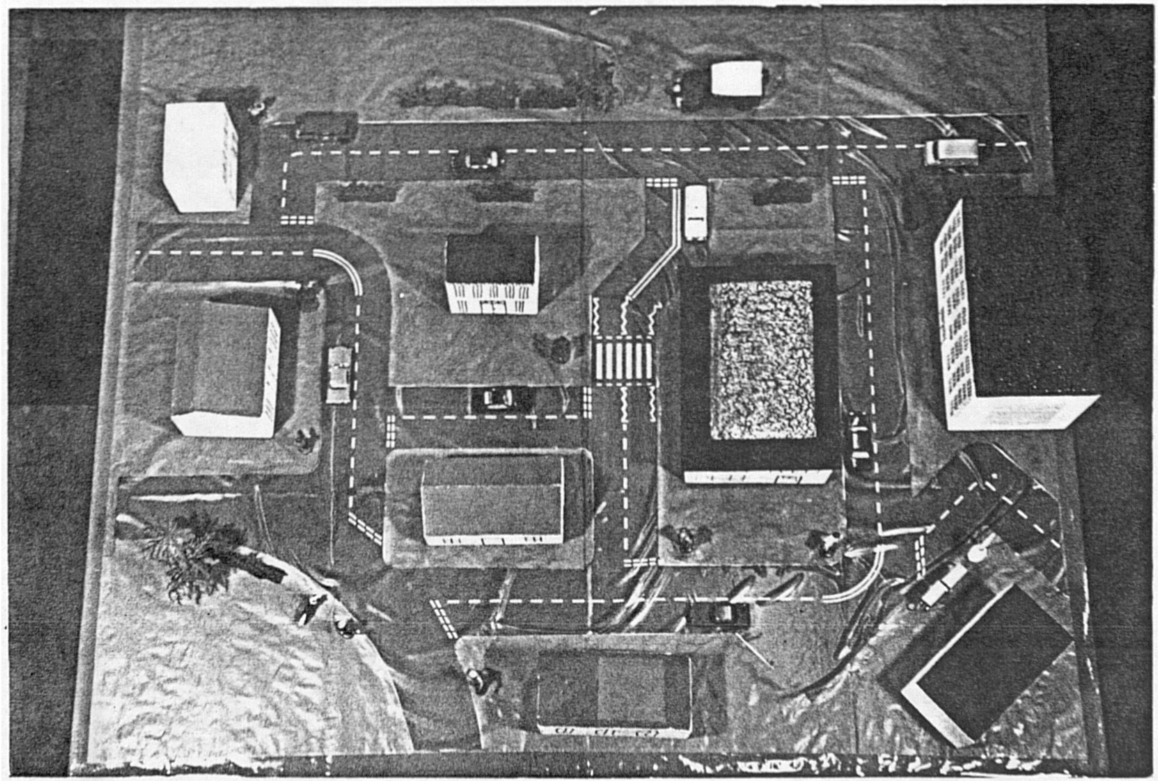

Figure 3.1. A general layout of the table-top model of road traffic situations used for Experiments 1, 2 and 3.

5 safe and 5 dangerous places, matched as far as possible, in situations with high frequency of child pedestrian accidents; bends, hedges, junctions, parked cars and zebra crossing (with or without cars on it) (see Table 1.8). The recognition tasks were evaluated in terms of how safe or dangerous they were by a team of road safety officers before the study (see 3.2.3). (In judging the tasks as either very safe or very dangerous they took into account the position of cars on the roads, the closeness of parked cars, bends, junctions, zebra crossings, hedges and relevant road markings).

3.2.2 Construction task

In the construction task the children were instructed to select routes they thought were safe for a doll-pedestrian to cross the road. The children were told the doll wanted to get from one point to another and their task was to find the safest route for it. The children did this by moving the doll across the road at the place he or she reasoned was the safest for it to cross the road to its destination. The children were again asked to justify their selection.

The areas chosen for the construction task (close to bends, hedges, junctions and zebra crossings) were comparable to those used in the recognition task. The suitability of the tasks were again determined by a group of road safety officers who took into consideration the nearness of relevant road features (bends, junctions and road markings) the position of cars on the roads and finally the closeness of obstacles (hedges and parked cars).

3.2.3 Evaluation of the recognition and construction tasks

Four road safety officers judged the suitability of the recognition and construction tasks. They at first evaluated the task situations individually assigning reasons for their ratings without any prompting from the experimenter. A meeting of the four officers was later convened where the individual assessments were collated. Only task-situations and explanations with 100% agreement amongst the four officers were included in the experiment.

3.3 Scoring

The scoring was done differently for both the recognition and construction tasks.

3.3.1 Recognition task

In the recognition task if the road crossing place was either safe or dangerous and the children correctly identified it, the experimenter (E) gave a score of (1) on the score sheet against that order of presentation. A score of (0) was awarded if a child erred by saying a particular road crossing site was dangerous when it was safe and vice versa.

The verbal responses justifying the choices made were also scored. A score of (1) was given when a child gave an explanation indicating that he or she appreciated the danger or safety in the situation. A score of (0) was given when an irrelevant explanation in terms of road safety was stated by a child. A child could therefore attain a total score between 0 and 2, for each of the recognition tasks. The determination of good or bad answers was done with the assistance of a team of road safety officers (see 3.3.3).

3.3.2 Construction task

Each child's choice of the route he or she considered safest for the doll to cross the road was marked on the schematic drawing of the traffic mat by the E (see Fig. 3.2). Accurate recordings of the children's responses on the schematic drawing were obtained by the E

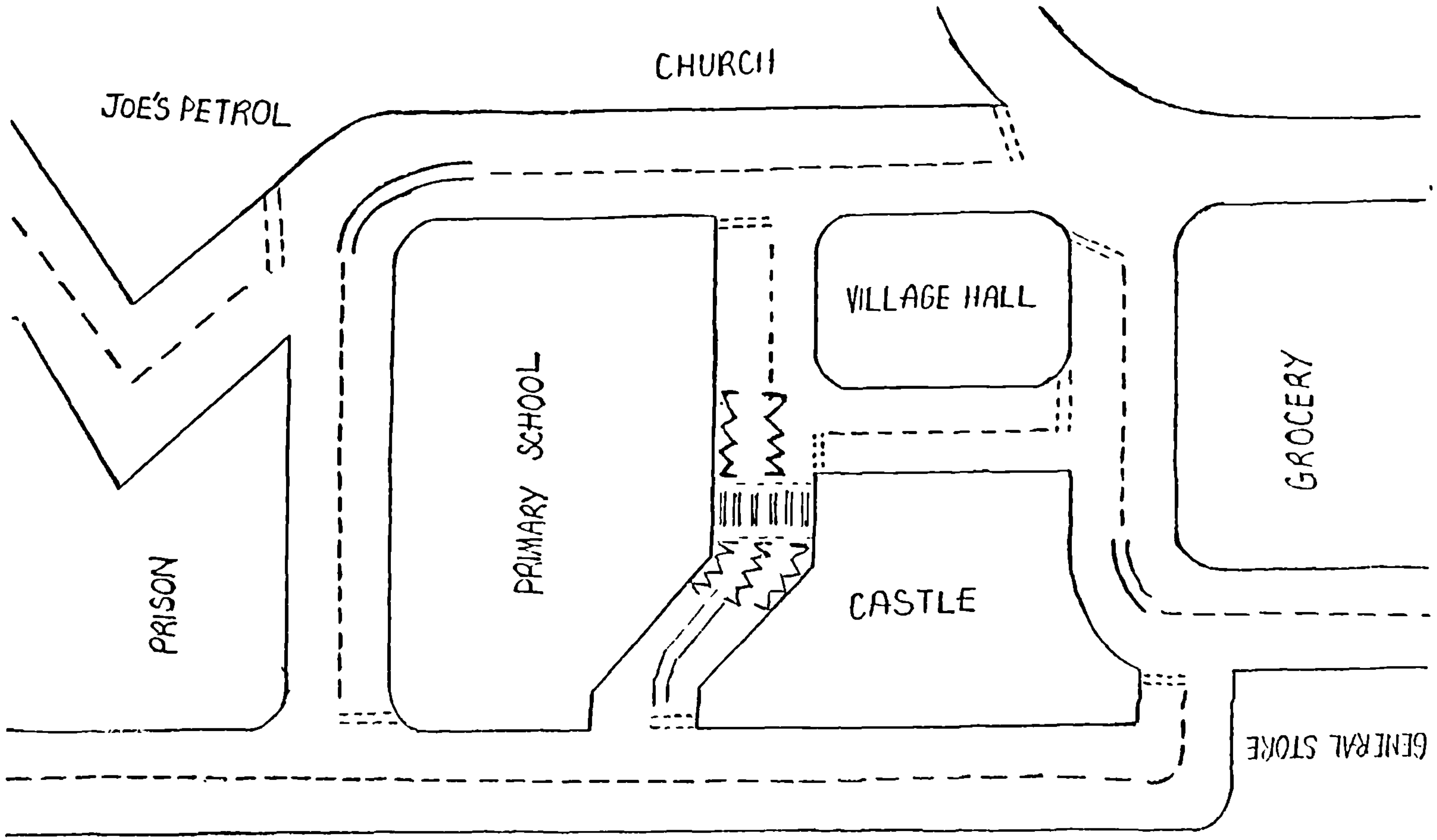

Figure 3.2. The schematic drawing of the traffic mat used for scoring the construction task. (A reduced size of the original sheet which measured 29.8cm x 42cm)

using the road markings as referents in noting the exact route a child moved the doll across the road.

The responses on the schematic drawing were later scored on a scale of:

4 - very safe

3 - safe

2 - unsafe

1 - very unsafe

With the help of the road safety officers detailed plans of safe and dangerous choices on the above 4-point scale were drawn and were used for the scoring. In setting out the scales for each of the 4 construction tasks the road safety officers dwelt on critical features such as the avoidance of obstacles near the roadway, number of roads crossed, number of cars likely to be encountered through each chosen route, avoidance of junctions and bends, and the extent to which use was made of available crossing facilities, dead-ends and give-ways.

The justifications for the selected routes were also scored on a 4-point scale in consultation with the road safety officers. The scoring was done as follows:

4 - Relevant explanation ensuring road safety with a mention of the road environmental feature in the situation.

3 - Relevant explanation that ensures road safety but with no mention of the specific road environmental feature prominent in the situation.

2 - Explanation including a reference to the road traffic situation but not ensuring safety.

1 - Irrelevant explanation not ensuring safety and also with no mention of the road traffic situation.

The children's score on each of the construction tasks was a combined score of the selected route and the explanation given for the chosen route. The maximum attainable score on each of the construction tasks was therefore 8.

3.3.3 Evaluating the measures for the scoring

Again, the four road safety officers provided the 'correct' answers for the recognition and construction tasks against which the children's responses were assessed. For each of the recognition tasks the officers individually gave correct identification and explanation. In the construction tasks also, detailed outlines on a 4-point scale for the selected routes and the justifications for them were completed individually by the road safety officers.

Later they all met and compared their answers with each officer justifying his identifications and reasons for them before they were included in the final pool for the scoring.

3.4 General design of experiments

Each child completed the recognition tasks according to a different order of presentation based on a table of random numbers (Myers, 1979). Similarly, the presentation of the construction tasks was separately randomised for each child using a table of random numbers.

The order of presentation of the recognition and construction tasks was counterbalanced so that half the children received the recognition task first and the other half received the construction task first.

3.5 Subjects

5, 7, 9 and 11 year-olds were tested under Experiments 1, 2 and 3, while only the 5 and 7 year-olds participated in Experiment 4 and the training scheme.

These four age groups were not arbitrarily chosen. On the contrary, their selection was based on the accident statistics which puts the most vulnerable age for pedestrian accidents at 5-9 years (O.E.C.D., 1983; England, 1976; Road Accidents Great Britain, 1985). Within this most vulnerable age group, the peak age occurs at 5-7 years (Foot, Chapman and Wade, 1982). These four age groups were subsequently chosen to investigate whether they will vary in their perceptions of safe and dangerous sites and routes by which to cross the road the same way as the accident statistics indicate age differences in their pedestrian casualty rates.

3.6 Procedure

A separate room was made available for the experiments in the school attended by the children. Each child was tested by the same male Experimenter (E). The E introduced the child to the situation informally, and allowed him or her to play with the table-top model during a preliminary period. The materials in the set-up were also explained to the child. An example of the recognition and the construction tasks in areas not included in the main tasks were completed with each child to ensure an understanding of the tasks. All the children did both the recognition and the construction tasks. The children also helped in the rearrangement of the task-situations where it was necessary to do so, to sustain their interest in the study. The children's justifications of their responses were tape recorded with their consent and were later content examined.

The procedure was similar across all the experiments with any differences highlighted under the individual experiments.

CHAPTER 4

EXPERIMENT 1

AN EXPLORATORY STUDY OF CHILDREN'S IDENTIFICATION OF SAFE AND DANGEROUS SITES, AND SAFE ROUTES TO CROSS THE ROAD USING A TABLE-TOP MODEL

4.1 Objectives of Experiment 1

The major questions investigated under Experiment 1 were a direct result of our earlier survey of the relevant literature pertaining to child pedestrian accidents, and also countermeasures designed to prevent or reduce them. Our objectives therefore focussed on factors observed as likely flaws within the educational countermeasures for child pedestrians, and also methodological issues in child pedestrian research. These questions were;

1. Can children distinguish between safe and dangerous sites and routes by which to cross the road?
2. Which environmental features or situations pose most difficulty for children in terms of safety and danger recognition? This was aimed at discovering whether the high frequency of child pedestrian accidents in specific areas such as junctions, bends hedges and parked cars were due to children's inability to perceive them as potentially dangerous road crossing places.

   The accident statistics surveyed also demonstrated a clearly defined age difference in the incidence of child pedestrian casualties. We therefore assessed;
3. Whether older children will have a better awareness of safe and dangerous places to cross the road.

   Boys are also twice as vulnerable to pedestrian accidents as girls. Explanation for this trend has so far been inconclusive. We therefore additionally investigated whether;
4. Girls will perform better on the distinction between safe

and dangerous places and routes to cross the road, and how far this explains the differential sex rates in child pedestrian accidents;

5. The review also showed that the methods used to assess children's understanding of safety and danger in traffic have limitations. Our study therefore devised an improved method - a table-top model of road traffic situations which drew upon the existing methods for the evaluation of children's perception of safety and danger in traffic (see 2.3; Chapter 2). Can the children understand the mechanisms of registering their responses on a table-top model? The experiment was designed to address this question.

4.2 Method

4.2.1 Subjects

64 children aged 5, 7, 9 and 11 years selected from schools in Glasgow and equally matched for age and sex participated in the experiment. The mean ages were 5 year-olds (boys; 5 years 6 months; girls; 5 years 5 months); 7 year-olds (boys; 7 years 4 months; girls; 7 years 6 months); 9 year-olds (boys; 9 years 5 months; girls; 9 years 5 months); and 11 year-olds (boys; 11 years 7 months; girls; 11 years 5 months).

4.2.2 Design

Each child completed 10 recognition tasks, made up of equally matched 5 safe and 5 dangerous sites to cross the road. These sites were set up at bends, junctions, hedges, parked cars and zebra crossings on the table-top model. Figure 4.1 (a-D) shows an example of the recognition task - involving the safe and dangerous road crossing

Figures 4.1 (a-b). The two road crossing sites of safe and dangerous at the zebra crossing in the recognition task.

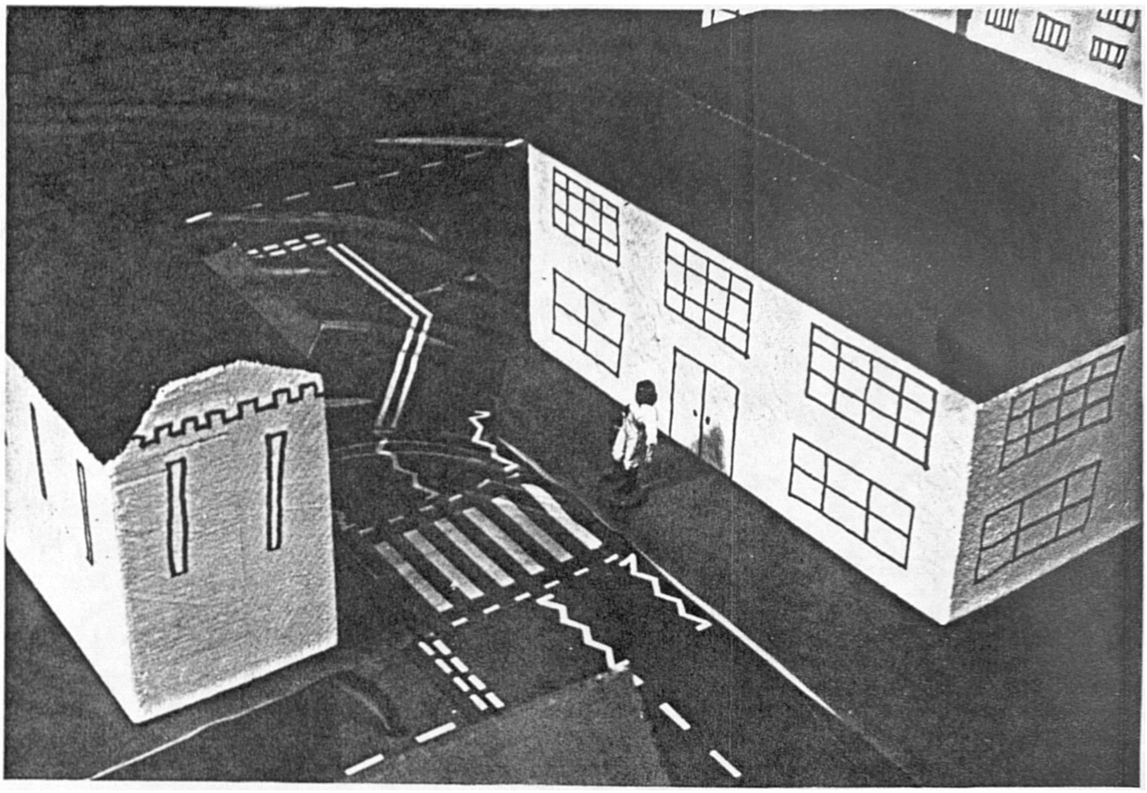

Figure 4.1 (a). The safe road crossing site at the zebra crossing.

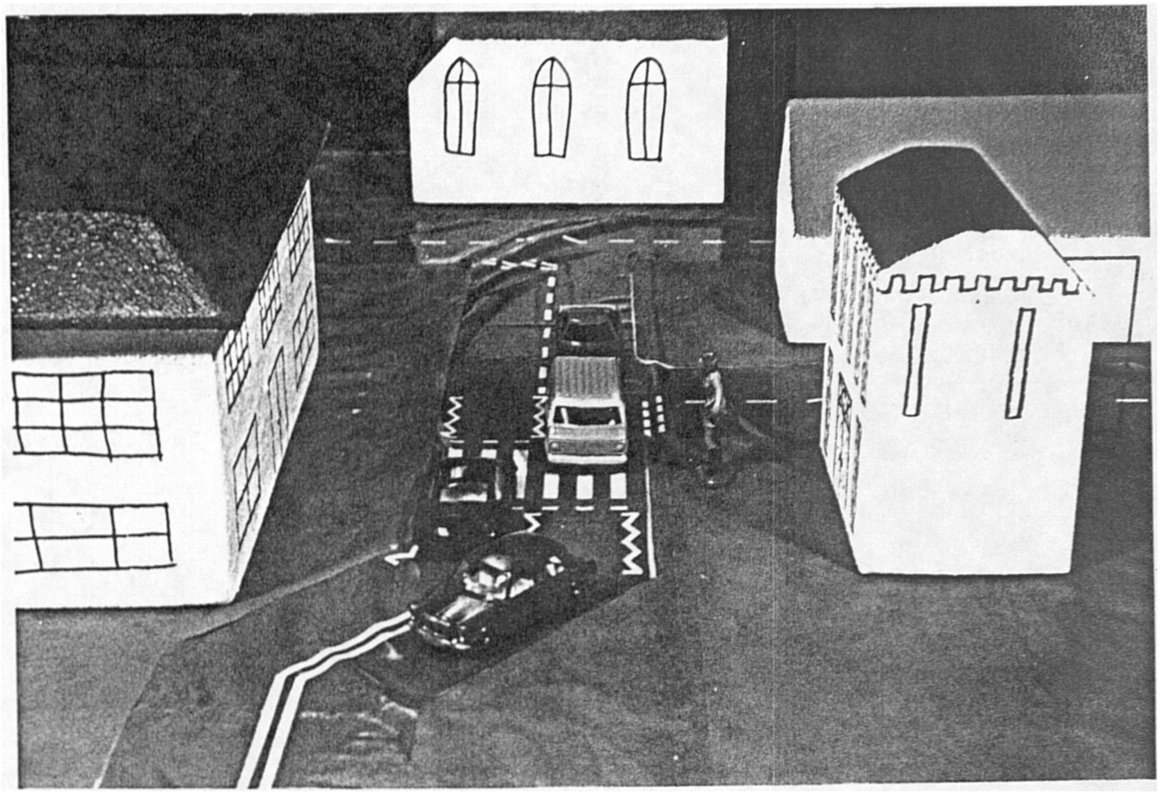

Figure 4.1 (b). The dangerous road crossing site at the zebra crossing.

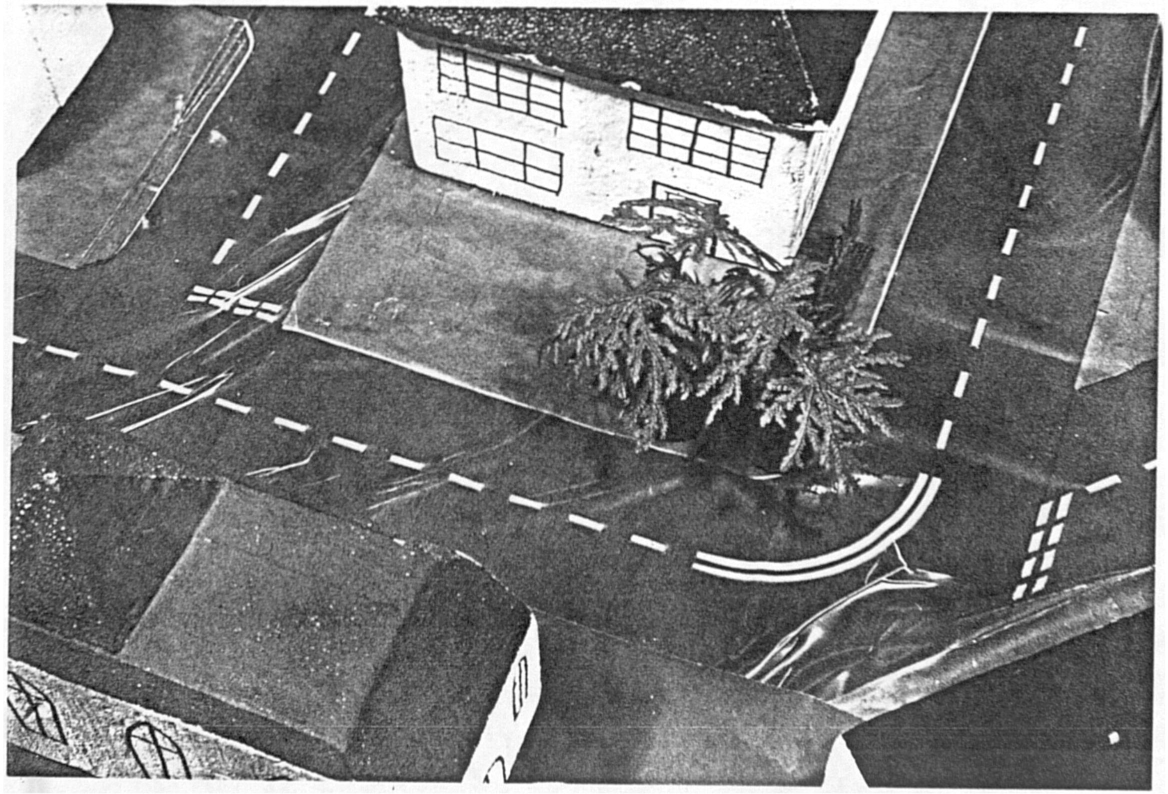

Figure 4.2. The road crossing situation near the hedge in the construction task.

situations at the zebra crossing. Each child, additionally, completed 4 construction tasks set up at bends, junctions, hedges and zebra crossings on the table-top model. Figure 4.2 shows an example of construction task involving the road crossing location near a hedge. The order of presentation of both the recognition and the construction tasks was differentially randomised for each child (see also 3.4; Chapter 3).

4.2.3 Procedure

A room was acquired in the school attended by the children. It was empty except for a table and two chairs which provided seating for the experiment. The chairs and table were carefully selected to suit heights of the children. This was to ensure that they had a good view of the table-top model and were also comfortable throughout the experiment.

Each child was taken to the experimental room by the same male experimenter (E). The child was invited to play with the table-top model to familiarise him or her with it and also relax them before the study proper. The E also completed examples of the recognition and construction tasks in locations not included in the actual experiment to make sure they understood the tasks.

In the recognition task the toy-pedestrian was carefully positioned near each road crossing location and the child's task was to judge whether it was safe or dangerous for it to cross the road from there. The child also justified his or her judgement. Under the construction task, however, the doll-pedestrian was carefully positioned near each road crossing location and the child's task was to select the safest route for it to cross the road to its destination. The child did this by manipulating the doll-pedestrian across the road using the route he or she perceived as being the safest. The route selected by the child was recorded on the schematic drawing of the table-top model set-up (see Figure 3.2) by the E. The E used road markings as referents to assist him record the exact route a child selected for the doll-pedestrian. The child was also requested to justify his or her constructed safe route (see also 3.2; Chapter 3 for details of the experimental tasks).

4.3 Scoring

The maximum possible score a child could attain on each of the recognition tasks was 2. This consisted of a combined score of the child's identification of the site as either safe or dangerous, and the explanation given for this identification.

The maximum possible score attainable on each of the construction tasks was 8. This consisted of a combined score of the child's constructed safe route (scored on a 4-point scale of Very Safe (4) to Very Unsafe (1) and the explanation advanced for this constructed safe route (scored on a 4-point scale of relevant explanation (4) to an irrelevant explanation (1) (see also 3.3 - Scoring; Chapter 3 for details of the scoring procedure for the recognition and construction tasks).

4.4 Results

4.4.1 Recognition task

A 4 (age; 5, 7, 9 and 11 year-olds) x 2 (sex; girls and boys) x 2 (road crossing site ; safe and dangerous) analysis of variance (ANOVA) was calculated. Table 4.1 gives the means for each road crossing site of safe and dangerous by age.

In the ANOVA age and sex were between subject variables and road crossing sites of safe and dangerous were within subject variables. The ANOVA showed a significant main effect of age ($F(3,56)=9.8, p<0.001$). The main effect of sex was, however, not significant ($F(1,56)=1.76$, n.s.).

Table 4.1: Mean correct recognitions of safe and dangerous sites to cross the road by age (Maximum possible score = 10).

Road crossing sites	Age (Years) 5	7	9	11
Safe	8.67	8.25	9.06	8.63
Dangerous	5.13	6.13	8.56	8.75

No interaction of age and sex was also recorded ($F(3,56)=1.22$, n.s.). The main effect of road crossing sites was, however, significant ($F(3,56)=15.42, p<0.001$) indicating that the children performed better on the recognition of safe than dangerous road crossing locations (see Table 4.1). A significant interaction of age and road crossing sites was also recorded ($F(3,56)=4.63, p<0.01$). Both the interaction of sex and road crossing locations; and age, sex and road crossing locations were, however, not significant ($F(3,56)=0.01$, n.s.) and ($F(3,56)=1.76$, n.s.).

Independent sample t-tests were conducted on the identifications of dangerous sites to cross the road, which showed a strong age trend (see Table 4.1). These showed the 9 and 11 year-olds as achieving more correct recognitions than the 5 year-olds ($t(30)=5.7, p<0.001$) for both comparisons. The 9 and 11 year-olds also performed better than the 7 year-olds ($t(30)=3.9, p<0.001$), and ($t(30)=4.2, p<0.001$). Both the comparisons between the 5 and 7 year-olds ($t(30)=1.5$, n.s.), and between the 9 and 11 year-olds ($t(30)=0.34$, n.s.) were not significant.

4.4.1.1 The effect of road environmental features of parked car, hedge, junction, bend and zebra crossing on children's correct recognitions of dangerous sites to cross the road

The idea behind this analysis was to find out which of the 5 road environmental features caused the strong age differences in the identification of dangerous road crossing locations (see Table 4.1). It was also, additionally, to investigate age trends in the children's responses under each of the 5 road crossing sites of parked car, hedge, junction, bend and zebra crossing. Table 4.2 indicates the number of children in each age group who scored correctly or wrongly on each of the 5 dangerous locations to cross the road.

Table 4.2: Number of children scoring correctly or wrongly on the recognition of dangerous sites to cross the road by road environmental feature and age

Road Environmental Features	Number of children who scored correctly by age				Number of children who scored wrongly by age			
	5	7	9	11	5	7	9	11
Parked car	1	6	12	14	15	10	4	2
Hedge	3	3	9	12	13	13	7	4
Junction	11	14	16	15	5	2	0	1
Bend	13	13	16	15	3	3	0	1
Zebra Crossing	15	14	16	15	1	2	0	1

For the purposes of these analyses the scores of the 5 and 7 year-olds were combined and compared with the combined scores of the 9 and 11 year-olds. There was the need to combine the scores because of the piecemeal nature of the data upon which the analyses were based (see Table 4.2). Moreover, the 5 and 7 year-olds overall had comparable results; and so were the scores of the 9 and 11 year-olds.

Since the scores were mostly either 1 or 0, (representing children who identified the situations correctly or incorrectly) the statistical analyses on the data had to be done in a piecemeal fashion using non-parametric tests. Comparison between age and performance under each road crossing situation was done by chi-square and Fisher exact probability tests as appropriate, while comparison among road environmental features was conducted with a Cochran Q test.

A chi-square test showed that the 5 and 7 year-olds were worse in their identifications of the road crossing locations of parked car ($X^2(3)=26.21, p<0.001$) and hedge ($X^2(3)=15.57, p<0.005$) than the 9 and 11 year-olds. Applying the Fisher's test it was observed that the 9 and 11 year-olds were marginally better in their recognitions at the junction than the 5 and 7 year-olds ($p<0.05$). There was, however, no significant differences between the 5 and 7 year-olds compared with the 9 and 11 year-olds at both the bend and the zebra crossing on the Fisher's test.

A Cochran Q test calculated to assess the effect of road environmental features (of parked car, hedge, junction, bend and zebra crossing) on the children's responses to the dangerous sites to cross the road was significant ($Q(4)=97.18, p<0.001$). A visual inspection of the data (see Table 4.2) showed that the overall good performance at the junction, bend and zebra crossing than the parked car and hedge must have caused the significant road environmental features effect.

4.4.1.2 Qualitative analyses of the explanations given for the responses to the recognition tasks

The explanations children gave for their recognitions were scored in terms of 1 - for explanations which indicated that they appreciated the safety or danger in the situation and 0 - for an irrelevant explanation (see also 3.3.1; Chapter 3). The content examination of the justifications were looked at in terms of each age group, and also for each road crossing site. An age trend was observed in the correct explanations and this s presented in Figures 4.3 (a-e) and 4.4 (a-e) which indicated clearly that younger children* (5 and 7 year-olds) were more inclined to use as their main determinant for the identification of safe sites a lack of cars in the roadway [see Figures 4.3 (a-e)], while older children* (9 and 11 year-olds) based on other relevant road features in the situation (Examples of these explanations are given in appendix 1).

A comparable age pattern also emerged under the recognition of dangerous places by which to cross the road. Here, however, while the younger children judged the situations by basing on the absence of cars on the roads, the older children in addition based their assessment on significant road features in the situations [see Figures 4.4 (a-e); (see appendix 2, for examples of these explanations)]. This differential mode of danger recognition may well explain the 5 and 7 year-olds overall poor perception of the road crossing sites featuring the parked car and hedge as dangerous, since they did not have cars on the roads near them.

It is worth emphasising here, however, that these categorisations were not decided upon prior to the study, but only emerged after a content assessment of the explanations for the children's responses to the recognition task.

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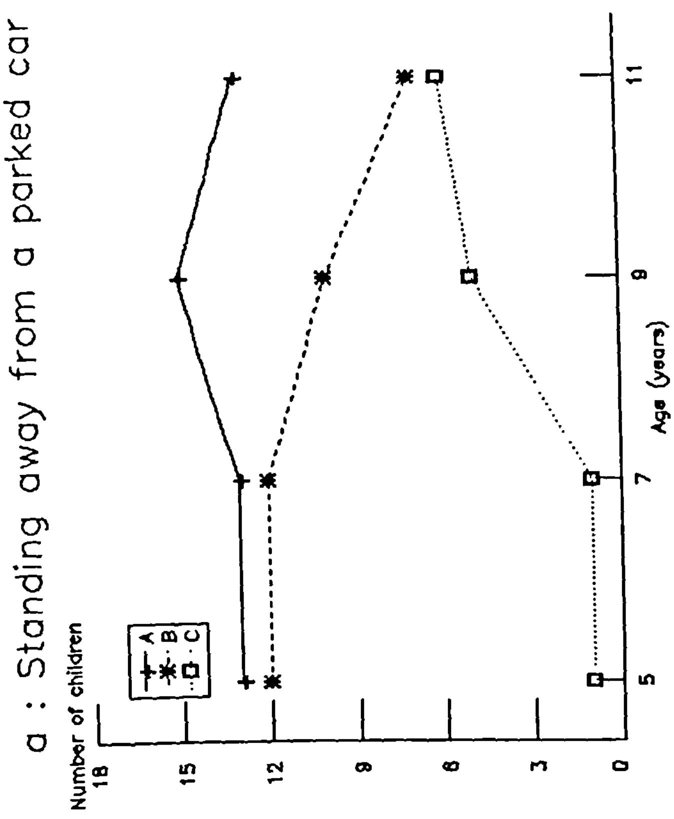
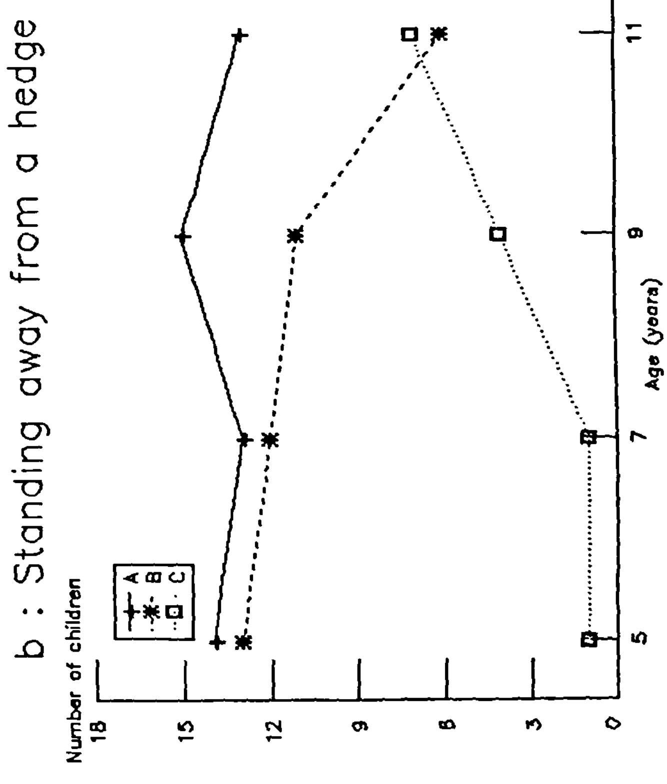
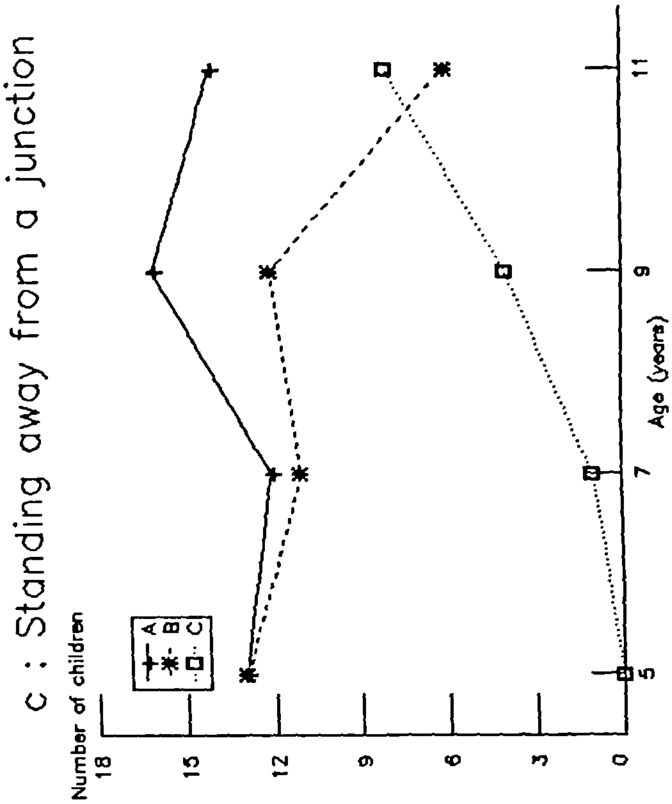
* Throughout this thesis younger children will be used synonymously for 5 and 7 year-olds; while older children will be used for 9 and 11 year-olds.

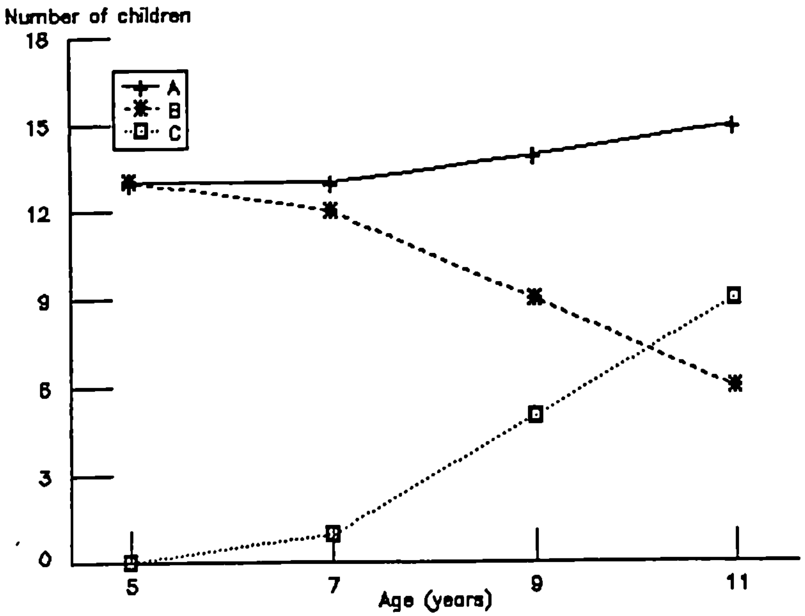
Figures 4.3 (a-e). Number of children offering the different explanations under the recognition of safe sites to cross the road (A = total number of children with correct explanation; B = number of children who relied only on the absence of cars on the road to judge safety; C = number of children who included other relevant road environmental features).


a : Standing away from a parked car
Number of children
Age (years)
A
B
C

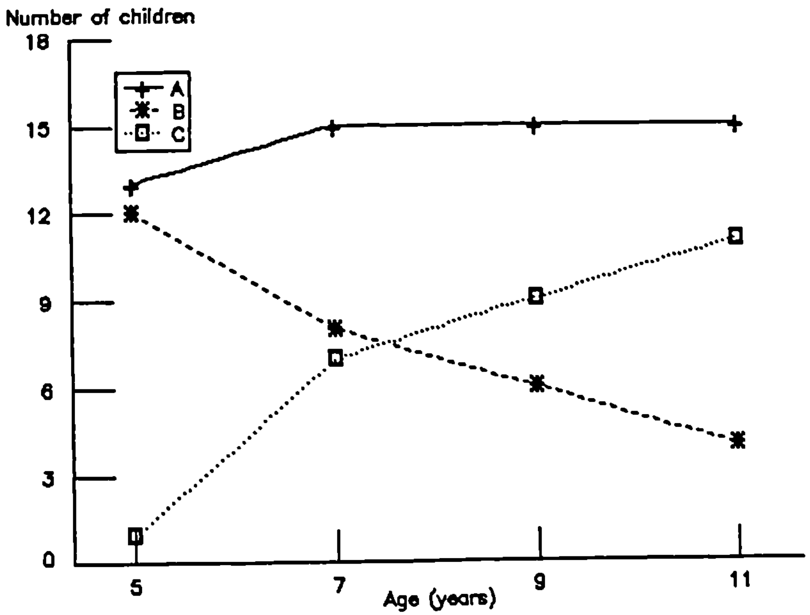

b : Standing away from a hedge
Number of children
Age (years)
A
B
C


c : Standing away from a junction
Number of children
Age (years)
A
B
C

d : Standing away from a bend



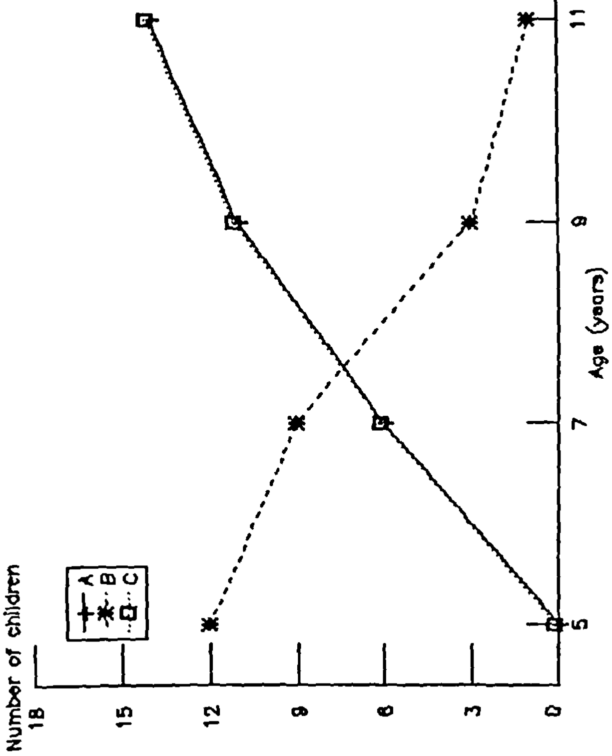
e : Standing close to a zebra crossing



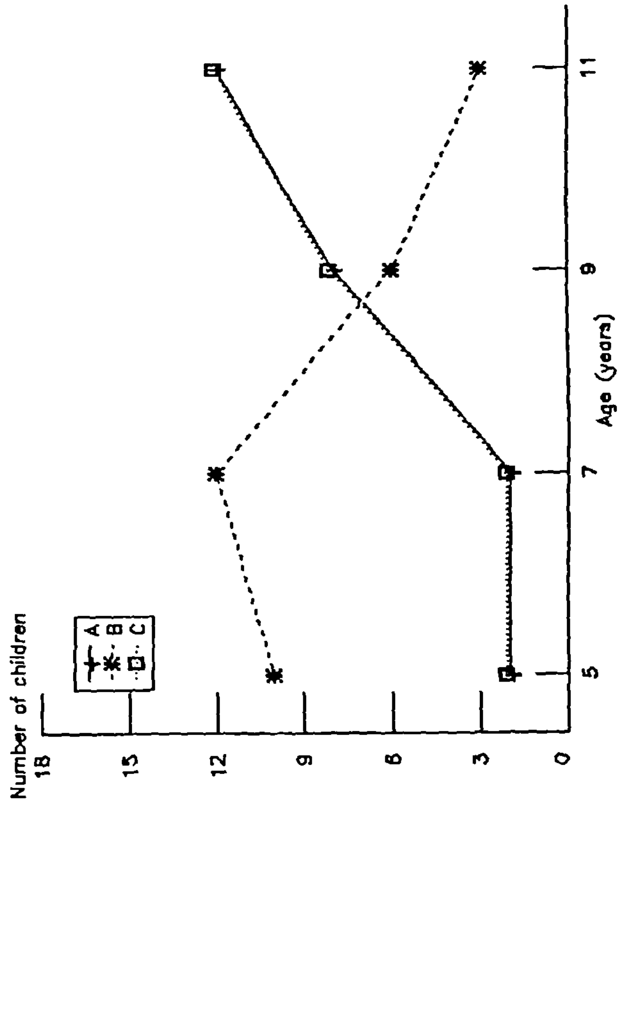
Figures 4.4 (a-b). Numbers of children who gave the different explanations under the recognition of dangerous sites to cross the road (A = total number of children with correct explanation; B = number of children who had their perceptions adjudged wrong for basing on the absence of cars on the road to estimate danger; C = number of children who relied on other relevant road landmarks).

Figures 4.4 (c-e). Numbers of children who gave the different explanations under the recognition of dangerous sites to cross the road (A = total number of children with correct explanation; B = number of children who based on the presence of cars on the roads to estimate danger; C = number of children who dwelt on other road featural characteristics).

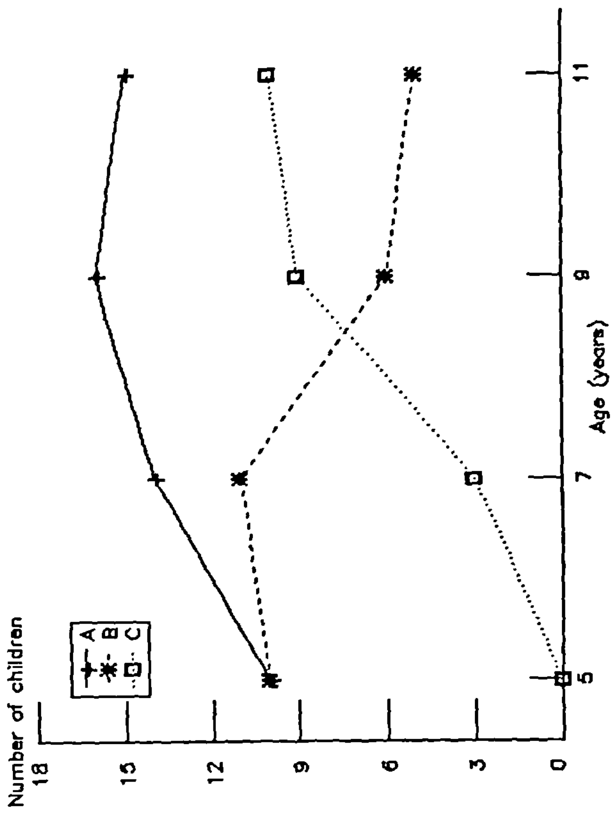
a : Standing in between parked cars



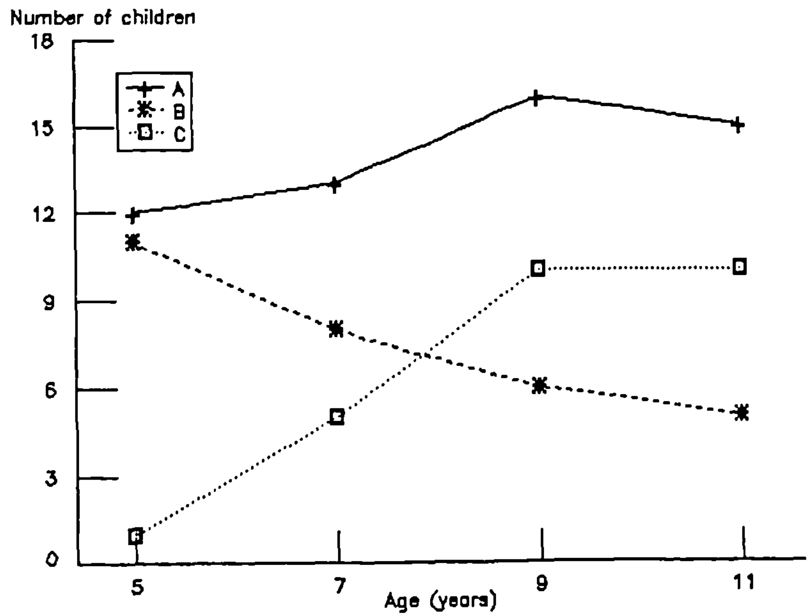
b : Standing close to a hedge



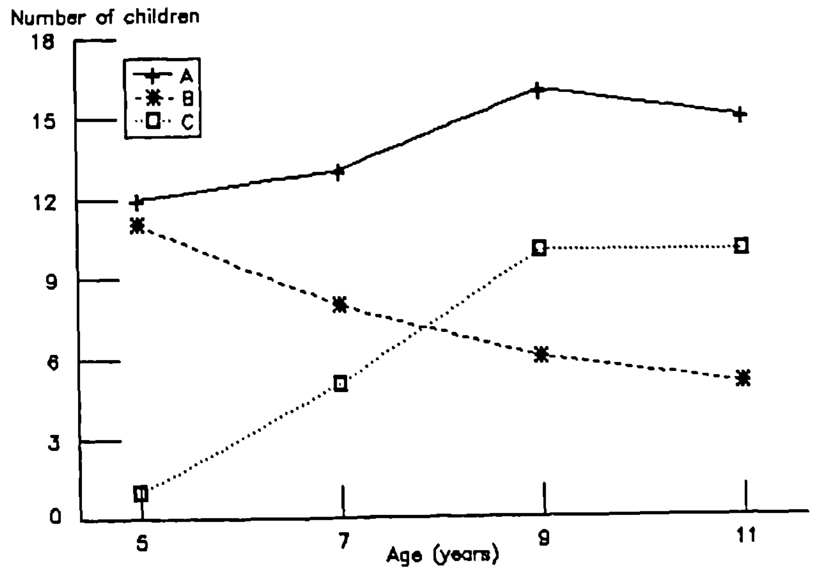
c : Standing at a junction



d : Standing at a bend



e : Standing at a zebra crossing with cars on it



4.4.2 Construction task

A 4 (age: 5, 7, 9 and 11 year-olds) x 2 (sex: girls and boys) x 4 (road crossing locations: hedge, junction, bend and zebra crossing) ANOVA with repeated measures on road crosssing locations was calculated. Age and sex were between subject variables, while road crossing locations were within subject variables. Table 4.3 indicates the mean constructed safe routes by age and road crossing situations.

A highly significant main effect of age was observed in the ANOVA ($F(3,56)=52.75, p<0.001$) indicating a better performance with increasing age (see Table 4.3). A significant effect of road crossing site was recorded ($F(3,168)=7.5, p<0.001$) and so was the interaction of age and road crossing locations ($F(9,168)=3.2, p<0.01$).

Table 4.3: Mean number of constructed safe routes by age and road crossing locations (Maximum possible score = 8).

	Road crossing locations				
Age (years)	Hedge	Junction	Bend	Zebra crossing	Age, road environmental features combined
5	4.06	3.63	2.88	5	3.89
7	5.94	5.88	5.88	5.5	5.80
9	6.75	6.13	6.44	7.25	6.64
11	7.13	6.69	6.63	7.13	6.90
All ages road environmental features combined	5.97	5.58	5.46	6.22	

There was, however, no significant sex effect; and age and sex interactional effect ($F(1,56)=0.06$, n.s.) and ($F(3,56)=0.21$, n.s.). Similarly, there were no interactions of sex and road crossing sites;

and age, sex and road crossing sites.

4.4.2.1 Comparisons of the safe road crossing routes selected by the 4 age groups at the hedge, junction, bend and zebra crossing on the construction task.

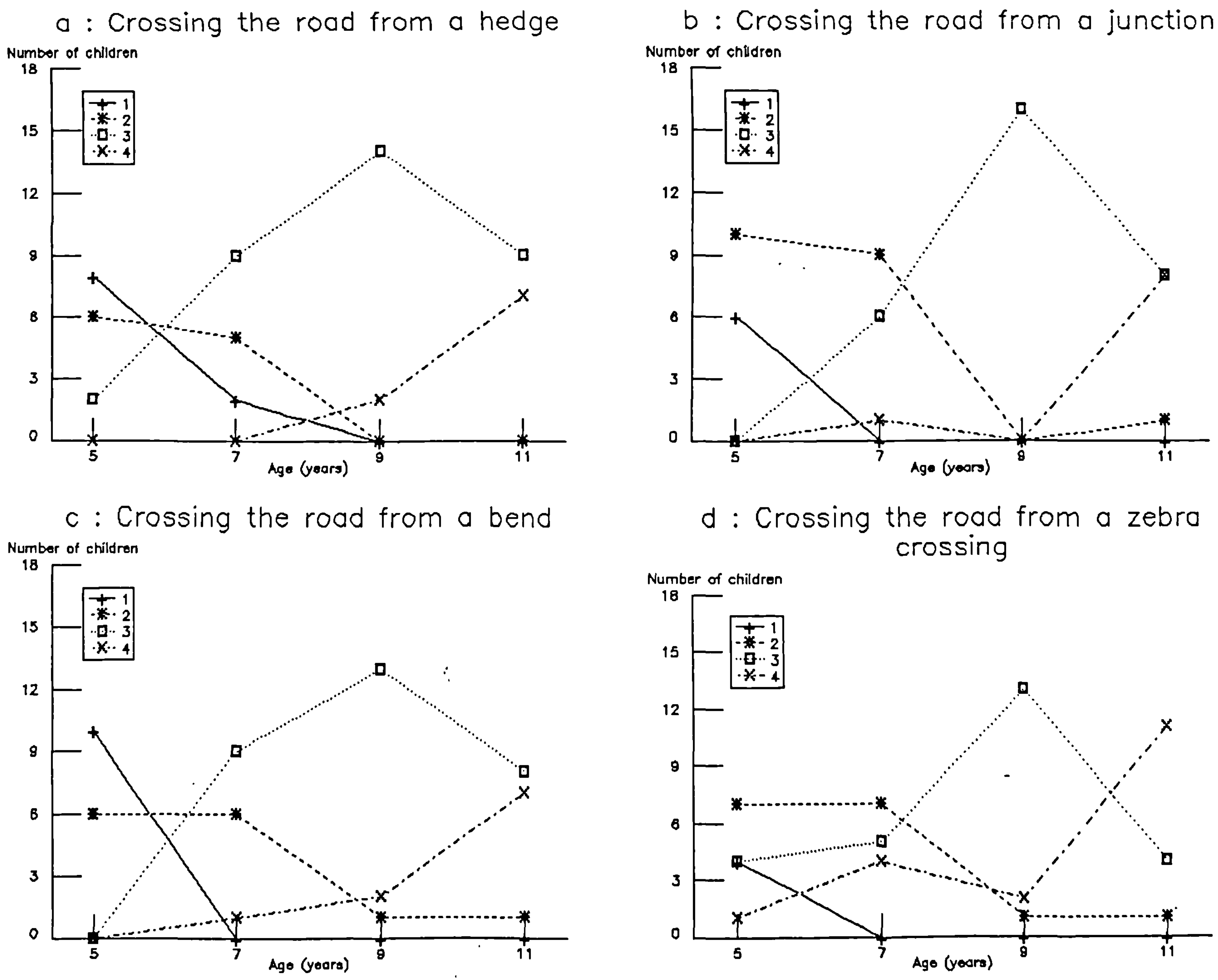
A matched pairs t-test was carried out to assess the effect of the various road crossing locations on children's performance on the construction task. This showed the children as having significantly more safe routes at the hedge than both the junction ($t(63)=2.3, p<0.05$) and the bend ($t(63)=3.4, p<0.01$). The children also constructed significantly more safe routes at the zebra crossing than at both the bend ($t(63)=2.9, p<0.01$), and the junction ($t(63)=3.2, p<0.01$). The constructed safe routes at the junction and bend did not show any significant difference ($t(63)=0.72$, n.s.), and so was the comparison between the hedge and the zebra crossing ($t(63)=1.3$, n.s.).

Overall, the children achieved better selection of safest road crossing route at the zebra crossing and hedge, than at the bend and junction.

4.4.2.2 Qualitative analyses of the explanations given for the choice of safe routes on the construction tasks.

Unlike the recognition tasks (see 4.4.1.1; Chapter 4), the basis for categorising the explanations to the constructed safe routes was defined before the experiment (see 3.3.2; Chapter 3). Figures 4.5 (a-d) show the pattern of explanation to the chosen safe routes at the hedge, junction, bend and zebra crossing given by the children. The 4 lines on each figure are labelled 1, 2, 3 and 4, and were based on the 4-point scale used for scoring the explanations given by the children for their constructed safe routes. They indicated how relevant a child's explanation was in terms of road safety (from

Figures 4.5 (a-d). Numbers of children who were categorised under the different scoring scales in the construction task (4 = explanation ensuring maximum safety with a mention of the relevant road landmark in the road crossing situation; 3 = explanation which ensures safety but with no mention of the road feature prominent in the road crossing situation; 2 = explanation with a reference to the road traffic situation but not ensuring safety; 1 = irrelevant explanation not ensuring safety, and with no mention of the road traffic situation).


a : Crossing the road from a hedge
b : Crossing the road from a junction
c : Crossing the road from a bend
d : Crossing the road from a zebra crossing
Number of children
18
15
12
9
6
3
0
5
7
9
11
Age (years)
1
2
3
4

relevant explanation (4) to irrelevant explanation (1)) (see also 4.3-scoring). From the figures it can be observed that while most 5 and 7 year-olds responses concentrated on categories (1) and (2), which did not ensure maximum safety, the 9 and especially the 11 year-olds gave category (3) and (4) responses which were relevant in terms of road safety. This showed a distinct age trend, with the 9 and 11 year-olds reasons safeguarding maximum safety than the 5 and 7 year-olds. (Examples of the justifications are given in appendix 3).

4.5 Discussion

4.5.1 Recognition and construction tasks.

The results of Experiment 1, indicated that 5 and 7 year-olds judge safety and danger on the road by the presence or absence of cars. This occurred on both construction, and recognition tasks. They exhibited a total lack of awareness of other featural aspects of the road, such as parked cars, hedges, bends, junctions and road markings also needed for such identifications. The 5 and 7 year-olds based almost all their judgements on cars, and failed to detect as dangerous the crossing of the road from sites such as beside hedges and close to parked cars where vision may be obstructed.

The 9 and especially the 11 year-olds, however, additionally based their estimations on significant road featural characteristics such as parked cars, hedges, bends, junctions and occasional reference to road markings.

It must be stressed here that, this developmental trend became particularly clear during content examination of the reasoning children advanced to justify their identifications.

4.5.2 The effect of road environmental features on the responses to the recognition and construction tasks.

Under both the recognition and construction tasks, it was difficult to assess the relative difficulty the various road environmental features posed to the children. And, though the children constructed more safe routes at the zebra crossing and the hedge, than at the junction and the bend on the construction task, it was impossible to ascertain which particular characteristics within them caused the vagaries in the results. Perhaps, an answer can be found for the good performance at the zebra crossing - it is a highly emphasised safe road crossing site in children's road safety education (Morris, 1972; Rothengatter, 1981c). The same observation can, however, not be said about the hedge where the children performed equally well. More importantly, however, the zebra crossing, bend and junction had cars near them, while the hedge did not, and this may partially explain the good performance at the hedge. A further experiment to discover what might have caused these differential results is therefore required.

The recognition task featuring the identification of dangerous sites to cross the road, however, showed the 5 and 7 year-olds as being poor at the hedge and parked car, and this was found to be attributable to how they determine safety and danger in traffic (see 4.4.1.1; Chapter 4).

4.5.3 Sex differences

Overall also, no significant main effect of sex was detected in the responses to both the recognition and construction tasks. The results, therefore, failed to offer an explanation for the over-involvement of boys than girls in pedestrian accidents (Foot, 1985;

Foot, et al., 1982; Strathclyde Police and Department of Roads, 1985). The results, therefore, did not confirm the hypothesis that boys greater vulnerability to pedestrian accidents than girls , may be due to their inability to select safe sites and routes to cross the road at the same level of efficiency as the girls.

4.5.4 The present results and children's road safety education.

We have by our present results confirmed our doubts about the clarity of the first injunction of the Green Cross Code to young children. 5 and 7 year-olds appear to employ a definite strategy in deciding sites and routes to be used in crossing the road (see Figures 4.3 (a-e), 4.4 (a-e), and 4.5 (a-d); Chapter 4). This referent, however, does not permit maximum safety in the roadway.

In the next series of experiments, different methods will be employed to find out if this basic determinant is all that young children use in their selection of safe sites and routes to cross the road.

4.5.5 Methodological issues and conclusions

The children understood and enjoyed the table-top model based tasks which involved the adoption of the perspective of a doll-pedestrian. Such tasks are purported to pose problems for young children (Piaget and Inhelder, 1956). Experiment 1, taking this into consideration used materials and settings familiar to the children in constructing the table-top model, completed examples of the tasks with the children prior to the study proper, and also insisted on clarity of experimental instructions. All these have been found to enhance the perceptual inference ability of young children (Cox 1980; Hughes, 1978; Borke, 1975; Donaldson, 1978).

Notwithstanding the above careful experimental arrangements these doubts about the children's comprehension of the tasks served as the basis for Experiment 2. For example, one can argue that most of the 5 and 7 year-olds who failed to discriminate between safe and dangerous sites, and the choice of safe routes by which to cross the road (to the same level of competence as the 9 and 11 year-olds) did so because they were unable to adopt the perspective of the doll-pedestrian in the tasks (see Piaget and Inhelder, 1956). Experiment 2 will subsequently create the task-situations in a manner which will permit the children to have the same view in the roadway as the doll-pedestrian. This is to eliminate any spatial perspective problems the children will otherwise have encountered (see Light and Nix, 1983).

Other plausible reasons may exist for the 'poor' performance of the 5 and 7 year-olds. It could be, perhaps, that the setting up of the situations in-between tasks on the table-top model caused the children to forget some of the essential details of the experimental procedure, which subsequently affected their performance. Experiment 2, in view of this will employ photographic tasks based on the table-top model, which will preclude the setting up of situations in-between tasks.

The 'poor' performance of the 5 and 7 year-olds may also be attributed to their lack of the same verbal ability as the 9 and 11 year-olds. These doubts can only be clarified through further experiments and our subsequent experiments addressed these problems through different methodological approaches.

CHAPTER 5

EXPERIMENT 2

CAN CHILDREN'S MODE OF IDENTIFYING SAFETY AND DANGER ON THE ROAD BE MODIFIED BY MAINTAINING THE SAME PERSPECTIVE FOR THEM AND THE DOLL-PEDESTRIANS IN THE TASK-SITUATIONS?

5.1 INTRODUCTION

In Experiment 1, we observed a developmental trend in the way children perceive safety and danger on the road. While 5 and 7 year-olds used as their main determinant - cars, 9 and 11 year-olds, additionally, centred on prominent featural aspects of the roadway in their estimations.

Doubts could, however, be raised about the results to Experiment 1, because of the manner in which the children were instructed to record their responses. They judged road crossing sites as either safe or dangerous, and also selected safe routes by which to cross the road from the perspective of a doll-pedestrian. Such tasks as mentioned under Experiment 1 (see 4.5.5; Chapter 4), are purported to pose difficulties for young children. Piaget and Inhelder (1956) first expressed this when they concluded after experiments that children aged about 7 years cannot take the viewpoint of others.

Three important methodological issues therefore follow logically from the results of Experiment 1;

(1) That the 5 and 7 year-olds did not perform as well as the 9 and 11 year olds because they could not fully understand the way they were required to record their responses - that is from the perspective of a doll-pedestrian. Experiment 2 will subsequently circumvent this egocentric problem by creating the task-situations in a manner which will ensure that the children now enjoy the same view of the roadway as the toy-pedestrian. Such task arrangement has been observed to enhance the spatial percept inference ability of young children (see Light and Nix, 1983). We shall be returning

to this later when considering the design of the task-situations for Experiment 2.

(2) As also mentioned under Experiment 1 (see 4.5.5; Chapter 4), the 5 and 7 year-olds inability to respond as efficiently as the 9 and 11 year-olds may also be attributed to the fact that they had forgotten the details of the experimental instructions. This was because there was the need for the rearrangement of the crossing situations in-between tasks. This is an important observation especially if one considers the evidence that clarity of experimental instructions is crucial to children's performance on such tasks (Hughes, 1978). To solve this anticipated difficulty, Experiment 2 will use photographic tasks based on the table-top model where there will be no need to rearrange situations in-between tasks.

(3) The 5 and 7 year-olds inability to perform at the same level of efficiency as the 9 and 11 year-olds may well be attributed to their lack of verbal competence. Experiment 2 will therefore, employ a new structural arrangement for the tasks with a view to 'forcing' the 5 and 7 year-olds to improve upon their verbalisations. For example, there will be a total elimination of <u>cars</u> on the roads in the tasks. Since the 5 and 7 year-olds constantly estimated safety and danger in Experiment 1, by using as their main referent the presence and absence of cars on the roads; will they now be compelled to give a more elaborate explanation with the removal of cars in the tasks?

Experiment 2 is designed to clarify these doubts regarding the results of Experiment 1. Before then, however, the literature will be reviewed on the relevant researches concerning both <u>children's</u>

spatial perspective abilities; and the use of photographs in children's road safety researches - since the two formed the nucleus of Experiment 2.

5.1.1 Researches on children's spatial percept inference ability.

Piaget and Inhelder's (1956) three mountain experiment is generally considered as a pioneering study in this area. Employing the three-mountain task, they observed that children aged about 7 years of age tended to choose photographs which represented their own view of the mountains as also indicating that of another observer (a doll). They concluded that a child aged less than 7 or 8 years; 'appears to be rooted in his own viewpoint in the narrowest and most restricted fashion, so that he cannot imagine any perspective but his own. Indeed he cannot imagine any perspective but that of the passing and moment, since with a change of position he repeats his performance in terms of his new position' (1956, p.242-243). This inability of young children to accurately differentiate the perspective of self and other was attributed to pervasive egocentrism embodied in pre-operational thinking.

Piaget and Inhelder's observation that young children have problems with spatial perspective tasks has been replicated by other researchers like Dodwell, 1963; Aebli, 1963; Laurendeau and Pinard, 1970; and Garner and Plant, 1972.

Other researchers, for example (Flavell, 1974; Fishbein, Lewis and Keiffer, 1972; Borke, 1975) have, however, obtained contradictory results to the Piagetian conclusions. These differential results typically assert that the failure of the young child on a visual perspective-taking task (reminiscent of Piaget and

Inhelder's three-mountain task) could be ascribed to a number of significant task and response variables. Fishbein et al., (1972) for example, observed that the number of experimental tasks, had significant effect on children's perceptual inference ability. In two studies involving children aged between 3 years 5 months and 9 years 5 months they observed that co-ordinating the perspective of 3 toys was more difficult than 1. Rosser (1983) also administered a set of 4 visual perspective-taking tasks to 120 children between ages 4 and 8 years. She found that children's competence with the tasks was a function of the number and type of spatial relationships embedded in the stimulus display.

Cox (1975) also concluded that children become less egocentric when a person acts as the other observer than when a doll is used. She argued that children may not regard a doll as having a view, and may therefore consider themselves as being the only observers in the situation. In consequence, they select their own view as also representing that of a doll. Cox (1980) also emphasised that a child's expectations when confronted with a visual perspective-taking task influences his or her responses. The young child may perceive the task as a matching game and may believe that they are being instructed to select a picture which matches their own view. It is, however, doubtful if such a misconception will occur if the experimental procedures are clearly explained to the child prior to the study (Donaldson, 1978). This view has been reinforced by Gzesh and Surber (1985) who challenged the very basis of the experimental procedure involved in spatial perspective-taking tasks. They found that children, and especially pre-schoolers, made a significant number of errors when asked to determine their self-views of a visual array from a group of photographs. They concluded that young children cannot reliably match a photograph to a physical array. They argued further that without this prerequisite, it is not possible to make clear inferences as to why children cannot reliably solve a perspective-taking task. Gzesh and Surber continued that, even if children possess an understanding of what it involves in predicting another person's view of a visual display, since they are unable to perform the basic task, this ability may be grossly under-estimated. Hughes (1978) lent credence to the importance of clarity, of experimental instructions in researches on children's spatial percept inference capabilities, when he observed that the nature of the instructions was crucial to children's understanding and performance on the tasks. In Hughes first experiment, almost all the 4 year-olds tested, failed to select pictures showing another person's view of an array similar to Piaget and Inhelder's three-mountains. In a second study, however, 13 out of 20 of the children succeeded when the task was preceded by preliminary questions which referred to critical attributes of the array and the pictures.

The above critical elements have been shown to significantly influence a child's performance on a visual perspective-taking task. One should, therefore, be cautious in thinking of the child as being totally egocentric and finding it difficult to ascertain that others may have a viewpoint which differs from his own. Perhaps, Light and Nix's (1983) statement that 'Piaget's concept of egocentrism is notoriously ambiguous even as it relates to spatial perspective-taking' (p.480), should serve as a cautionary guide to researchers to be wary of any hasty conclusions regarding the precise nature of young children's percept inference abilities. It must also be pointed out that most of the conflicting results appear resolved when researches are grouped on the basis of methodology. Rosser (1983) supported this view when she concluded that 'a perusal of the existing perspective-taking literature leads to the conclusion that findings tend to be task specific' (p.660).

5.1.1.1 Piagetian postulations on spatial perspective-taking ability and road safety research involving children.

Road safety research has for a long time been plagued with a lack of concrete empirical and theoretical formulations to guide researchers. This is not surprising since 'accounts of children's accidents have rarely drawn upon theories of child development' (David *et al.*, 1986a; p.117). David *et al.*, further highlighted this lack of theoretical guides to child pedestrian research when they stated that 'an absence of relevant theory has led empirical researchers to confront specific non-theoretical problems or aspects of problems, one consequence being that empirical studies have tended to relate only loosely to one another, and hence there is no substantial or cohesive literature' (p.117).

So far, for example, no conclusive evidence has emerged on the applicability of table-top models in road safety researches with children. Neither have the Piagetian findings on perceptual inference been applied to table-top model in children's road safety research. Rothengatter (1981c) commenting on the success achieved by (Page, Iwata and Neef, 1976) in using a table-top model for the traffic training of mentally retarded adults therefore stressed that it was still left to be seen whether such a method will be feasible with young children.

Perhaps, an answer to Rothengatter's doubt had earlier been provided to a certain extent by Boyle (1973) who was able to significantly modify the road crossing behaviour of 6½ and 7½ year-old children at junctions using a table-top model. Boyle concluded that 'by the use of table-top models of road situations, the behaviour of young children can be modified, that the modification is relatively permanent, and that the children can generalise from the situation in which they are instructed to an analogous, but unfamiliar road situation' (p.96). But just like Rothengatter, Boyle stressed that one unanswered question from his study was whether the children understood what is taught them by means of table-top models. And, indeed, one may criticise Boyle's study for its neglect of the Piagetian formulations on the spatial percept inference capabilities of young children which have relevance to table-top model researches. Boyle, however, realised such a need, and stated that at the outset of his research he had Piaget's views in mind. However, the nature of these views and their relevance to his study were not explicit.

Our table-top model used for Experiment 1 and on which the photographic tasks for Experiment 2 will be based also, provided a more comprehensive view of the real traffic situation than earlier ones (see, for example, Boyle, 1973; Firth, 1973b; Page et al., 1976 which were all based on only specific sections of the traffic situation). Firth's (1973b) table-top model, for example, included only a zebra crossing. Page et al., also drew or pasted the cardboard houses, cars, trees and people on their model. In due course we will review the literature to show that children have been observed to experience comprehensional problems with such drawings.

Experiment 2, taking into consideration the above conceptual problems associated with table-top models will employ a methodological design which will attempt to circumvent them.

5.1.2 Pictorial usage in road safety researches

Photographs serve a dual purpose in road safety research. First, they are used as educational aids aimed at improving children's knowledge and safe behaviour in traffic. They are used extensively in schools, playgroups and other organisations by trained teachers, policemen and road safety officers to teach children principles of road safety (Firth, 1973a).

Comprehension problems are, however, often encountered by children with these pictorial learning aids. Colborne and Sheppard (1966), for example, tested children aged 5-7 years' understanding of a poster intended to dissuade them from running across the road to their mothers which often resulted in accidents. The majority of the children misinterpreted what the poster was designed to teach them. Most of the 5 and 6 year-olds tested said it was about shopping, a response which was attributed to the distracting features in the poster. Even among the 7 year-olds only half were able to understand what the poster was telling them.

Symbols in pictorial learning aids such as arrows used to represent movement and lines used to show speed of vehicles have also been found to present difficulties even to 10 year-olds (Firth, 1973a . Sheppard (1975) also found children m´sinterpreting arrows used to indicate the movement of vehicles to mean road markings. To circumvent these problems of comprehension of pictures Firth (1973a) suggested that 'new aids should be copy tested on groups of children before they are printed and put into wide circulation' (p.1).

It must be made clear, however, that the majority of these earlier pictorial road safety aids were cartoons and drawings and this may have contributed to the children's difficulty in understanding them. The practise nowadays is to present children with real photographs of the specific traffic situations they are supposed to learn. Real photographs obviously present more 'life-like' situations than is otherwise possible with cartoons or drawings. Such photographs are usually broken down into 'parts' to make them more meaningful to the child. A ROSPA (undated) photographic aid intended to instruct children aged 9 to 11 years on how to cross safely in-between parked cars was broken down into 6 steps with each step being represented by a photograph. The importance for comprehension of breaking road safety photographs into meaningful parts instead of one whole presentation has been shown empirically. Colborne and Sheppard (1966) found that a road safety poster re-designed in strip-cartoon form doubled the level of comprehension for children aged 5-7 years.

The second use of photographs is in studies of children's perception of danger in traffic. In this type of research, however, photographs are more often used than either cartoons or drawings. The most cited of these has been Martin and Heimstra's research already discussed (see 2.3; Chapter 2). Schreiber and Lukin (1978) also used photographs to study children aged 3½-7½ years' perception of hazard. Their study, just like Martin and Heimstra's, did not however focus on traffic accidents alone, but also included scenes involving poisoning, drowning and burning.

There are, however, a number of problems in research using photographs to study children's perception of safety and danger in traffic. For example, if the photographs are not carefully taken they may include features not relevant to the specific situations to be studied. These unwanted features can distract and subtly influence the responses of the subjects. In view of this, Experiment 2 will use carefully taken photographs which will preclude all distracting scenes (see method section below).

5.2 Method

5.2.1 Subjects

A group of 48 (5, 7, 9 and 11 year-old) children chosen from a school in Glasgow served as subjects. They were equally matched for age and sex. They were randomly selected from the class registers and none had participated in Experiment 1. Their mean ages were;

5 year-olds (boys; 5 years 4 months; girls; 5 years 3 months);
7 year-olds (boys; 7 years 5 months; girls; 7 years 2 months);
9 year-olds (boys; 9 years 3 months; girls; 9 years 5 months);
11 year-olds (11 years 3 months for both boys and girls).

5.2.2 Stimulus material and design

Experiment 2 used task-situations which involved photographs taken from the table-top model used in Experiment 1 (see Figure 3.1; Chapter 3, for a photograph of the table-top model). The photographs were carefully taken in a room where all distracting objects were completely eliminated. This involved a total removal of all seating from the room, and also all pictures from the walls. This arrangement was essential since research evidence indicates that distracting features can hinder children's comprehension of road safety photographic aids (Firth, 1973a; Sheppard, 1975; Colborne and Sheppard, 1966; see also 5.1.2).

During the taking of the photographs the camera was closely and carefully positioned behind the doll-pedestrian. This was important in helping to maintain the same perspective for the doll-pedestrian, and the children to be tested. Figures 5.1 (a-b) show an example of this arrangement for the safe and the dangerous road crossing sites near the junction in the recognition tasks. The 5 safe and their comparable 5 dangerous road crossing sites for the recognition task, and the 4 crossing situations for the construction task were carefully set up one at a time on the table-top model by the E, for the photographs to be taken. The road crossing situations for the recognition task were set up at bends, junctions, parked cars, hedges and zebra crossings, while those for the construction task were at bends, junctions, hedges and zebra crossings (see also 3.2; Chapter 3 for an explanation of the choice of these specific road features). The major experimental tasks of recognition and construction were, aside of some modifications, comparable to those described earlier (see 3.2; Chapter 3). For example, cars were totally eliminated from the roads in all the tasks for Experiment 2 (see 5.1; introduction to Chapter 5, for the explanation given for the removal of cars from the roads). In the construction task also, toys representing dog, mother, sister and father were placed at the locations the doll-pedestrian wanted to cross the road to. The child was informed the doll-pedestrian wanted to cross the road to them, to find out how this affects their choice of safest route for the doll to cross the road. Figure 5.2 shows an example of the construction task; here the doll-pedestrian is about to cross the road from the bend to his sister.

In all the tasks for Experiment 2 the child was given the

Figures 5.1 (a-b). The two road crossing locations of safe and dangerous at the junction used in the recognition task.

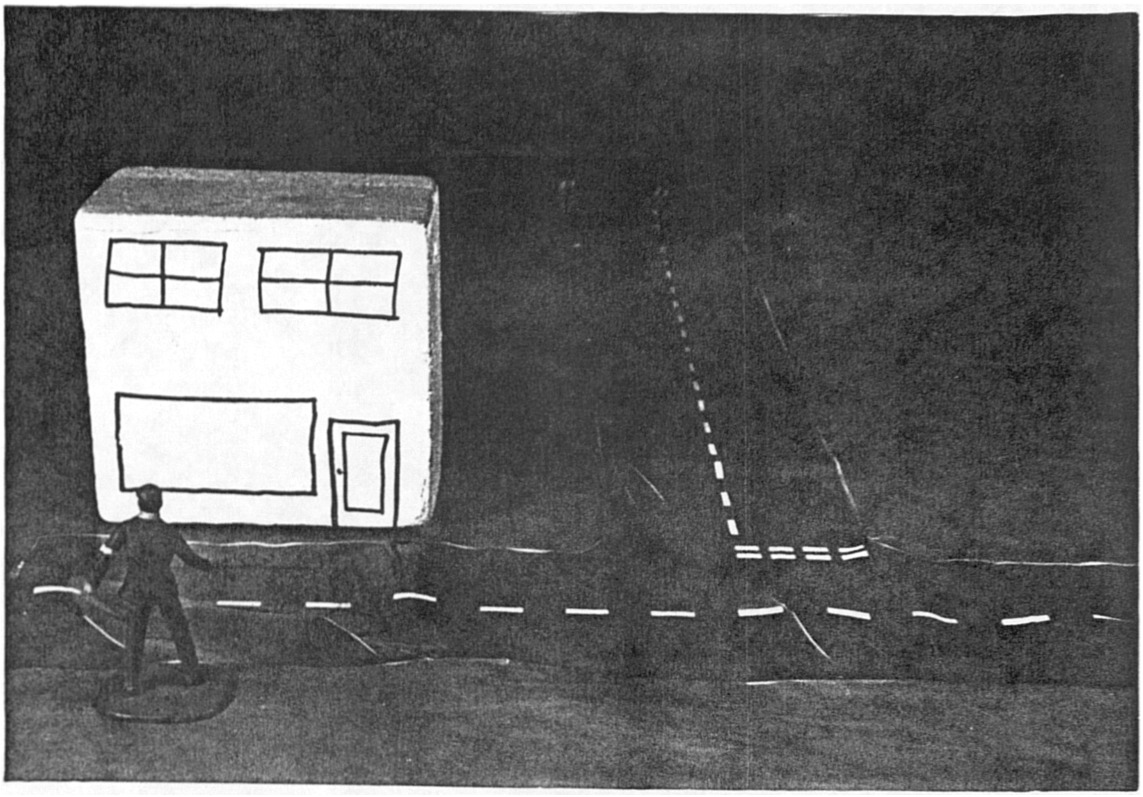


Figure 5.1 (a). The safe road crossing location at the junction.

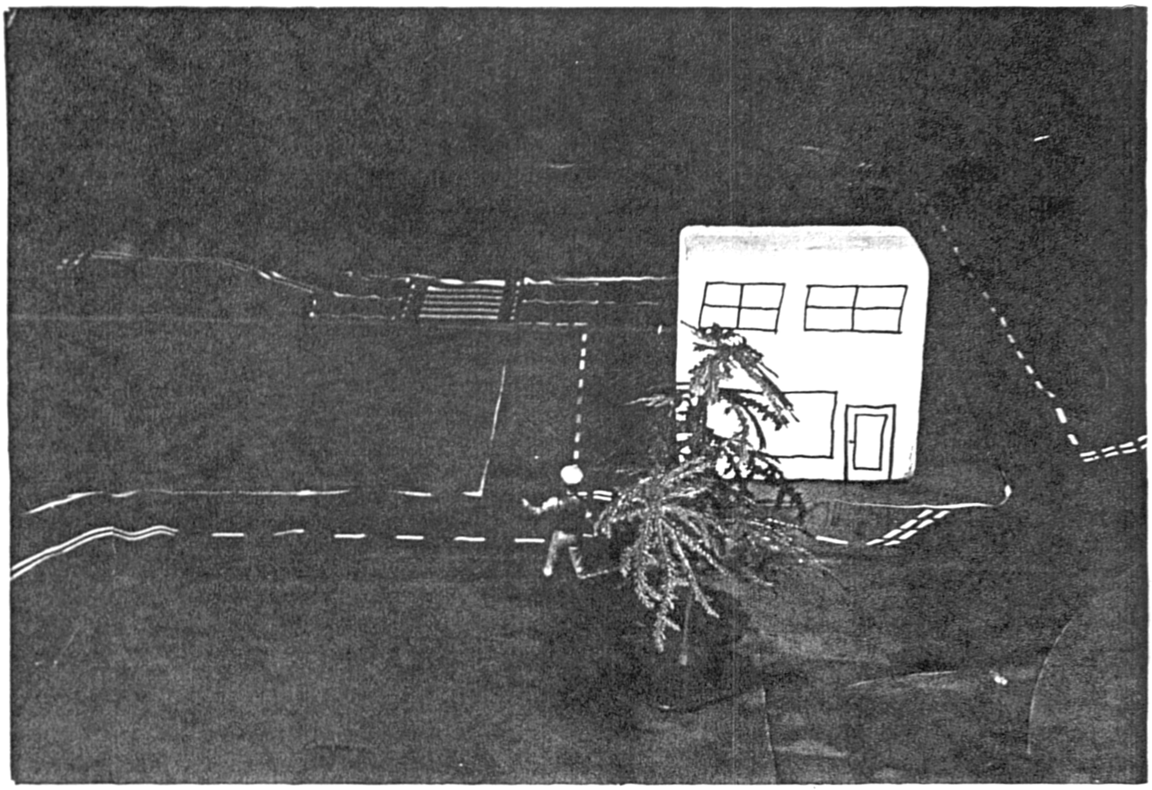


Figure 5.1 (b). The dangerous road crossing location at the junction.

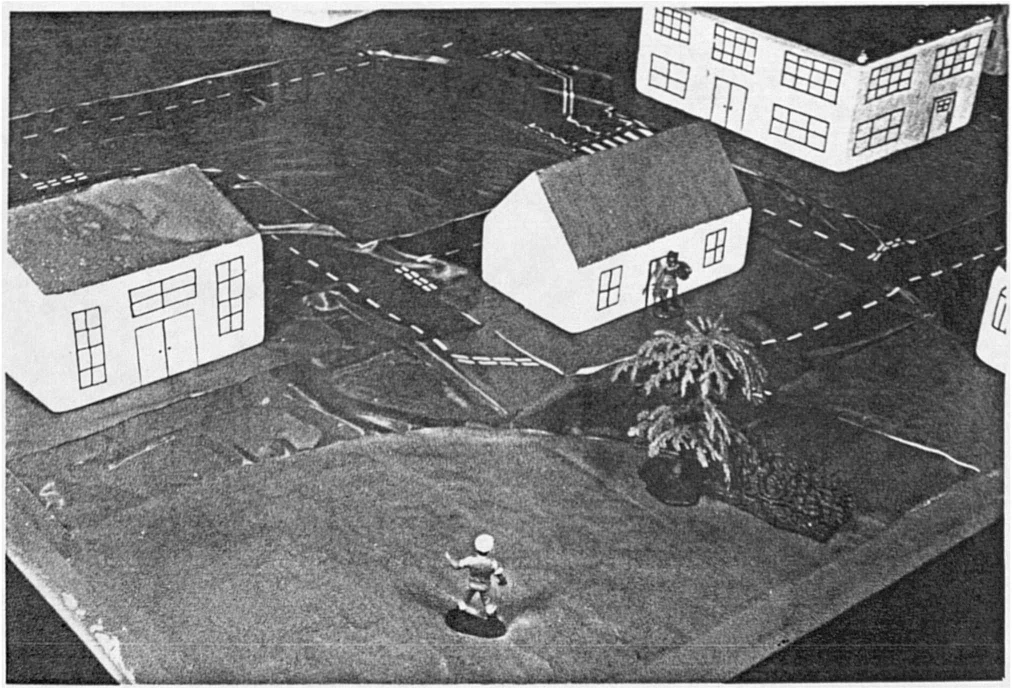


Figure 5.2. The road crossing situation at the bend used in the construction task.

doll-pedestrian's view directly, hence overcoming the egocentric problem (see 4.5.5; Chapter 4 and 5.1; Chapter 5). The task arrangement employed for Experiment 2 has support from Light and Nix's (1983) study. Light and Nix's experiment was inspired by suggestion and research evidence from Kielgast (1971) and Liben and Belknap (1981). Kielgast, for example, concluded that children in the Piagetian three mountains task are most frequently tested in a position which enabled them to have a good view of the array. The child's apparent preference for pictures showing his own view, he argued, may therefore reflect only a preference for a good view of the array. Using this as a frame of reference Light and Nix (1983) found in an experiment involving 40 children aged between 4 and 6 years, with a mean age of 5 years 2 months, that the children did not display any bias towards their own view when it was a poor one.

With the child and the doll-pedestrian now having the 'same good view' in our tasks for Experiment 2 we attempted to eradicate any spatial perspective problems the children would have otherwise encountered.

In the experiment itself each child completed 10 recognition and 4 construction tasks which were differentially randomised for the individual children (see also 3.4; Chapter 3).

5.2.3 Procedure

The experiment was conducted in a room in the school normally attended by the children. All furniture was removed from the room except a table and two chairs which provided seating for the experiment. These were specially chosen chairs and table to suit the stature of the children to enable them to have a good view of the photographic tasks and also feel comfortable.

E. tested the children individually. The procedure was aside of minor modifications comparable to what had been described in Chapter 3 (see 3.6). Instead of the table top model, for example, each child was shown a photograph of the overall set-up of the table-top model (see Figure 3.1; Chapter 3). During a preliminary period, the child was asked questions about what she or he could see from the photograph to relax them. Each subject also completed an example each of the recognition and construction tasks in situations not included in the main experiment to ensure their understanding of the tasks.

During the running of the experiment each photographic task was carefully placed on the part of the table nearest to the child. The photographs were also positioned on the table in a manner which allowed the child to have the same perspective as the doll-pedestrian in the tasks.

The recording of the safest route to cross the road in the construction task by the child, however, differed from Experiment 1, where the children manipulated the doll across the road on the table-top model (see also 3.2.2; Chapter 3). Here, the child indicated where he or she considered to be the safest route for the toy-pedestrian to cross the road between two points in the roadway on the photograph with a small blunt stick. To prevent any marks being made on the photographs the E. carefully fitted transparencies over them.

5.2.4 Scoring

As under Experiment 1, the maximum possible score a child could attain on each of the recognition tasks was 2. This consisted of a combined score of the child's identification of the site as either safe or dangerous, and the explanation given for this identification.

The maximum possible score attainable on each of the construction tasks was 8. This comprised of the child's constructed safe route (scored on a 4-point scale of very safe (4) to very unsafe (1) for the selected safe route, and the explanation advanced for this chosen safe route also scored on a 4-point scale of relevant explanation (4) to an irrelevant explanation (1) (see also 3.3 - Scoring, for details of the scoring procedure for the recognition and construction tasks)).

5.3 Results

The results were analysed using the same format as was used in Experiment 1. The only extra analysis was a graphical presentation of the choice of the shortest and most direct route as the safest by the children on each of the 4 construction tasks.

5.3.1 Recognition task

A 4 (age: 5, 7, 9 and 11 year-olds) x 2 (sex: boys and girls) x 2 (road crossing site: safe and dangerous) three way ANOVA with repeated measures on the last factor was calculated. Age and sex were between subject variables and road crossing sites of safe and dangerous were within subject variables. Table 5.1 shows the mean correct recognitions for each road crossing site of safe and dangerous by age.

In the ANOVA the main effect of age was significant ($F(3,40) = 12.35, p<0.001$). The main effect of sex, and the interaction between age and sex were, however, not significant. Significant main effects were recorded for road crossing sites ($F(1,40) = 57.91, p<0.001$). Significant age and road crossing sites interaction was also detected ($F(3,40) = 10.31, p<0.001$). The interactions of age and road crossing places and also age, sex and road crossing places were, however, not significant.

Table 5.1: Mean correct identifications of safe and dangerous sites to cross the road by age (Maximum possible score = 10).

	Age (Years)			
Road Crossing Sites	5	7	9	11
Safe	9.75	8	7.29	8.67
Dangerous	1.08	2.83	6.42	8.08

Additional statistical analyses were made on the correct recognitions of dangerous locations to cross the road which showed pronounced age variation (see Table 5.1). Using the independent groups t-test this was found to be significant when the 5 year-olds were compared with the 9 and 11 year-olds ($t(22) = 6.14, p<0.001$) and ($t(22) = 4.15, p<0.001$). The 7 year-olds also performed significantly worse than the 9 and 11 year-olds ($t(22) = 2.59, p<0.05$) and ($t(22) = 4.20, p<0.001$). The 5 year-olds performed at the same level as the 7 year-olds ($t(22) = 1.55, p<0.05$, n.s.). The 9 year-olds performance did not vary significantly from the 11year-olds ($t(22) = 1.18, p<0.05$, n.s.).

Overall, therefore, the extra statistical analyses showed the 9 and 11 year-olds as achieving more correct identifications of dangerous locations to cross the road than the 5 and 7 year-olds.

5.3.1.1 The effect of road environmental features of parked car, hedge, junction, bend and zebra crossing on children's correct recognition of dangerous sites to cross the road

Again, as under Experiment 1 (see 4.4.1.1; Chapter 4), the piecemeal nature of the data compelled us to employ non-parametric statistical tests for analysing it. For the purposes of the statistical analyses the scores of the 5 and 7 year-olds were combined and compared with the combined scores of the 9 and 11 year-olds for each of the 5 road crossing sites. This was done because of the fragmentary nature of the data. Moreover, the 5 and 7 year-olds achieved similar scores and the 9 and 11 year-olds also had comparable scores.

Table 5.2 shows the number of children who scored correctly or wrongly on each of the 5 dangerous locations to cross the road in each age group.

Table 5.2: Number of children scoring correctly or wrongly on each of the 5 dangerous sites to cross the road by age.

Road Environmental features (in the road crossing sites).	Number who scored correctly by age 5	7	9	11	Number who scored wrongly by age 5	7	9	11
Parked car	1	4	9	10	11	8	3	2
Hedge	1	2	8	10	11	10	4	2
Junction	1	4	8	10	11	8	3	2
Bend	1	3	7	8	11	9	5	4
Zebra crossing	3	4	7	11	9	8	5	1

Comparison between age and performance under each road crossing situation was done by Chi-square and Fisher exact probability tests as appropriate, while road environmental features effect on performance was assessed with a Cochran Q test.

Chi-square tests showed the 9 and 11 year-olds as performing significantly better than the 5 and 7 year-olds at the road crossing sites featuring the parked car ($X^2(3) = 18, p<0.001$); hedge ($X^2(3) = 19.89, p<0.001$); zebra crossing ($X^2(3) = 12.94, p<0.01$) and junction ($X^2(3) = 17.26, p<0.001$). A Fisher's test also showed the 9 and 11 year-olds as performing better at the bend ($p<0.01$) than the 5 and 7 year-olds.

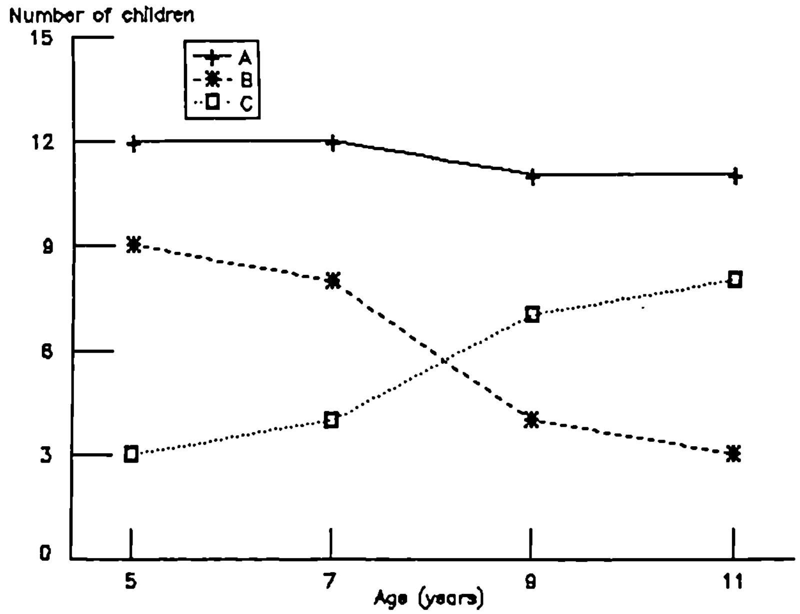
A Cochran Q test computed to find out the influence of the road environmental features on children's responses to the dangerous locations to cross the road was significant ($Q(4) = 10.12, p<0.05$). An inspection of the data (see Table 5.2) showed that the overall good performance at the zebra crossing, parked car, junction and hedge than at the bend might have been responsible for the observed significant difference in the effect of the various road environmental features on children's identifications on the dangerous sites to cross the road.

5.3.1.2 Qualitative assessment of the justifications advanced for the responses to the recognition tasks

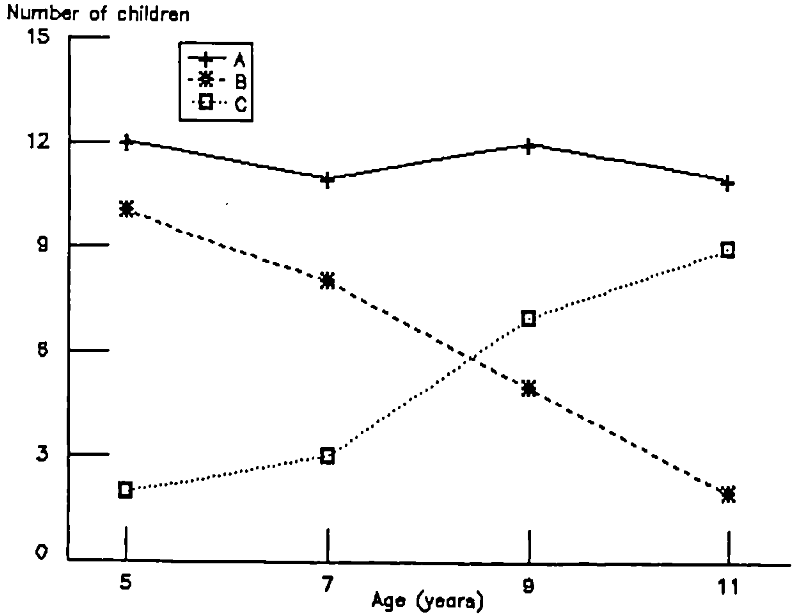
The explanations given for the identifications of the road crossing sites were content examined (for examples of these verbalisations see appendix 1). Figures 5.3 (a-e) show the pattern of explanations to the recognition of safe sites to cross the road. From the figures it can be observed that all the 4 age groups total correct justifications were almost at par on all the 5 road crossing situations. A further assessment of the nature of the verbalisations, however, revealed a clearly defined age variations. While most 5 and 7 year-olds used as their main referent for the estimation of safety the absence of cars

Figures 5.3 (a-e). Numbers of children under each age group advancing the different explanations in the recognition of safe sites to cross the road (A = total number of children with correct explanation; B = number of children who relied only on the absence of cars on the roads to perceive safety; C = number of children who included other relevant road featural characteristics).

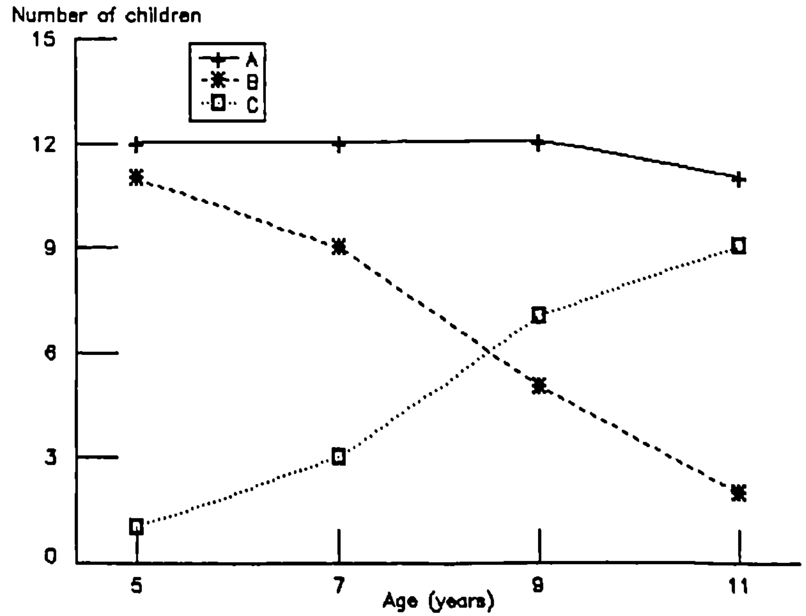
a : Standing away from a parked car



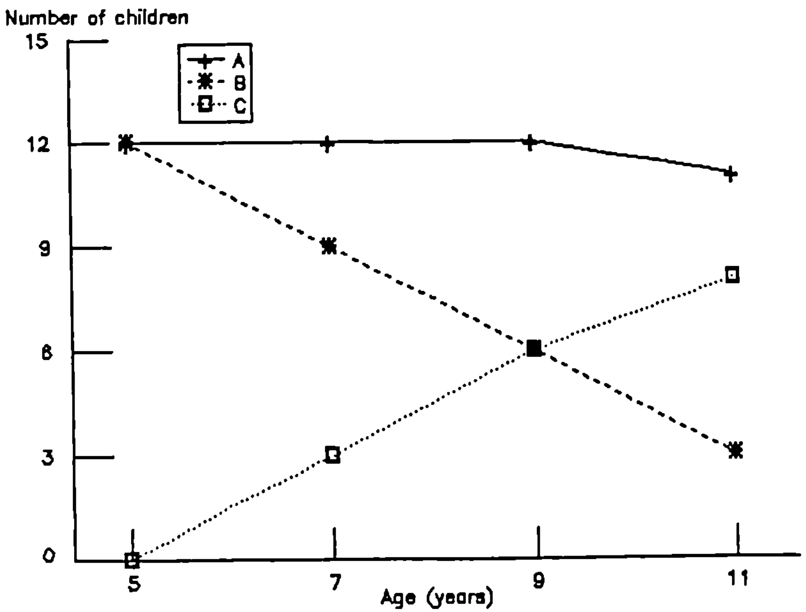
b : Standing away from a hedge



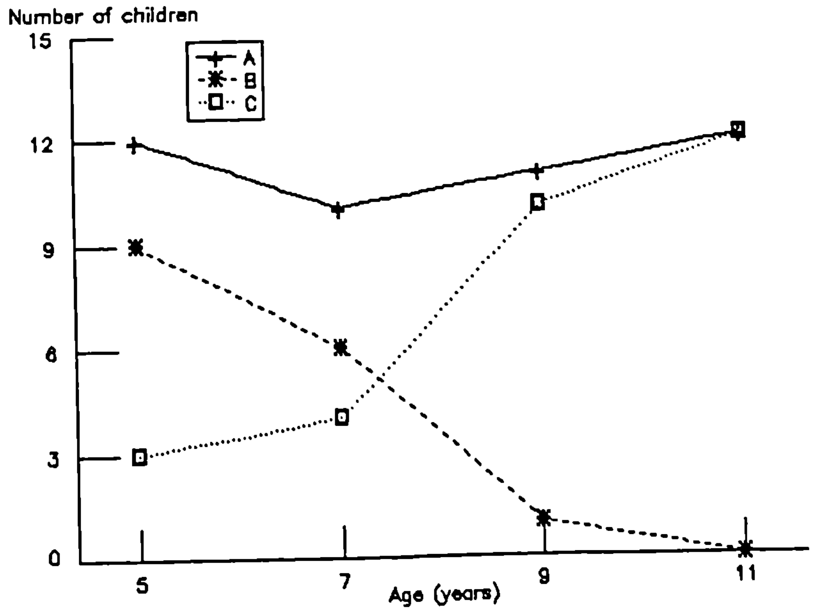
c : Standing away from a junction



d : Standing away from a bend



e : Standing near a zebra crossing



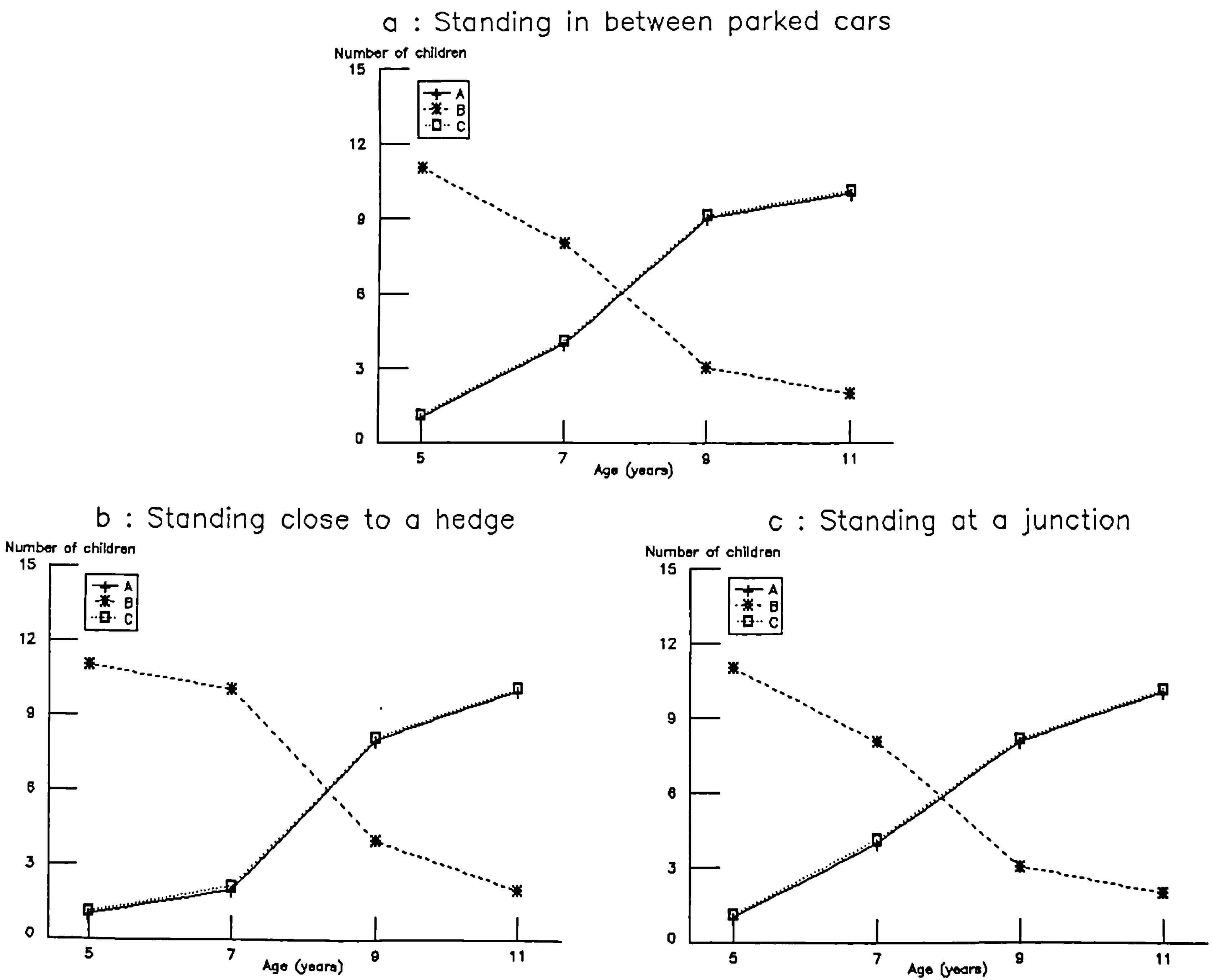
on the road; the 9, and especially, the 11 year-olds were more inclined to additionally mention prominent road features which made a crossing site safe.

As shown in Figures 5.4 (a-e), however, the younger the children were the poorer they performed in explaining how they perceived the crossing situations as being dangerous for the doll-pedestrian to cross the road. A breakdown of the explanations given to the responses also revealed an interesting age trend. In all the crossing situations, the younger the children were, the more they were inclined to wrongly perceive the situations as safe because of the absence of cars on the roads. The older children, however, reasoned correctly that even without cars on the road, some road crossing situations could be potentially dangerous because of obstacles obstructing vision; or at junctions or bends where one may have to contend with looking at, and crossing, many roads (for examples of the explanations refer to appendix 2). These results were comparable to those of the dangerous road crossing sites of parked car and hedge in Experiment 1.

5.3.2 Construction task

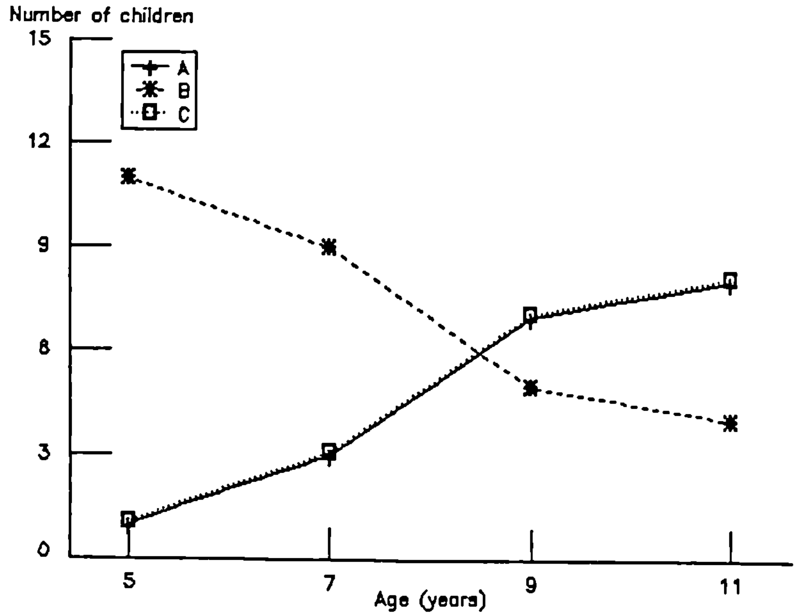
As in Experiment 1, the data was analysed with a 4 (age: 5,7, 9 and 11 year-olds) x 2 (sex: boys and girls) x 4 (road crossing site: hedge, junction, bend and zebra crossing) ANOVA with repeated measures on the last factor. Age and sex were between subject variables, with road crossing sites being within subject variables. Table 5.3 shows the mean scores on the construction tasks by age.

In the ANOVA significant effects were found for age ($F(3,40) = 26.67, p<0.001$) showing a strong age trend in the selection of safe routes to cross the road (see Table 5.3). A significant effect of road crossing situations was recorded ($F(3,120) = 17.09, p<0.001$), Figures 5.4 (a-e). Children in each age group who gave the different explanations under the recognition of dangerous places to cross the road (A = total number of children with correct explanation; B = number of children who wrongly based on the absence of cars on the road to estimate danger; C = number of children who relied on other road environmental features).

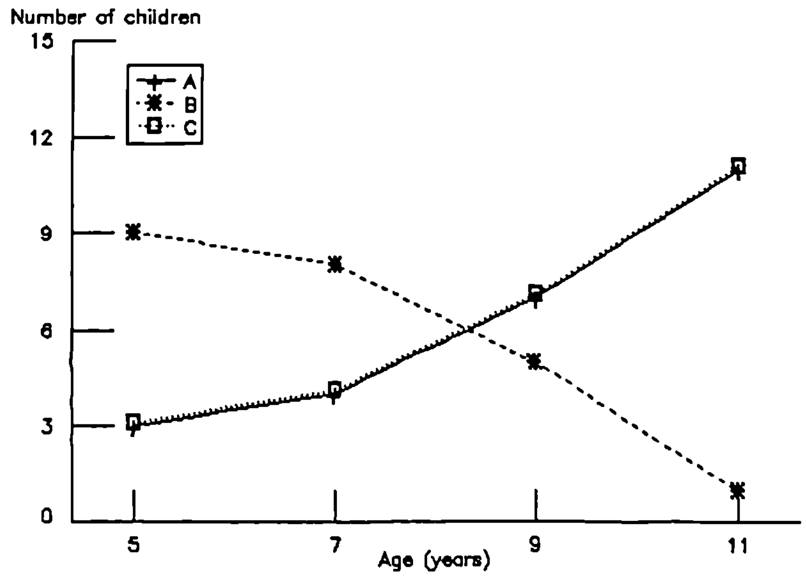


a : Standing in between parked cars
Number of children
15
12
9
6
3
0
A
B
C
5
7
9
11
Age (years)
b : Standing close to a hedge
Number of children
15
12
9
6
3
0
A
B
C
5
7
9
11
Age (years)
c : Standing at a junction
Number of children
15
12
9
6
3
0
A
B
C
5
7
9
11
Age (years)

d : Standing at a bend



e : Standing near the zig–zag of a zebra crossing



with the zebra crossing and the junction probably affording the children more safe constructed routes than the bend and hedge (see Table 5.3). There were, however, no significant main effect of sex; interactions of age and sex; age and road crossing places; sex and road crossing places.

Table 5.3 Mean correct responses on the construction task by age and road crossing locations (Maximum possible score = 8).

	Road crossing situations				
Age (Years)	Hedge	Junction	Bend	Zebra Crossing	Age, road crossing sites combined
5	3.67	4.75	3.08	4.5	4
7	3.75	5.08	3.25	5.33	4.35
9	5.08	6.08	5.33	7.58	6.02
11	6.58	6.5	6.83	8	6.98
All ages, road crossing loca- combined	4.73	5.60	4.63	6.35	

5.3.2.1 Comparisons of the safe road crossing routes selected by the 4 age groups at the hedge, junction, bend and zebra crossing in the construction task

As in Experiment 1, these analyses were done with matched pairs t-test. These showed the children as performing better at the junction than at the hedge and the bend ($t(47) = 2.96, p<0.01$) and ($t(47) = 3.67, p<0.001$). The children also performed better at the zebra crossing than at the bend ($t(47) = 6.63, p<0.001$); junction ($t(47) = 2.84, p<0.01$) and hedge ($t(47) = 5.14, p<0.001$). The children's performance was at par at the hedge and bend.

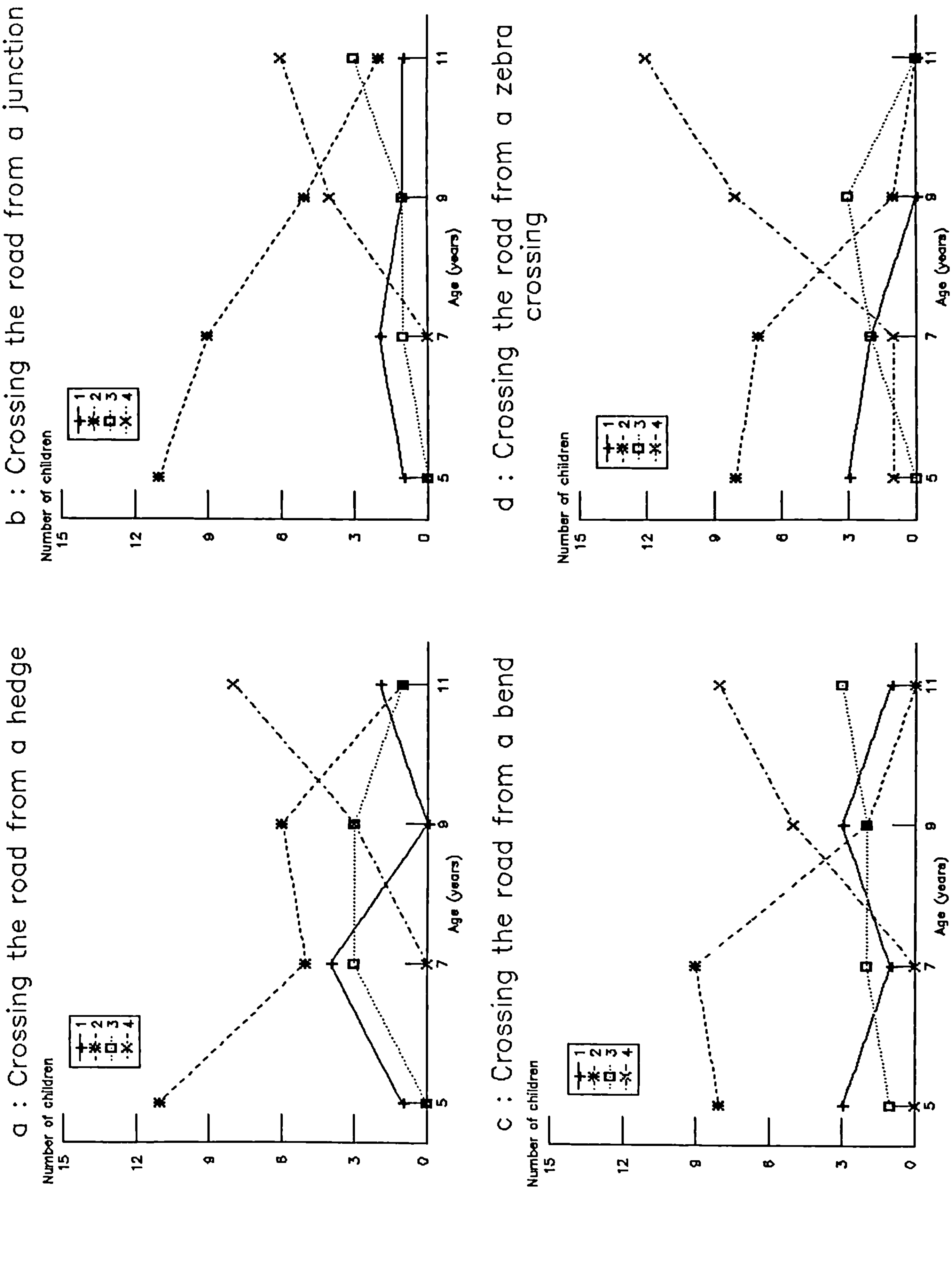
Overall, the 4 age groups constructed more safe road crossing routes at the junction and zebra crossing. These observed results were different from Experiment 1 (see 4.4.2.1; Chapter 4), where the children's performance was superior on the hedge and zebra crossing. A discernible trend in the choice of the most selected safe routes in the construction tasks led to their presentation graphically (see 5.3.2.2) in an attempt to discover what must have caused the vagaries in the results of Experiments 1 and 2.

5.3.2.2 Explanations given for the selected safe routes to cross the road on the construction task

The explanations on the 4 construction tasks shown in Figures 5.5 (a-d), demonstrate clearly that the older the child is, the more probably he or she would make a 'mature' assessment of the entire road traffic environment before selecting a route which affords maximum safety to cross the road. In achieving this, the older children not only fixated on the 'absence of cars on the road' (as most 5 and 7 year-olds tended to do) but also based on the road environmental feature prominent in the situation (the basis for categorising the explanations was the same as under Experiment 1, see 4.4.2.2; Chapter 4). (Examples of the explanations are given in appendix 3).

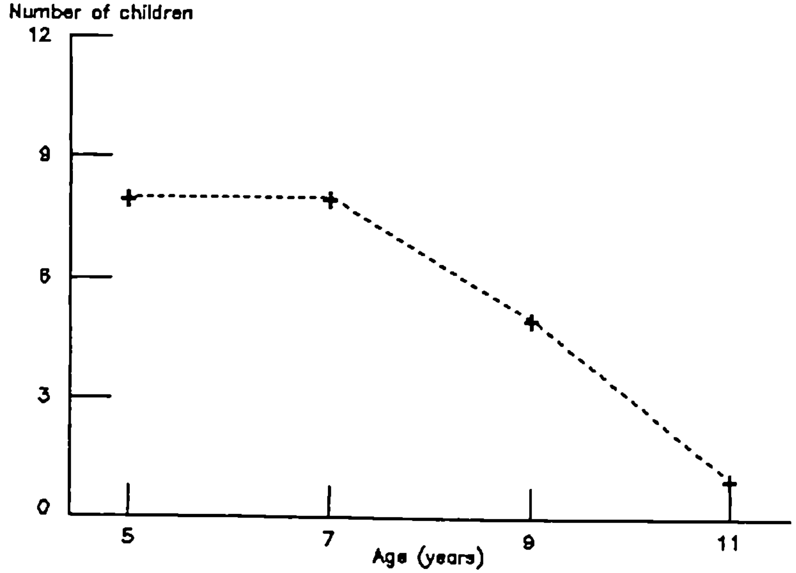
The question as to whether young children rely only on the presence and absence of cars on the roads to determine danger and safety in traffic, led us to carry an extra examination of the responses to the construction tasks. And it was additionally observed that the younger the child is the more likely he or she will choose the shortest and most direct route as the safest once there is no car in sight (see Figures 5.6 (a-d)). From the Figures, it can be seen that the 'scale-values' of the shortest and most direct route

Figures 5.5 (a-d). Numbers of children who gave the different justifications under the construction task (4 = explanation safeguarding maximum road safety with a mention of the important road landmark in the crossing situation; 3 = explanation which guarantees safety but with no mention of the road feature prominent in the crossing site; 2 = explanation with a reference to the road traffic situation but not guaranteeing safety; 1 = irrelevant explanation not ensuring safety with no mention of the road traffic situation).

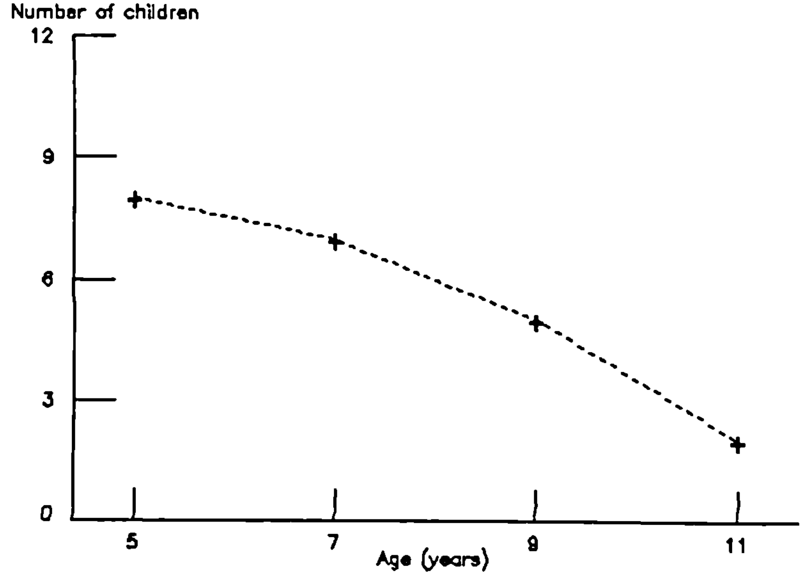

a : Crossing the road from a hedge
b : Crossing the road from a junction
c : Crossing the road from a bend
d : Crossing the road from a zebra crossing
Number of children
Age (years)
1
2
3
4
0
3
6
9
12
15
5
7
9
11

Figures 5.6 (a-d). Numbers of children selecting the shortest and most direct route as the safest in the construction task.

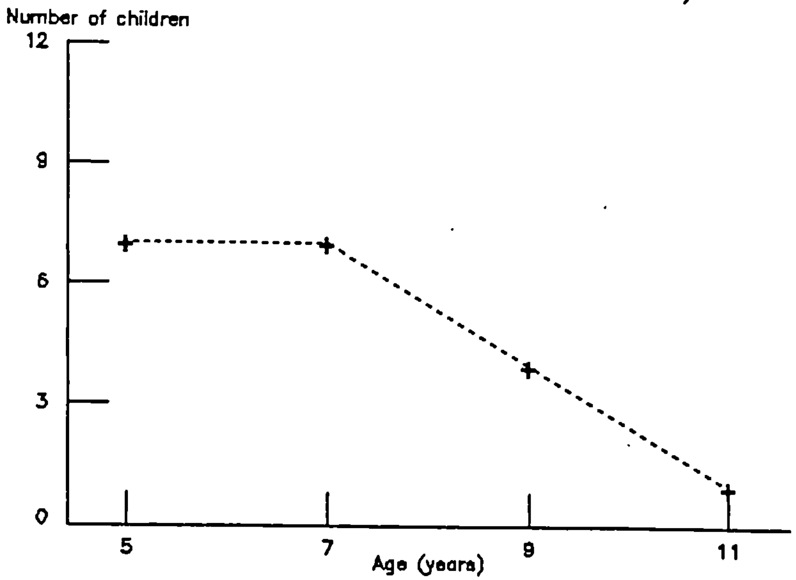
a : Near the hedge (score of the shortest and most direct route = 1)



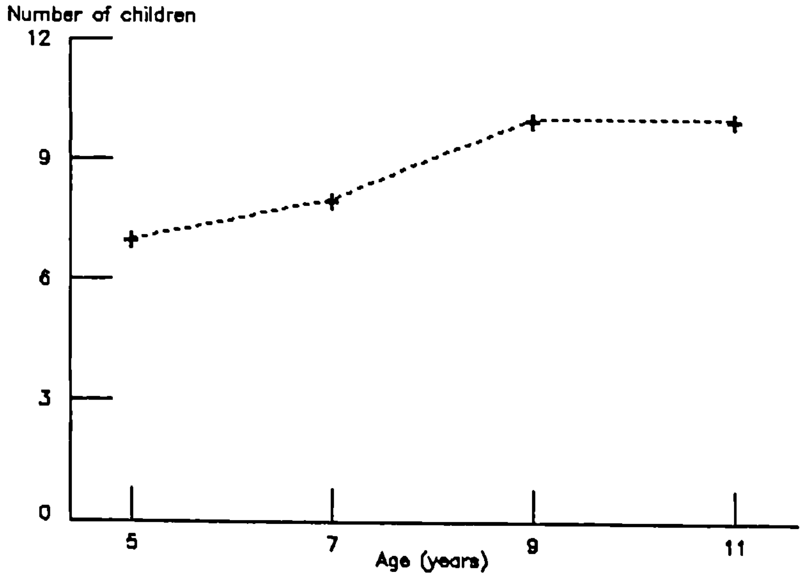
b : At the junction (score of the shortest and most direct route = 3)



c : At the bend (score of the shortest and most direct route = 1)



d : At the zebra crossing (score of the shortest and most direct route = 4)



on the 4 construction tasks were not the same. This obviously must have aided the overall superior performance on the junction and zebra crossing than at the hedge and bend.

This tendency on the part of the children, and especially, the 5 and 7 year-olds, to select the shortest and most direct route as the safest must have contributed to the detected variances in the results of Experiment 1 and 2. A post-hoc assessment of Experiment 1 results, however, revealed no detectable trend regarding the children's choice of the shortest and most direct route as the safest. Experiment 3, will therefore systematically assess this in a more controlled design.

The introduction of human figures and a dog in the construction tasks in Experiment 2 did have a marginal influence on the subjects' choice of safe routes. However, this was too negligible to permit a graphical or statistical analysis. A few 5 and 7 year-olds, indeed, justified their choice of safest route by stating additionally that, the elder figure, the individual intended to cross the road to, will help him or her cross the road. This result even though marginal may be a 'subtle' explanation of the behavioural observation of children running heedlessly across the road once they see a parent by the roadside and which often results in accidents (see Colborne and Sheppard, 1966; Sheppard, 1982). A future study can make a critical assessment of this finding by making it its main objective (see also discussion section below).

5.4 Discussion

5.4.1 Recognition task

In the recognition of safe sites to cross the road the 5 and 7 year-olds performed better than the 9 year-olds, and even the 5 year-olds achieved a better performance than the 11 year-olds, though these fell short of statistical significance.

The 9 and 11 year-olds 'poor' performance was due to the more mature nature of their perceptions. Even when the situations were reasonably safe they still judged some as dangerous - false alarms - because they reasoned they were still close to junctions, bends, hedges, and parked cars. This demonstrated a better appreciation of salient elements needed for safety on the roads, even if it was 'incorrectly perceived' in some particular contexts. These 'errors' were, however, too negligible to allow for a meaningful statistical or qualitative error-analyses.

A more marked age trend was, however, observed in the responses to the identification of dangerous sites to cross the road. This may be attributed to the modifications in the tasks which involved the removal of cars the main referent for perceiving danger by the 5 and 7 year-olds from the roads in all the tasks.

5.4.2 Construction task

In Experiment 1, the children constructed more safe routes at the hedge and zebra crossing, while it was the junction and zebra crossing in Experiment 2. Again, the relative ease at the zebra crossing was understandable, but it was difficult to explain the vagaries in the results at the other road situations. Perhaps, the nature of the selected shortest and most direct route in Experiment 2 (see Figures 5.6 (a-d) partially explains this; though a post-hoc examination of Experiment 1 results did not indicate any such trend (see also 5.3.2.2)).

The introduction of human figures and a dog in the construction tasks, as where the doll-pedestrian wanted to cross the road to, did not significantly affect the results. This could, however, be experimented with younger age groups since they are more likely to be vulnerable to such situations (Grayson, 1975b).

5.4.3 The photographic tasks

The children enjoyed the photographic tasks which might have been due to the shorter time it took to administer them, since there was no need to re-arrange the situations in-between tasks (as was the case with the table-top model in Experiment 1). No problems were detected in the children's understanding of the tasks. This ran contrary to the evidence suggesting that children experience problems with photographic tasks (see 5.1.2; Chapter 5). Perhaps, the special arrangements made before and during the taking of the photographs which ensured the elimination of all distracting scenes, and the maintenance of the same view for the doll and the child, held the key to the high level of understanding of the tasks displayed by the children (see also method section).

Some 'disadvantages' observed with the photographs were that some of the roads became shortened and a few of the buildings appeared in parts presenting a 'condensed' form of how the situations were on the table-top model. While not dismissing the fact that these features might have had a subtle influence on the responses of the children, it did not significantly affect the overall pattern of the results.

5.4.4 Sex differences

Once again the girls did not perform significantly better in their perceptions of safety and danger than the boys. We can therefore conclude that boys higher involvement in pedestrian accidents than girls is not due to differences in the way they distinguish between safe and dangerous sites, and their selection of safe routes to cross the road.

5.4.5 The effect of road environmental features on the children's responses to the recognition and construction tasks

In the recognition tasks the children's performance across all the road situations were comparable for the safe sites to cross the road. In the dangerous sites to cross the road there was a marginally significant effect of the road crossing situations. This was attributed to the good performance at the road crossing situations of zebra crossing, parked car, junction, hedge than at the bend. The variations recorded here were 'slight' compared with Experiment 1 where a more marked significant effect of road crossing situations was recorded under the dangerous recognition tasks. The observed trend in Experiment 2 might have been caused by the modifications in the tasks which included the elimination of cars on the roads near all the tasks (see 5.2.2; Chapter 5).

In the construction tasks, the children were observed to have selected more safe routes at the zebra crossing and junction than the bend and hedge. This appeared to have been due to variations in the scores of the shortest and most direct routes at these road situations (see Figures 5.6 (a-d)).

5.4.6 Methodological issues and conclusions

Once again the children displayed a high level of understanding of the tasks which involved appreciating the perspective of a doll-pedestrian. This must have been due to the maintenance of the same view of the roadway for both the child and the doll-pedestrian. Furthermore, our task arrangement which involved situations entirely meaningful to the children might have also contributed to their comprehension of the tasks. Selecting road crossing sites and crossing routes is a thing the children do themselves on their daily walk to school. This contrasts markedly from the Piagetian three-mountains task which offers no such direct experience to children. More importantly also, buildings, roads, bends, parked cars, junctions, zebra crossings, hedges and doll-pedestrians, provide easily discriminable features than the similarly configurated Piagetian three-mountains task. And there is evidence to show that easily discriminable features within an array enhances children's percept inference abilities (see Borke, 1984).

The above views are also supported by Hughes and Donaldson (1984) who conducted a series of experiments designed along the lines of the Piagetian tasks, but employing different task situations. The three experiments differing in complexity were each administered to a group of three-and-four-year-olds. These experiments involved what is now known as the 'policeman task' - that is - hiding a doll-boy from a doll-policeman. In Experiment 1, the child was instructed to place a wall so that the policeman could not see the boy. Experiment 2, however, had two policemen, a boy and a cross-shaped configuration of walls. The children were asked to hide the boy from the two policemen, and thus had to keep in mind two different points of view at once. Experiment 3 had two versions of the task. The first version had a wall arrangement involving five sections and two policemen. The second version had a wall arrangement of six sections with three policemen. The children's task in each version, was to hide the boy so that none of the policemen could see him.

They observed a remarkably high level of performance in all the three studies. Few of the children had any difficulty with the one-policeman task (Experiment 1), or the two-policemen task (Experiment 2). It was only when the task was more complex, in Experiment 3, that the three year-olds started to make an appreciable number of errors, and even here, the majority of the children still performed extremely well.

They concluded that the children's high success was caused by the fact that the policeman tasks made 'human sense' in a way that the mountains task did not. 'The motives and intentions of the characters (hiding and seeking) are entirely comprehensible, even to a child of three, and he is being asked to identify with - and indeed to do something about - the plight of a boy in an entirely comprehensible situation. This ability to understand and identify with another's feelings and intentions is in many ways the exact opposite of egocentrism, and yet it now appears to be well developed in three year-olds', (Hughes and Donaldson, 1984, p.253). So perhaps, the most crucial things needed to obtain the exact nature of children's percept inference ability are the provision of experimental situations involving role settings familiar to the children and the inclusion of easily discriminable objects in the array.

In conclusion, it must be pointed out that despite controlling for the egocentric problem by ensuring a same view of the roadway for both the doll and the child; and also modifying the experimental procedure through the administration of photographic tasks, the results of Experiment 2 were overall comparable to that of Experiment 1.

CHAPTER 6

EXPERIMENT 3

TASK MODIFICATIONS AND CHILDREN'S PERCEPTION OF SAFETY AND DANGER ON THE ROAD

6.1 INTRODUCTION

Experiment 1, investigated children's notions about safe and dangerous sites to cross the road, and their choice of safest route to cross the road using a table-top simulation of road traffic situations. The experimental procedures involved in the tasks for Experiment 1, had relevance to the Piagetian formulations of the child being extremely egocentric until the ages of 7 or 8 years. The children were specifically instructed to determine safety and danger in the roadway from the point of view of a doll-pedestrian. Children have often been found to experience difficulties with such tasks and these methodological problems were considered in the design and administration of Experiment 1.

Experiment 2, further examined these methodological issues with a different research format. There was, for example, the re-arrangement of the tasks so that the child now enjoyed the same perspective as the doll-pedestrian. This was to obliterate the egocentric problem the children would have otherwise encountered in registering their responses (see Light and Nix, 1983). The study also used a new method - photographs of the tasks instead of the actual table-top model used for Experiment 1. The results of Experiment 2 were comparable to that of Experiment 1 indicating that the results so far obtained under the two studies were not significantly influenced by any methodological problems the children, and especially the 5 and 7 year-olds, might have experienced.

Any anticipated difficulties in understanding the tasks, however, still concerned the 5 and 7 year-olds (see Piaget and Inhelder, 1956). Furthermore, the 5 and 7 year-olds in both Experiments 1 and 2 identified safe and dangerous sites, and constructed safe routes by which to cross the road; by using a specific determinant - cars - reinforcing our doubts about their comprehension of the tasks. Were the 5 and 7 year-olds inhibited in their responses because of the mode of task presentation? Experiment 3, therefore, adopts a new mode of task presentation with an elaborate questioning procedure with the intention of 'forcing' the children's road safety knowledge out of them. In the recognition task, for example, a forced-choice technique will be employed, with the safe and dangerous sites to cross the road presented side by side. The children will be instructed to select in each case one of the two road crossing sites he conceived safer for the doll-pedestrian to cross the road. This was to compel the child to make a choice out of two road crossing situations. It was assumed at this stage that since the children were able to understand and identify various road crossing situations in Experiments 1 and 2, this ability should permit them to discriminate between two road crossing situations on a single dimension. Forced to discriminate between two road crossing sites presented at the same time, will the pattern of results change? Experiment 3 seeks to assess this.

The two methods of table-top model and photographs will also be administered together in Experiment 3, to systematically assess whether there will be vagaries in the results due to the different methods.

Since no significant sex differences were established in Experiments 1 and 2, it was decided to discontinue the sex comparison in Experiment 3. Equal number of boys and girls were, however, still maintained in the 4 age groups.

6.2 Method

6.2.1 Subjects

A sample of 48 (5, 7, 9 and 11 year-old) Glaswegian school children were selected for the study. They were equally distributed over age and sex. Their mean ages were; 5 year olds (5 years 5 months); 7 year-olds (7 years 4 months); 9 year-olds (9 years 4 months); and 11 year-olds (11 years 3 months).

6.2.2 Stimulus materials and design

As in Experiment 2, the photographic tasks for Experiment 3 were carefully taken in a room where all seating and other distracting objects had been removed. The photographs were taken from the table-top model used for Experiment 1 (see Figure 3.1; Chapter 3 for a photograph of the table-top model). The table-top model was placed on a large table to make it easier for the photographs to be taken. In the recognition task, the 5 safe and their equally matched 5 dangerous locations to cross the road (from road situations involving hedges, parked cars, bends, junctions and zebra crossings) were set up individually on the table-top model and photographed. (Figures 6.1 (a-b) are examples of the recognition tasks. These feature the safe and its equivalent dangerous road crossing sites near the parked cars. Similarly, the construction task featuring 4 road crossing situations of bend, hedge, junction and zebra crossing were set up individually on the table-top model before the photographs were taken. Figure 6.2 shows an example of the construction task featuring the zebra crossing.

As in Experiment 2, the camera was carefully positioned behind the doll-pedestrian. This arrangement helped to maintain the same perspective of the roadway for the children and the doll-pedestrian.

The same task situations in the photographs were used for the

Figures 6.1 (a-b). The two road crossing sites of safe and dangerous near the parked cars in the recognition task.

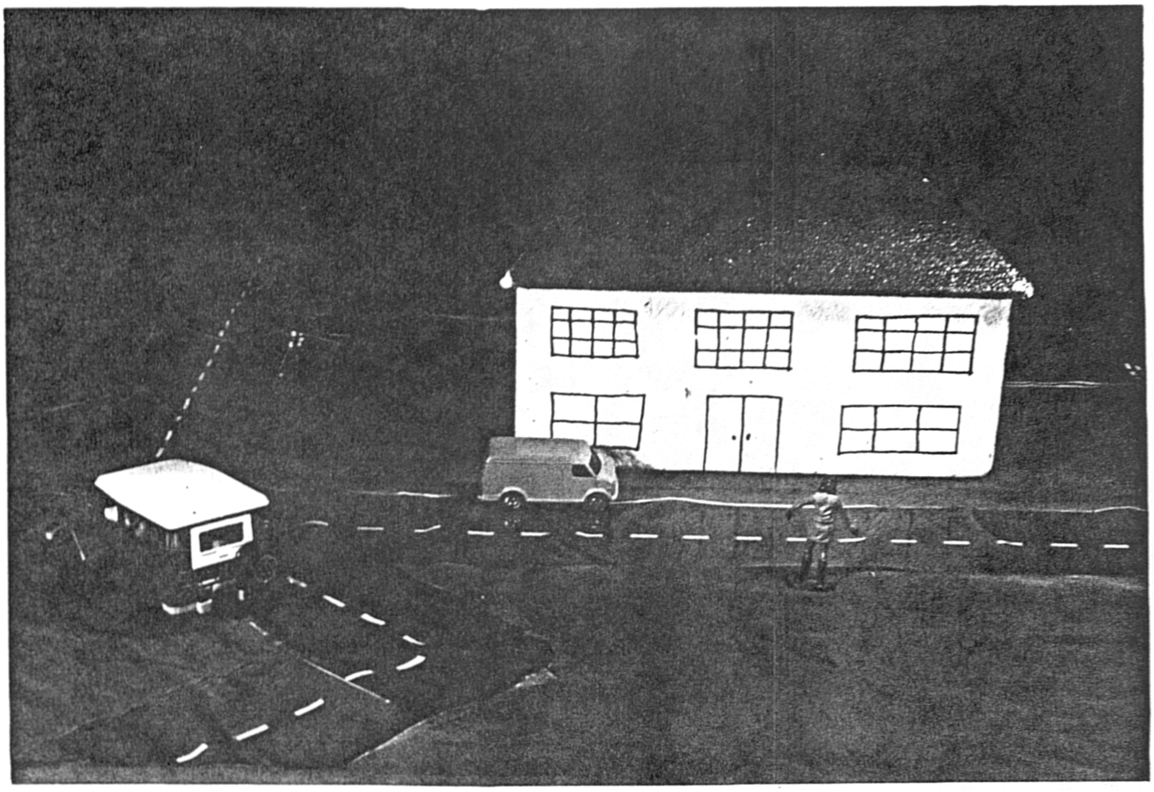


Figure 6.1 (a). The safe road crossing location involving the parked cars.

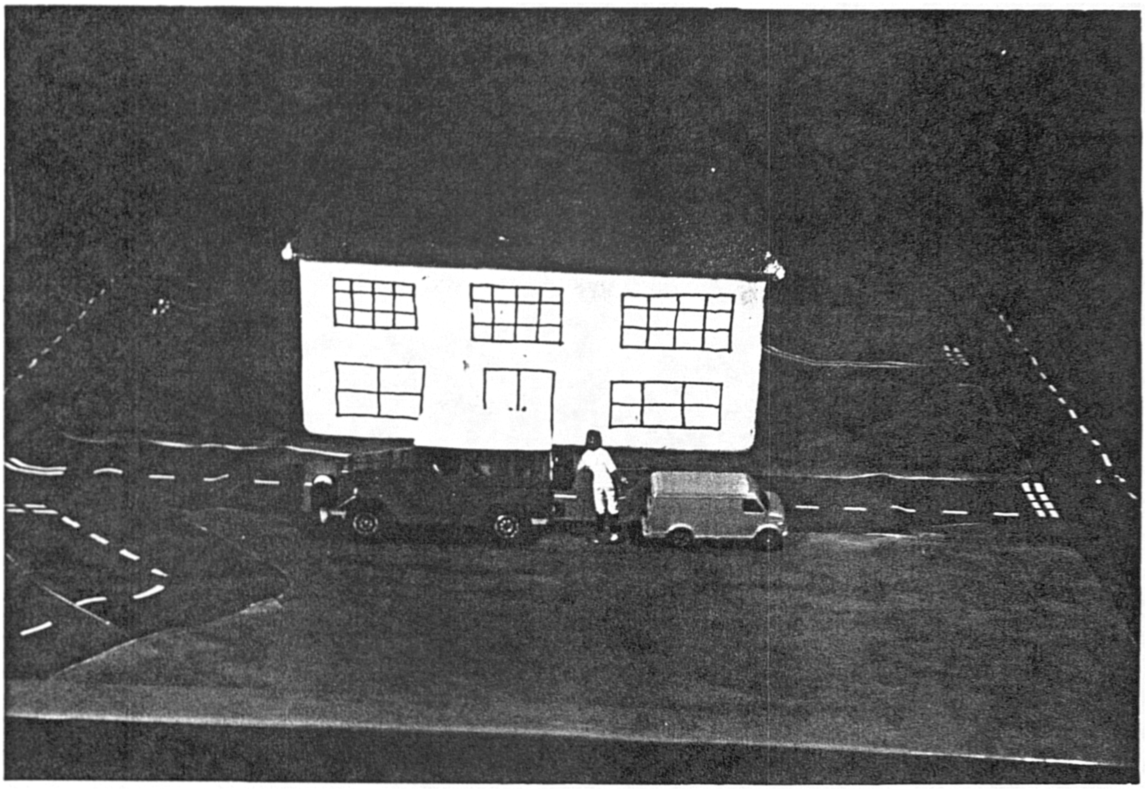


Figure 6.1 (b). The dangerous road crossing locations involving the parked cars.

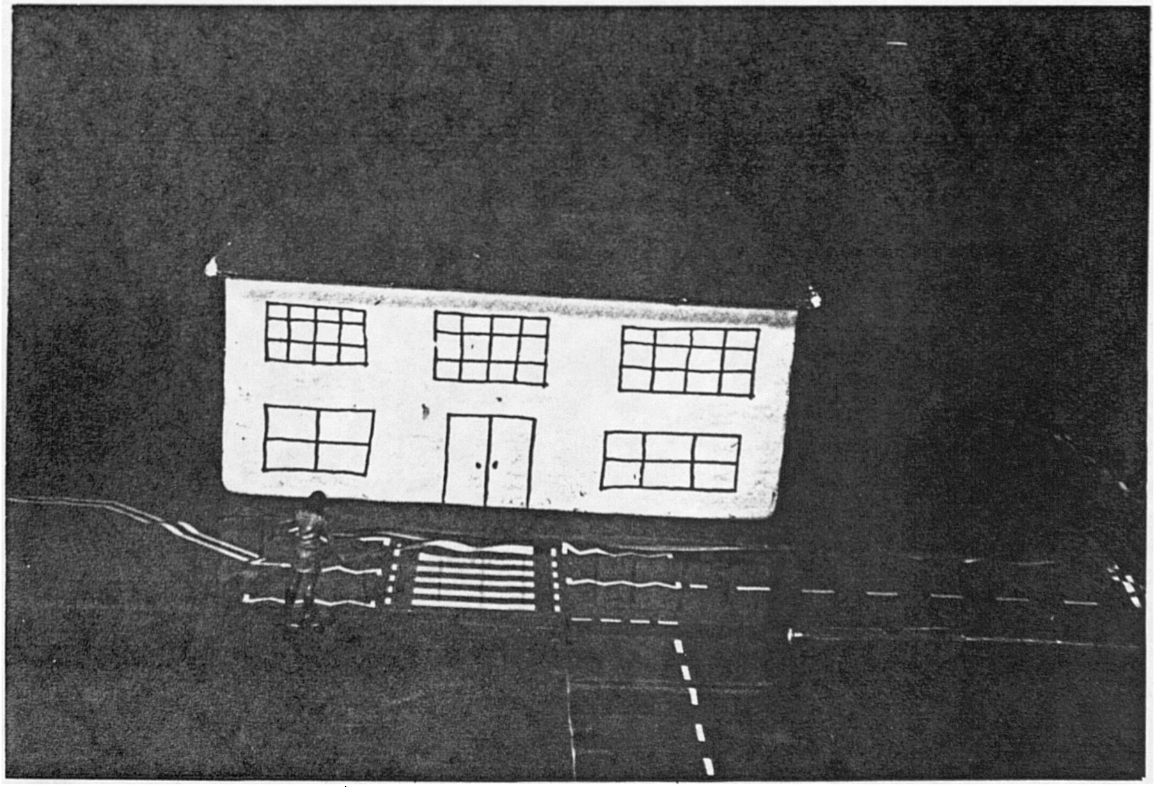


Figure 6.2. The road crossing situation at the zebra crossing used in the construction task.
(A reduced size of the original photograph which measured 20 x 25.5 centimetres).

table-top model based tasks. Here also, the experimenter created each task situation carefully ensuring that the child enjoyed the same view of the roadway as the toy-pedestrian. This table-top model was the same as the one on which the photographic tasks were based.

As in Experiment 2, cars were completely removed from all the roads in Experiment 3 with the hope of improving the verbalisations of the 5 and 7 year-olds, since they mainly fixated on cars in registering their responses under Experiments 1 and 2.

Experiment 3 also employed a new methodological approach for the recording of the responses to the construction tasks. In the photographic tasks 4 lines indicating the 4 alternate routes the doll-pedestrian could use to cross the road were drawn on transparencies and later carefully fitted on the photographs. To make the lines conspicuous the photographs had to be enlarged from 10 x 14.80 centimetres to 20 x 25.5 centimetres. One centimetre wide cardboard cuttings were used to show the same 4 alternate routes on the actual table-top model.

Each of the 4 alternate routes were painted (as with the cardboard cuttings for the table-top model) or drawn (as with the transparencies for the photographic tasks) in a different colour. The colours were blue, violet, black and brown. Green, red and yellow the 'more popular' colours were not used because of the biasing effect they might have had on the results. The 4 colours of blue, violet, black and brown represented one each of the 4-point scale of 'very safe' to 'very unsafe'. These colours were differentially randomised over 4-point scale for each construction task. This simplified mode of recording responses on the construction task was adopted to enhance the performance of the children.

Structurally also, the <u>shortest and most direct</u> route for the doll-pedestrian to cross the road to its destination in each of the construction tasks was scaled 'very unsafe'. The effect of this modification on the children's responses was to be examined (see Figure 6.2 for an example of this task modification).

Whether tested with the photographs or on the table-top model, each child completed the 5 pairs of recognition tasks and the 4 construction tasks based on a different order of presentation. The presentation of the recognition or construction tasks first was also counterbalanced which ensured that half the children tackled the recognition task first and the other half the construction task. Similarly, half the children in each of the 4 age groups were randomly assigned to the photographic tasks and the other half to the table-top model tasks.

6.2.3 Procedure

The experiment took place in an empty room. The only furniture in the room was the one used for the experiment. As in Experiments 1 and 2, the child was informally introduced to the task situation before the experiment proper began. With the table-top model the child was invited to play with the materials on it before the study proper. Whilst, with the photographic tasks the child was shown an overall, photograph of the table-top model (see Figure 3.1; Chapter 3) and was instructed to name some of the objects in it during a preliminary period.

Before the experiment proper began the experimenter carefully completed examples of the recognition and construction tasks with the child to ensure that he or she understood the tasks.

In the experiment itself, the recognition task used an entirely different mode of task presentation (see also 6.1; Chapter 6). The alternate road crossing sites of safe and dangerous were in each case pair-presented to the child and was instructed to discriminate between them by the experimenter through the following questions;

- and - are about to cross the road to - and - from where they are each standing (in each case the experimenter drew the child's attention to the two doll-pedestrians in the situation by letting him or her point at them);

1. Which of the two is a safer place to cross the road?
2. Why is it safer to cross the road from there?
3. Why is the other one not a safe place to cross the road?
4. What must be done to make it a safe place to cross the road?

Each pair of road crossing locations of safe and dangerous for the recognition tasks were carefully placed side by side on the table (as with the photographic tasks) or set up side by side (as with the table-top model) in a manner which maintained the same view of the roads for the doll-pedestrian and the child. The child's responses were tape-recorded and later content examined.

In the construction task also, each task was positioned (as with the photographic tasks) or set up (as with the table-top model) in front of the child in a manner which permitted the child to have the same view of the roadway as the doll-pedestrian. The child was instructed to select a route he or she saw as the safest for the doll-pedestrian to cross the road to its destination. The child did this by selecting one of the 4 coloured lines (as in the photographic tasks), or one of the cardboard lines (in the table-top model based tasks) representing the 4 different routes. The child was additionally made to run his or her finger along the selected route from the starting point to the intended destination of the doll-pedestrian. Again, the child was requested to justify his or her choice of routes and these were recorded. The child was also asked to explain why he or she considered the other routes as not very safe for the doll-pedestrian to cross the road (this was an additional question first introduced in Experiment 3, to gain more insight into what children used as their main determinant in their choice of safest route).

6.2.4 Scoring

The scoring for both the recognition and construction tasks were comparable to what has been described under scoring in Chapter 3 (see 3.3). Here also, the tapes with the explanations children gave for their responses to the recognition and construction tasks were played back and scored. In the recognition task, a child's score on each of the pair of safe and dangerous sites to cross the road was separated. Each child's score under each road crossing location of either safe or dangerous consisted of the identification of the site (scored as correct (1) or incorrect (0) and the explanations given for it also (scored as correct (1) and incorrect (0)). A child's score on each road crossing site of either safe or dangerous was a combination of the identifications and the explanations given for it in the range of 0 to 2.

In the construction task also, a child's score on each task was a combined score given for the constructed safe route (scored on a 4-point scale of very safe (4) to very unsafe (1)) and the explanation assigned for this constructed safe route (scored on a 4-point scale of relevant explanation (4) to irrelevant explanation (1)). The maximum possible score a child could achieve on each of the construction tasks was 8.

6.3 Results

The results were analysed using the same format as was used for Experiments 1 and 2.

6.3.1 Recognition task

A 4 (age: 5, 7, 9 and 11 year-olds) x 2 (method: table-top model and photographs) x 2 (road crossing site: safe and dangerous) ANOVA with repeated measures on the last factor was calculated. Age and method were between subjects variables, and road crossing locations were within subjects variables.

Table 6.1 shows the mean correct scores for the 4 age groups on the recognition of safe and dangerous road crossing places.

Table 6.1: Mean correct identifications of safe and dangerous sites to cross the road by age and task type (Maximum possible score = 10).

	Age (Years)			
Road Crossing Sites	5	7	9	11
Safe	Photographic Tasks			
	9.33	10	9.83	8.5
	Table-top model Tasks			
	10	8.67	7.33	9.67
Dangerous	Photographic Tasks			
	1	4.17	9	9.33
	Table-top model Tasks			
	3	5.83	8	9.67

The observed trend of the results was similar to that of Experiments 1 and 2. Again, only slight age differences were detected in the recognition of <u>safe</u> places to cross the road, while a marked age difference was observed in the responses to the <u>dangerous</u> sites to cross the road.

In the ANOVA a main effect of age was observed $F(3,40) = 13.35, p<0.001$. The main effect of method and the interaction between age and method were, however, not significant. The main effect of road crossing sites were observed $F(1,40) = 51.68, p<0.001$, (with mean scores of 9.17 (safe) and 6.27 (dangerous)). Significant age and road crossing places interaction was also recorded $F(3,40) = 22.13, p<0.001$. The interactions of method and road crossing places; and also age, method and road crossing places were, however, not established.

Follow-up analysis using independent t-tests were conducted on age and correct identifications of <u>dangerous</u> sites to cross the road which revealed striking age differences. Significant differences were detected when the 5 year-olds were compared with the 7 year-olds ($t(22) = 2.14, p<0.05$); 9 year-olds ($t(22) = 8.01, p<0.001$); and 11 year-olds ($t(22) = 10.09, p<0.001$). The 7 year-olds also performed poorer than the 9 ($t(22) = 2.72, p<0.05$), and the 11 year olds ($t(22) = 3.61, p<0.01$). The 9 and 11 year olds did not differ significantly on their correct detections.

Again, the 9 and 11 year-olds achieved significantly more correct recognitions of dangerous locations by which to cross the road than the 5 and 7 year-olds.

6.3.1.1 <u>The effect of road environmental features of parked car, hedge, junction bend and zebra crossing on children's correct identifications of dangerous sites to cross the road.</u>

As under Experiments 1 and 2 the pattern of the data demanded that we use non-parametric tests for analysing it. To permit this analysis the scores of the 5 and 7 year-olds were combined and compared with the combined scores of the 9 and 11 year-olds under each road crossing site. Furthermore, the 5 and 7 year-olds had comparable scores, and the 9 and 11 year olds also had similar scores. Thus, combining the scores did not attenuate any possible age differences in the responses. Chi-square, Fisher's and Cochran Q tests were employed as appropriate.

Table 6.2 shows the number of children who scored correctly or wrongly on each of the 5 dangerous locations to cross the road. Table 6.2 did not include a breakdown on the basis of task-type because of a lack of significant effect of task nature on the overall trend of the results (see Table 6.1; Chapter 6).

Table 6.2: Number of children scoring correctly or wrongly on each of the 5 dangerous sites to cross the road by age

	Number who scored correctly by age				Number who scored wrongly by age			
Road environmental features (in the road crossing situations).	5	7	9	11	5	7	9	11
Parked car	2	5	12	11	10	7	0	0
Hedge	3	5	10	10	9	9	2	2
Junction	2	7	11	12	10	5	1	0
Bend	1	5	6	12	11	7	6	0
Zebra crossing	4	7	11	12	8	5	1	0

Chi square tests showed the 5 and 7 year-olds as being poorer in their identifications than the 9 and 11 year-olds at the hedge ($X^2(3) = 14.3, p<0.005$) and bend ($X^2(3) = 20.67, p<0.001$). Fisher's test showed the 9 and 11 year-olds as being significantly better in their perception of dangerous site to cross the road at the parked car, junction and zebra crossing than the 5 and 7 year-olds and they were all significant at ($p<0.001$).

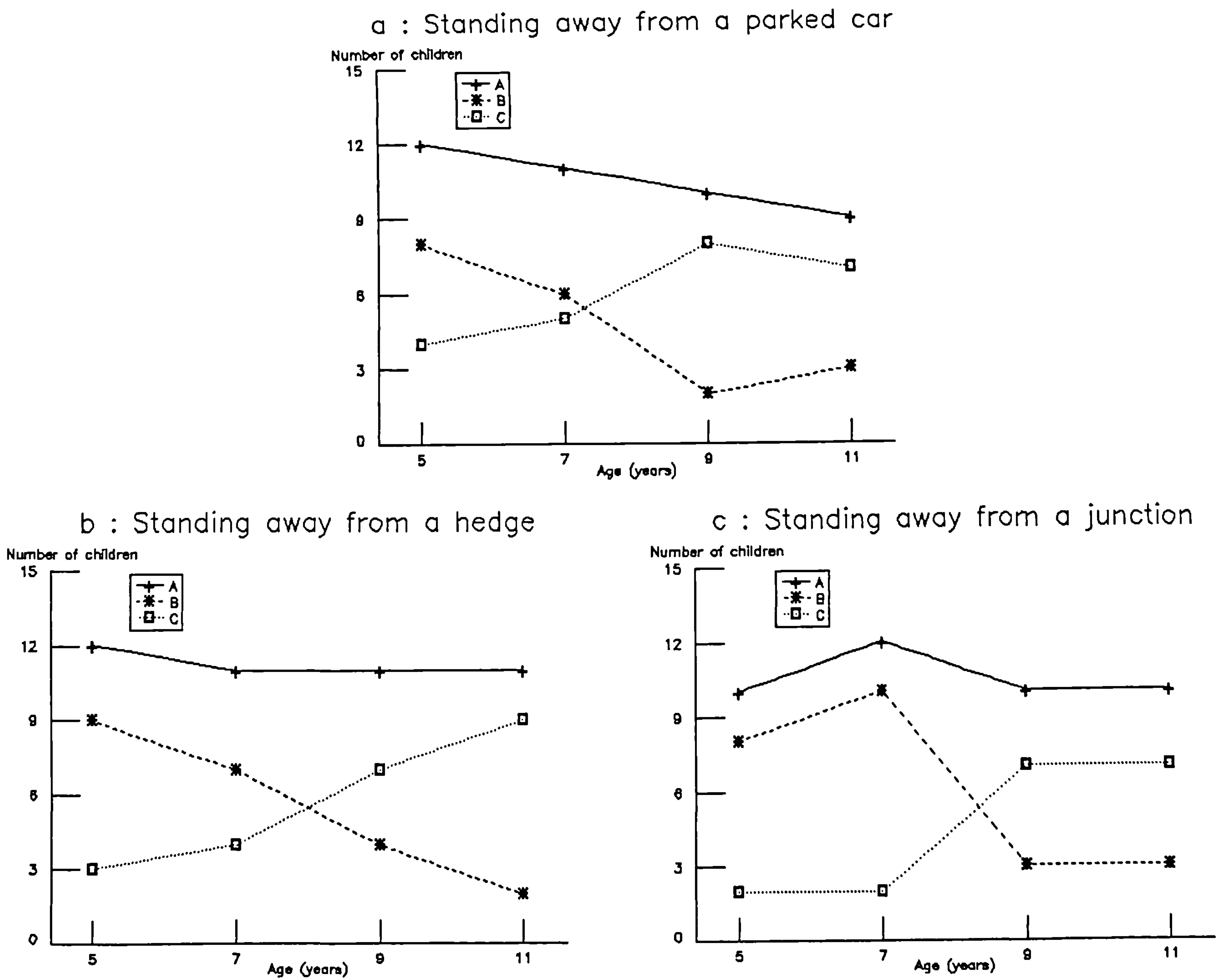
The effect of road environmental features of parked car, hedge, junction, bend and zebra crossing on children's correct recognition of dangerous sites to cross the road was assessed using a Cochran Q test. The data for this analysis consisted of (1) for any child who perceived the situations correctly and (0) for any child who perceived the situations wrongly under each of the road crossing sites. This was significant ($Q(4) = 20.28, p<0.001$). An inspection of the data (Table 6.2) shows that the significant effect might have been caused by the overall good performance at the dangerous road sites of parked car, junction, zebra crossing and hedge than at the bend.

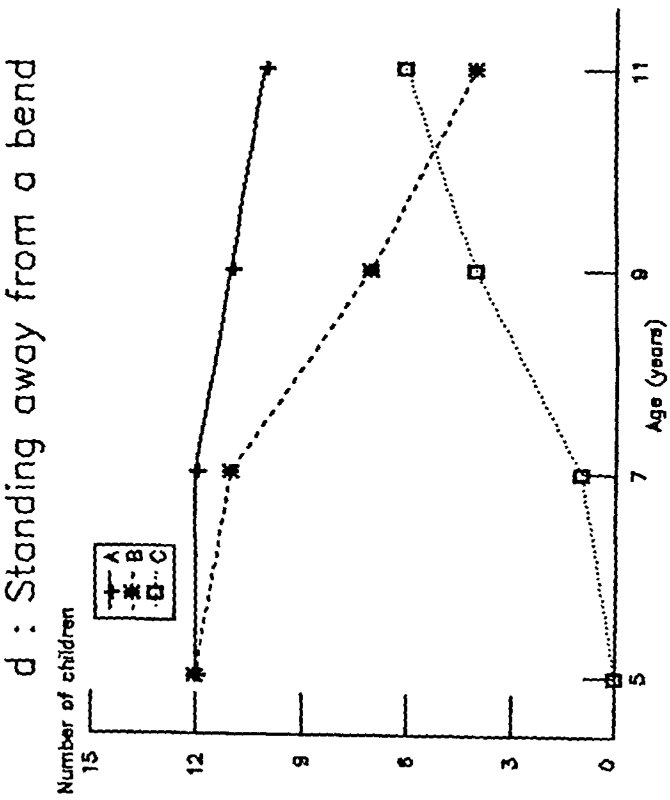
6.3.1.2 Qualitative analyses of the justifications given for the identifications on the recognition task.

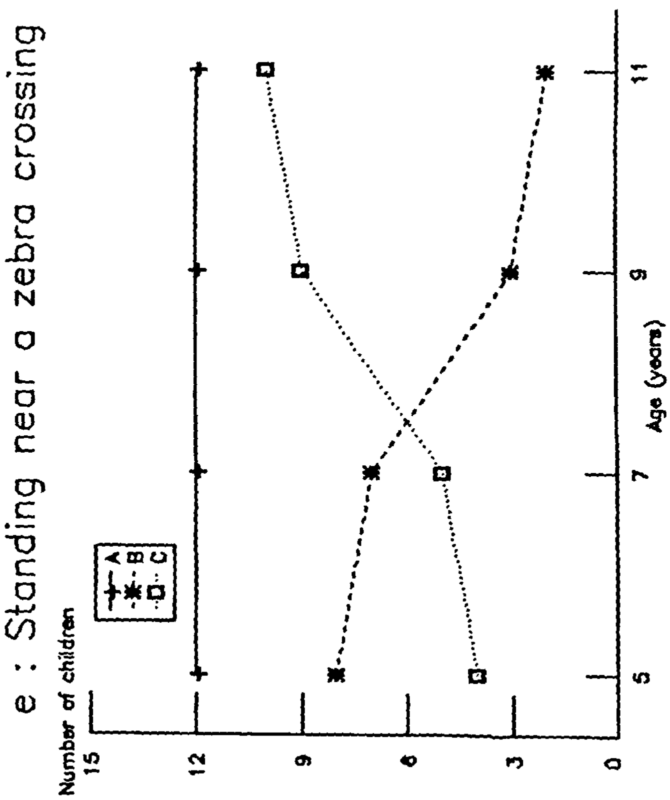
The explanations given by the children for their responses to the recognition of safe and dangerous locations to cross the road were once again qualitatively assessed. Figures 6.3 (a-e) represent explanations on the safe while Figures 6.4 (a-e) were the pattern of justifications on the dangerous sites to cross the road. These trends of reasons were comparable to those observed under Experiments 1 and 2. (Examples are shown in Appendix 1 - for safe and Appendix 2 - for the dangerous road crossing sites). Again, the younger children fixated on the presence and absence of cars on the roads, while the older children were influenced by significant road environmental features in their judgements.

Only few responses were obtained for the set of ancillary questions included in the recognition tasks for Experiment 3. The responses were so few to permit any meaningful analyses. An interesting age pattern, however, emerged from the results. In the

Figures 6.3 (a-e). Numbers of children who gave the different explanations under the recognition of safe locations to cross the road (A = total number of children with correct explanation; B = number of children who relied only on the absence of cars on the roads to judge safety; C = number of children who included other relevant road environmental features).

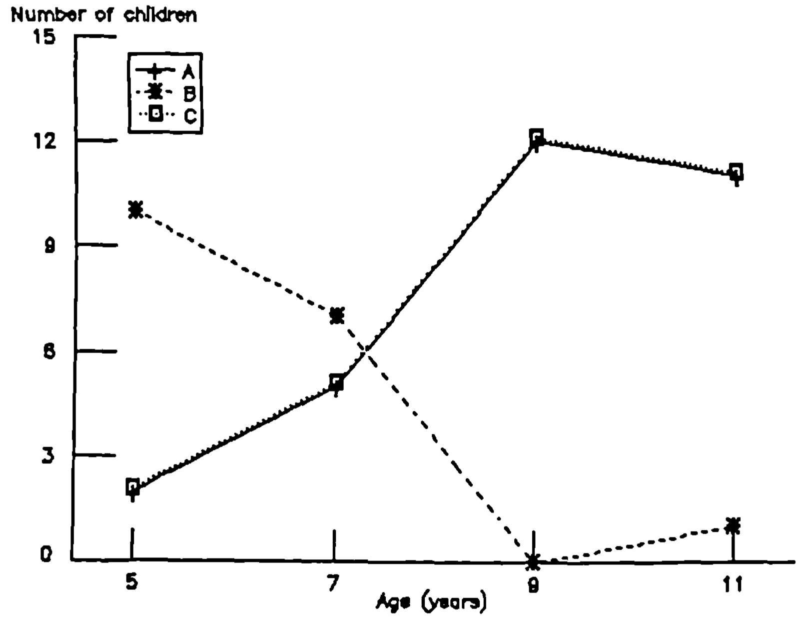

a : Standing away from a parked car
Number of children
15
12
9
6
3
0
A
B
C
5
7
9
11
Age (years)
b : Standing away from a hedge
Number of children
15
12
9
6
3
0
A
B
C
5
7
9
11
Age (years)
c : Standing away from a junction
Number of children
15
12
9
6
3
0
A
B
C
5
7
9
11
Age (years)


d : Standing away from a bend
Number of children
Age (years)
A
B
C
0
3
6
9
12
15
5
7
9
11

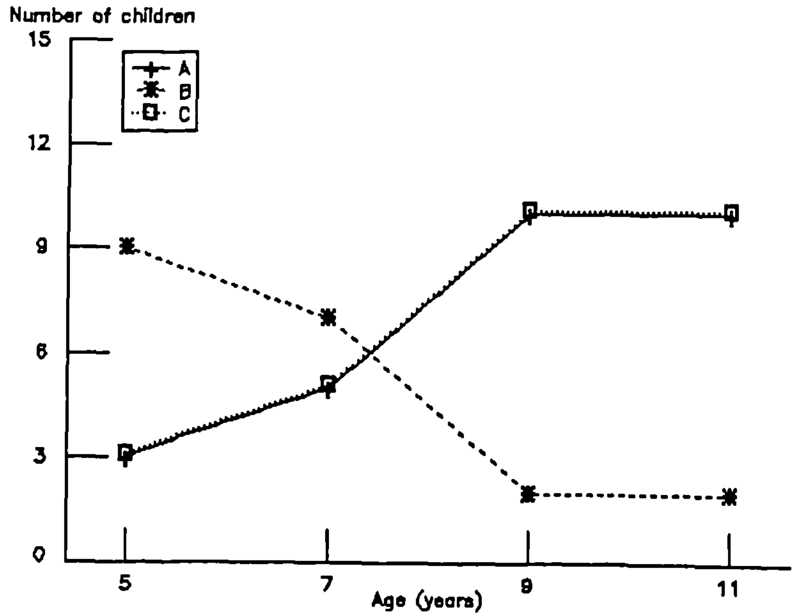

e : Standing near a zebra crossing
Number of children
Age (years)
A
B
C
0
3
6
9
12
15
5
7
9
11

Figures 6.4 (a-e). Numbers of children who gave the different reasons under the recognition of dangerous places to cross the road (A = total number of children with correct justification; B = number of children who had their perceptions wrong because of their being influenced by the absence of cars on the roads; C = number of children who relied on relevant road landmarks in achieving their correct identifications).

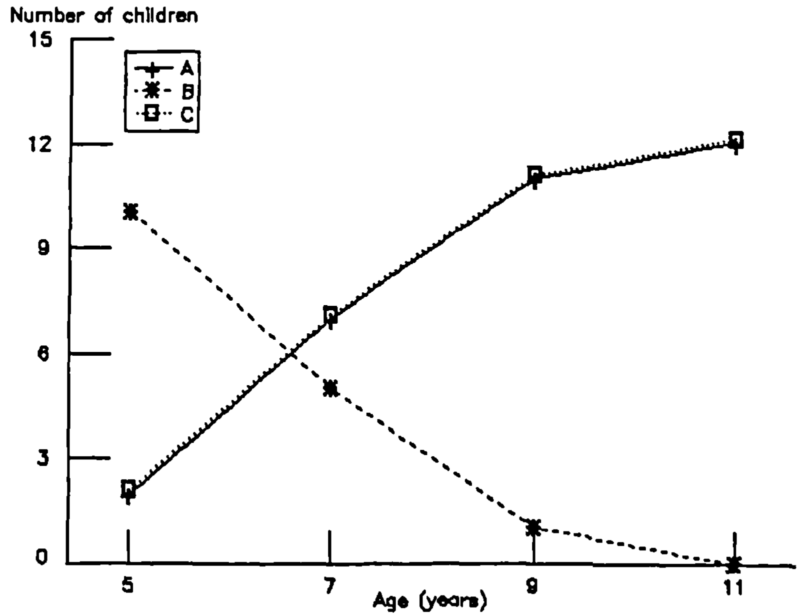
a : Standing in between parked cars



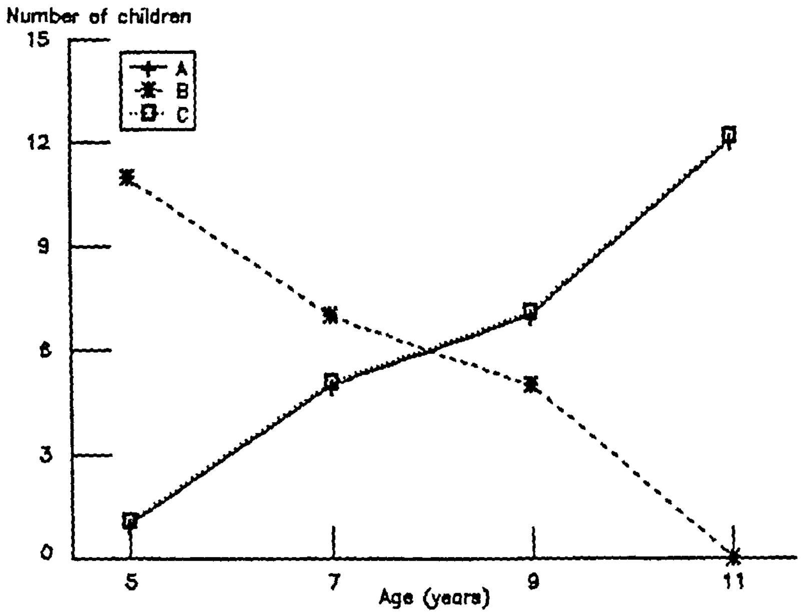
b : Standing close to a hedge



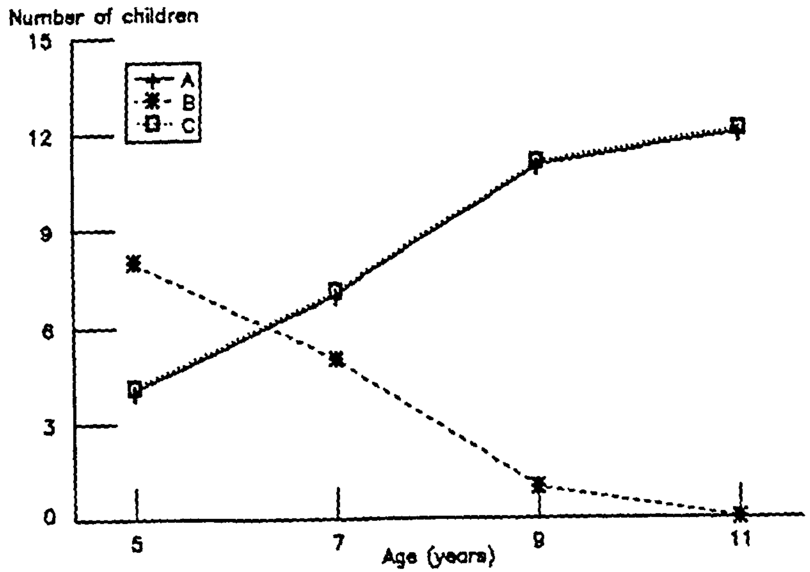
c : Standing at a junction



d : Standing at a bend



e : Standing near the zig–zag of a zebra crossing



dangerous road crossing situations the younger children advised that the doll-pedestrian should move to a safer place, while the older children advocated for constructional changes in the roadway to remove the danger. This included suggestions such as the levelling of bends and the cutting down of the hedges.

6.3.2 Construction task

A 4 (age: 5, 7, 9 and 11 year olds) x 2 (method: photographic tasks and table-top model tasks) x 4 (road crossing situation: hedge, junction, bend and zebra crossing) ANOVA with repeated measures on the last factor was calculated.

Table 6.3 shows the mean correct scores on the construction tasks by age and task type.

Table 6.3: Mean correct responses on the construction task by age and task type (Maximum possible score =8).

Road Crossing Locations	Task type	Age (Years) 5	7	9	11
Hedge	Photographic Tasks	2.83	3.83	3.83	5.67
	Table-top model Tasks	3.83	3.67	4.00	7.83
Junction	Photographic Tasks	3.33	3.83	4.50	5.67
	Table-top model Tasks	3.16	3.17	5.67	6.67
Bend	Photographic Tasks	2.83	3.33	5.83	4.83
	Table-top model Tasks	3.00	2.83	4.17	7.50
Zebra Crossing	Photographic Tasks	3.17	5.00	7.83	8.00
	Table-top model Tasks	3.50	5.17	5.33	7.67

In the ANOVA, there was a main effect of age $F(3,40) = 18.41, p<0.001$, indicating a better performance in the constructed safe routes with increasing age (see Table 6.3). A significant effect of road crossing situations was also registered ($F(3,120) = 10.39, p<0.001$) with the zebra crossing probably permitting the children more safe constructed routes than the other road crossing locations (see Table 6.3).

There were, however, no significant main effect of method; the interaction of age and method; age and road crossing locations; method and road crossing locations; and age, method and road crossing locations.

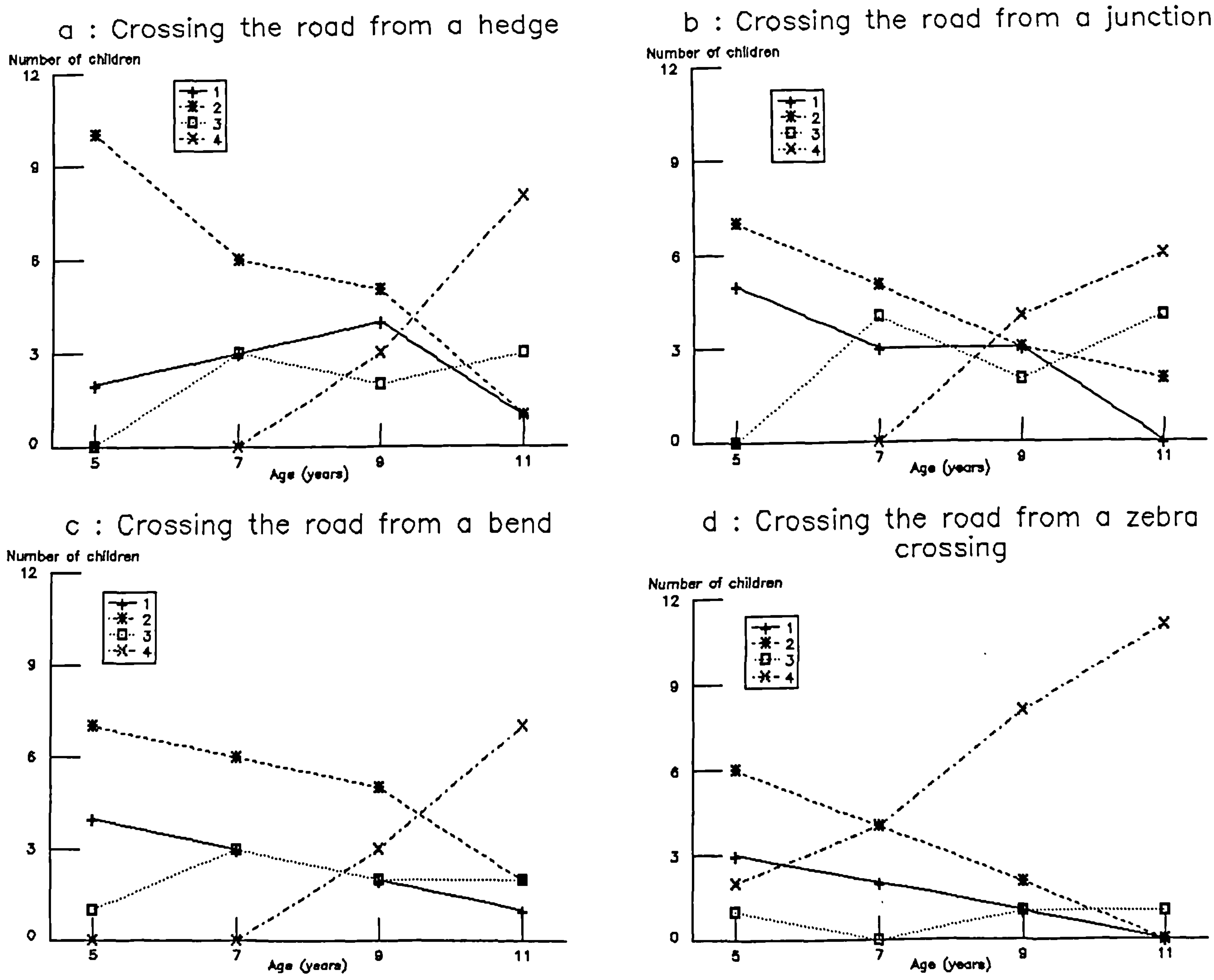
6.3.2.1 Comparison of the safe road crossing routes chosen by the 4 age groups at the hedge, junction, bend and zebra crossing in the construction task.

As in Experiments 1 and 2, matched pair t-test was used for this analysis. There were no significant differences in the children's selection of safe road crossing routes when the bend, hedge and junction were compared with each other. The zebra crossing, however, permitted the children more safe constructed road crossing routes than the hedge ($t(47) = 3.97, p<0.001$); junction ($t(47) = 3.48, p<0.01$) and bend ($t(47) = 4.54, p<0.001$).

6.3.2.2 Qualitative analysis of the explanations to the chosen safe routes on the construction tasks.

Content assessment of the explanations advanced for the selected safe routes are shown in Figures 6.5 (a-d) and they confirmed the trend observed under Experiments 1 and 2. So once again, it was found that with increasing age, children became more aware of significant road features one should use in choosing safe routes to cross the road (see appendix 3 for examples of the explanations).

Figures 6.5 (a-d). Numbers of children who were categorised under the various verbalisations in the construction task (4 = explanation ensuring adequate safety with a mention of the relevant road landmark in the crossing situation; 3 = explanation which ensures safety but with no mention of the road feature prominent in the crossing situation; 2 = explanation including a reference to the road traffic environment but not guaranteeing safety; 1 = irrelevant explanation not ensuring safety with no mention of the road traffic situation).


a : Crossing the road from a hedge
Number of children
12
9
6
3
0
1
2
3
4
5
7
9
11
Age (years)
b : Crossing the road from a junction
Number of children
12
9
6
3
0
1
2
3
4
5
7
9
11
Age (years)
c : Crossing the road from a bend
Number of children
12
9
6
3
0
1
2
3
4
5
7
9
11
Age (years)
d : Crossing the road from a zebra crossing
Number of children
12
9
6
3
0
1
2
3
4
5
7
9
11
Age (years)

Experiment 3, also controlled for the first time, the scale-value of the shortest and most direct route across all the 4 construction tasks. The results are shown through Figures 6.6 (a-d) and they indicated that the younger the child was, the more likely he or she will select the shortest and most direct route as the safest.

Few responses were obtained for the subsidiary question introduced in the construction task for Experiment 3. Since the responses were so few, no meaningful analyses could be performed on them. It was observed from the few data, however, that the 5 and 7 year-olds were more inclined to justify their refusal to choose the other routes as either being too long or that a car might come. The 9 and 11 year olds, however, reasoned that the alternate routes were not particularly safe because they would not permit a good view of all the roads, due to obstacles, too many intersecting roads and bends. These, they argued, would make it difficult for one to detect approaching vehicles.

6.4 Discussion

The results of Experiment 3 can be summarised as follows: The children's responses to the discrimination of safe and dangerous sites and their construction of safe routes to cross the road did not vary significantly with the innovations in the mode of task presentation. The results to both the recognition and construction tasks were, therefore, overall similar to those of Experiments 1 and 2.

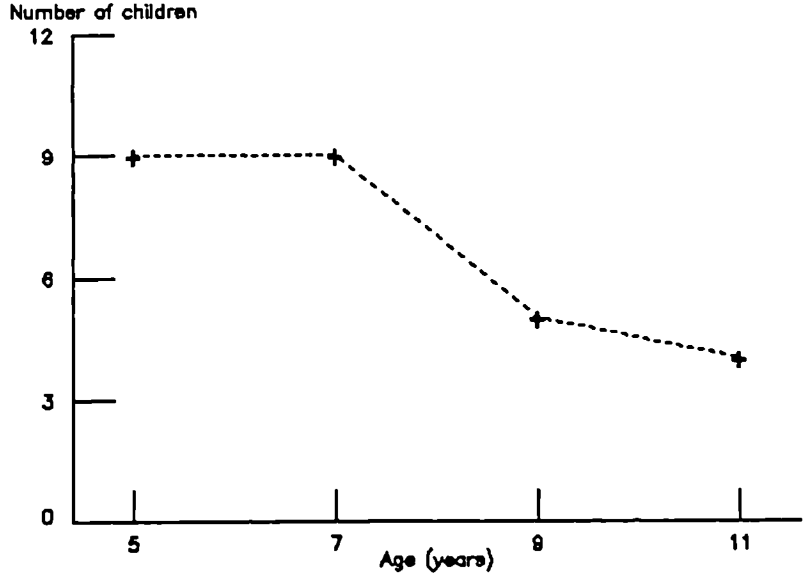
6.4.1 Recognition task

As in Experiments 1 and 2, the 5 and 7 year-olds were better in their identifications of safe than dangerous sites to cross

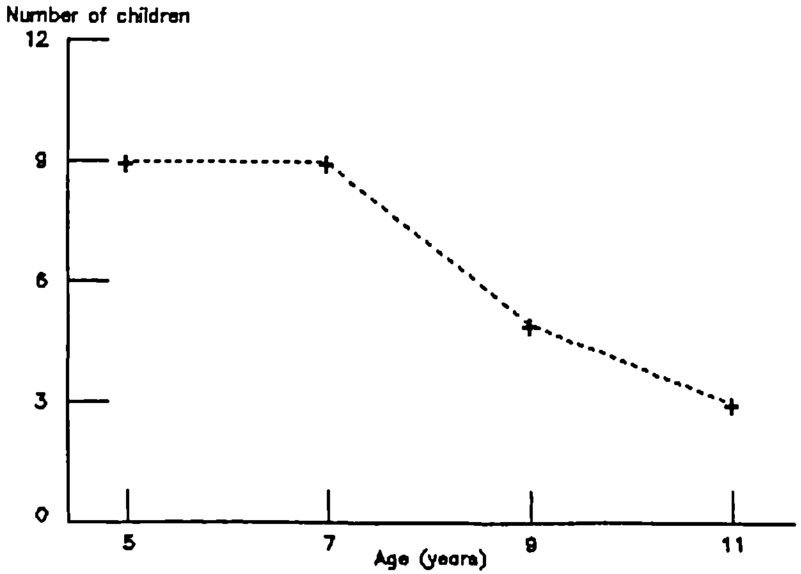
Figures 6.6 (a-d). Numbers of children selecting the shortest and most direct route as the safest in the construction task.

a : Near the hedge (score of the shortest and most direct route = 1)

b : At the junction (score of the shortest and most direct route = 1)



c : At the bend (score of the shortest and most direct route = 1)



d : At the zebra crossing (score of the shortest and most direct route = 1)

the road. The observed pattern of results was again greatly influenced by their fixation on cars. They perceived crossing sites as safe when no car was around, and even wrongly identified potentially dangerous road crossing sites as safe once there was no car on the road. They, therefore, did not achieve significant improvements in their identifications even with the modifications in the structure and presentation of the tasks.

It, however, appears that the 9 and 11 year-olds slightly benefited from the pair-presentation of the safe and dangerous sites. Their awareness of the safe and dangerous situations was enhanced through this new mode of task presentation. With the two road crossing sites of safe and dangerous presented side by side the - false alarms - where some safe situations were wrongly perceived as dangerous (in Experiments 1 and 2), were eliminated. As in Experiments 1 and 2, they overall achieved a better identification of the dangerous sites to cross the road than the 5 and 7 year-olds. Once again, they achieved this higher level of perception by basing on all relevant road environmental characteristics needed for such judgements.

The results to the ancillary questions to the recognition tasks, though few indicated that children hold fundamental ideas as to what could be done to make the dangerous road crossing sites safe. Perhaps, children's views must be closely studied before any constructional measures to improve or facilitate their safe use of the roads are designed and implemented.

6.4.2 Construction task

The modification of the construction task which maintained the shortest and most direct route as very unsafe across all the task situations revealed an interesting age trend. The younger the child was the more likely he would select the shortest and most direct route as the safest for the doll-pedestrian to cross the road (see Figures 6.6 (a-d)).

Overall, the 5 and 7 year-olds exhibited a total lack of awareness of other important featural characteristics of the road environment essential for the choice of safe routes to cross the road. They mostly justified their choice of safest route by basing on cars, and the distance to be travelled by the doll-pedestrian.

The 9 and 11 year-olds, however, achieved an overall better selection of safe routes by which the doll-pedestrian could cross the road than the 5 and 7 year-olds. Furthermore, the 9 and 11 year-olds advanced cogent reasons which revealed that they critically evaluated the road situation. Their reasons showed that they employed all relevant features of the traffic situation to aid their selections.

The responses to the supplementary question (first introduced in Experiment 3) though limited revealed interesting ideas about how children select safe routes in traffic. For example, the 5 and 7 year-olds did not choose the other road crossing routes because they either thought they increased the distance the doll-pedestrian had to cross the road to his destination, or that a car might come. This clearly gave credence to their inclination to choose the shortest and direct route as the safest, and their use of cars as the main determinant of safety and danger on the road. However, the 9 and 11 year-olds were prepared to select longer routes as safe for the doll-pedestrian to cross the road to its destination, provided such routes avoided obstacles (parked cars and hedges) and complicated road networks (bends and junctions).

6.4.3 The effect of road environmental features on children's responses to the recognition and construction tasks

Despite the introduction of modifications which made all the construction tasks in Experiment 3 comparable, the children still constructed significantly more safe road crossing routes at the zebra crossing than at the bend, hedge and junction. This might have been due to the emphasis placed on zebra crossing in children's road safety education.

In the recognition task, however, the significant results obtained from the effect of the road environmental features might have been caused by the good performance at the zebra crossing, hedge, parked car, and junction than at the bend. While, the overall good performance at the zebra crossing was understandable, it was difficult to work out what caused the vagaries in the results at the other road crossing sites.

6.4.4 The table-top model tasks and the photographic tasks

One caution which needs to be made of the present results concerns the comparison between the tasks based on the table-top model and those based on photographs which failed to yield significant differences. Perhaps, this was achieved because of the careful arrangements made before the photographs were taken.

On the other hand, however, the fact that comparable results were obtained with these two different task approaches provided a validation of our results. It reinforced our conviction that the children's responses to the tasks reflected how they perceived safety and danger in traffic and not an artefact of any methodological difficulties they might have faced.

6.4.5 Conclusions

It can be concluded, therefore, that 5 and 7 year-olds have only a very rudimentary understanding of safety and danger in traffic since they were only able to do this differentiation on the basis of a single major referent - cars. The 9 and 11 year-olds, however, exhibited a more adequate understanding of safety and danger in traffic as their perceptions incorporated all the relevant road featural characteristics needed for such identifications.

At this stage, however, we must concede that we have been able to achieve the examination of the nature of children's conceptions of safety and danger in traffic through novel experimentation. This involved tasks based on a table-top model of road traffic situations, and photographic tasks based on the same table-top model. Doubts could be raised as to whether such findings reflect children's notions about safety and danger in traffic (see David, *et al*., 1986a; Sandels, 1975; Sheehy, 1982). One can argue, for example, that the results reported here are only one step towards understanding the complex pattern of things children base on to identify safety and danger in the real traffic situation. Such doubts can only be clarified through further experimentation. Our next experiment will therefore attempt to study how children will respond to comparable situations in the real road traffic situation.

CHAPTER 7

EXPERIMENT 4

CHILDREN'S IDENTIFICATION OF SAFETY AND DANGER IN THE NATURAL TRAFFIC ENVIRONMENT

7.1 INTRODUCTION

The three preceding experiments investigated the same basic problems, but employed different experimental strategies. Experiment 1, for example, was based on a table-top model, Experiment 2 utilised photographs based on the table-top model, and Experiment 3 used a combination of the table-top model and photographs of the table-top model.

The results from Experiments 1, 2 and 3 revealed an age trend in the way children select sites and routes by which to cross the road in traffic. Children aged 5 and 7 years, on the whole, relied on the presence and absence of cars on the roads to determine safety and danger. They additionally, tended to choose the shortest and most direct route as the safest. The 9, and especially the 11 year-olds however, relied on other relevant road environmental features to perceive safety and danger. This strategy influenced them to select longer routes as safe, provided they avoided obstacles, junctions and bends.

In all three experiments the children had to record their responses from the perspective of a doll-pedestrian. The major questions likely to spring to mind concerning these experiments are therefore;

(1) how far did the children understand the mechanisms of having to register their responses from the perspective of a doll-pedestrian?, and

(2) to what extent do the results so far obtained reflect children's notions about safe and dangerous sites and routes in traffic?

Question 1 was tackled in the design and administration of Experiments 1, 2 and 3, taking into consideration the Piagetian findings on children's performance on such perceptual inference tasks (Piaget and Inhelder, 1956). The comparable results obtained under these three experiments enabled us to conclude that the results obtained so far represented children's conceptions about safety and danger fairly well and were not a mere artefact of the methods employed.

The question yet to be answered is how children will react towards comparable situations in the normal traffic environment. To investigate this, we will have to examine children's notions about safety and danger in real traffic using road situations and experimental procedures similar to what were employed in the three previous experiments. With the children now positioned in the actual road traffic situation, what will be the pattern of their identifications of safety and danger? The present experiment will systematically analyse this question.

We will begin by reviewing the literature on the role of the real traffic environment in researches of this type. The actual traffic situation has served a number of purposes in road safety researches involving children. It has been used, for example, to examine how children perceive safety and danger in traffic (Russam, 1975); for training in safe road behaviours (Rothengatter, 1984); and for evaluating the effectiveness of traffic safety educational programmes (Boyle, 1973). Whatever purpose it serves, however, the invitation of children to indulge in behavioural activities in the real traffic situation is always bound to be greatly opposed on the grounds of safety. This is because the child is introduced to potential sources of danger - moving traffic - and any slight errors might lead to injury or death. For this reason teachers in most countries are not allowed to conduct road safety education of children in the normal traffic situation (Rothengatter, 1981b) (see also 2.2.1; Chapter 2).

This is indeed a worrying situation since the most important area for road safety researches of children should be the real roads, where trained behaviour, for example, will eventually be put into use. They are also freely and generally available and there is no need to invest or maintain anything (Rothengatter, 1981b). It is against this background that it becomes important that alternate safe but realistic methods should be developed for road safety researches with children. The table-top model of road traffic situations offers such a promise, though its feasibility with young children is still inconclusive (Boyle, 1973; Rothengatter, 1981c).

7.2 Method

7.2.1 Subjects

24 children were tested. They consisted of 12 each of 5 and 7 year-olds with equal numbers of boys and girls in each age group. The mean ages were 5 year-olds (5 years 4 months) and 7 year olds (7 years 3 months). Parental consent was solicited for the children's participation in the experiment. The local police station was also approached and invited to provide an observer. They, however, did not do so after expressing satisfaction about our measures to ensure the safety of the children.

It was decided to exclude the 9 and 11 year-olds from this 'real behavioural' assessment in the normal traffic because they already showed considerable competence in the earlier tasks

(Experiments 1, 2 and 3) and there seemed little room for extensive improvement here - unlike the younger children.

7.2.2 General methodology of the experiment

A school in Glasgow was chosen for the experiment. The selection of the school was not done arbitrarily. On the contrary, it was chosen after the road networks in the vicinity of a number of schools in Glasgow had been carefully scrutinised. This assessment was undertaken by the experimenter and four road safety officers. The school was selected because it had all the road features we were interested in; parked cars, obstructive obstacles*, junctions and bends. In addition, these features were on roads fairly close to the school. This ensured that the children were not taken too far from their school. This arrangement also avoided the experimenter having to use too many experimental assistants to help guard the children from wandering on to the roads during the experiment. This also averted the subtle influence the presence of a couple of adult experimental assistants might have had on the responses of the children.

Figure 7.1 shows a general overview of a section of the roads used for the experiment. The two tasks of recognition and construction were based on this road network.

7.2.2.1 Recognition task

The rationale behind this was to position children at pre-evaluated safe and dangerous sites to cross the road, where they stated whether it was safe or not safe to cross the road. Additionally, they were instructed to explain why they thought a

*The obstructive obstacles were a line of large trees close to the road networks where the experiment was conducted.

Figure 7.1. A general overview of a section of the roads used for Experiment 4.

road crossing site was either safe or dangerous. This gave them the chance to identify safe and dangerous road crossing sites from their own perspective in a natural road traffic environment.

The 4 road safety officers evaluated the sites individually before meeting to collate their ratings. Only crossing sites which received a hundred percent agreement as either being really safe or dangerous were included in the recognition tasks.

7.2.2.2 Construction task

In the construction task, the children were stationed beside specific road environmental features (which were bends, junctions and obstructive obstacles) and they were instructed to select routes they considered safe for them to cross the road to specific points. They did this by pointing towards the direction they perceived was the safest route, and also explained why they thought so. The children were not asked to cross the road because of the inherent danger from traffic, in case of slight errors in behaviour such as tripping while walking across the road.

Again, only road situations with a hundred percent agreement from the road safety officers concerning their suitability were included in the construction tasks.

7.2.2.3 Scoring

A child's score on each of the recognition tasks consisted of both his or her identification of the road crossing site as safe or dangerous (scored (1) for correct and (0) for incorrect responses), and the explanation assigned for it also similarly scored ((1) for correct and (0) for incorrect responses).

In the construction task a child's response on each task was made up of a combined score of the selected safe route (scored on a

4-point scale of (1) very unsafe to (4) very safe) and the explanation given for it also scored on a 4-point scale ((1) irrelevant explanation to (4) relevant explanation).

Detailed plans for scoring both the recognition and construction tasks were drawn by each of the 4 road safety officers. A meeting was later convened to collate their evaluations. Only identifications and explanations that enjoyed an overall agreement amongst the road safety officers were included in the final pool for scoring. The structure of the road safety officers' evaluations for the scoring were the same as detailed out under scoring (see 3.3; Chapter 3).

7.2.3 Setting and design

The study took place on a fairly busy road close to the selected primary school in Glasgow. No officially designated road crossing facility was near the school. There was, however, a lollipop lady who helped the children cross the road to and from the school. The work of the lollipop lady was, however, limited since she was at work only during the time immediately prior to, and after the morning and afternoon sessions. Any child who arrived after these periods had to cross the road unaided.

The experiment itself was conducted beside a bend, obstructive obstacles, junction and parked cars. The zebra crossing was, however, precluded from these studies since it appeared to be a fairly well known safe road crossing site and route in the three earlier experiments, and also on an earlier survey on children (Ampofo-Boateng, 1986).

The bend which was used in the experiment joined up into a main road to form a type of T-junction. It had no pedestrian guard-rail or barrier which made it possible for pedestrians to cross from any section of the bend.

The obstructive obstacles were close to the main road. The experiment was conducted very close to two of these trees which were very large and adequately obscured the vision of the children.

The junction consisted of two side roads joining up into the main road to form a four road network junction (see Figure 7.2 for the junction which was used for the experiment).

The parked cars were made up of truck for carrying refuse and a car.

Both the recognition and construction tasks were undertaken close to these four road environmental features.

Each child completed a total of 8 recognition and 3 construction tasks. The recognition tasks included 4 safe, and their equally matched 4 dangerous road crossing sites at junctions, bends, obstructive obstacles and parked cars. The 3 construction tasks were (aside of the exclusion of the parked cars) at the same road situations as were used for the recognition tasks. Each child completed the recognition and construction tasks to a different order of presentation. Half the children were also made to perform the recognition task first and the other half the construction task first.

7.2.4 Procedure

Children were tested individually. Each child was taken out of his or her classroom by the same male experimenter and an experimental assistant to the roadside. During the short walk to the roadside the experimenter chatted with the child about what they would be doing.

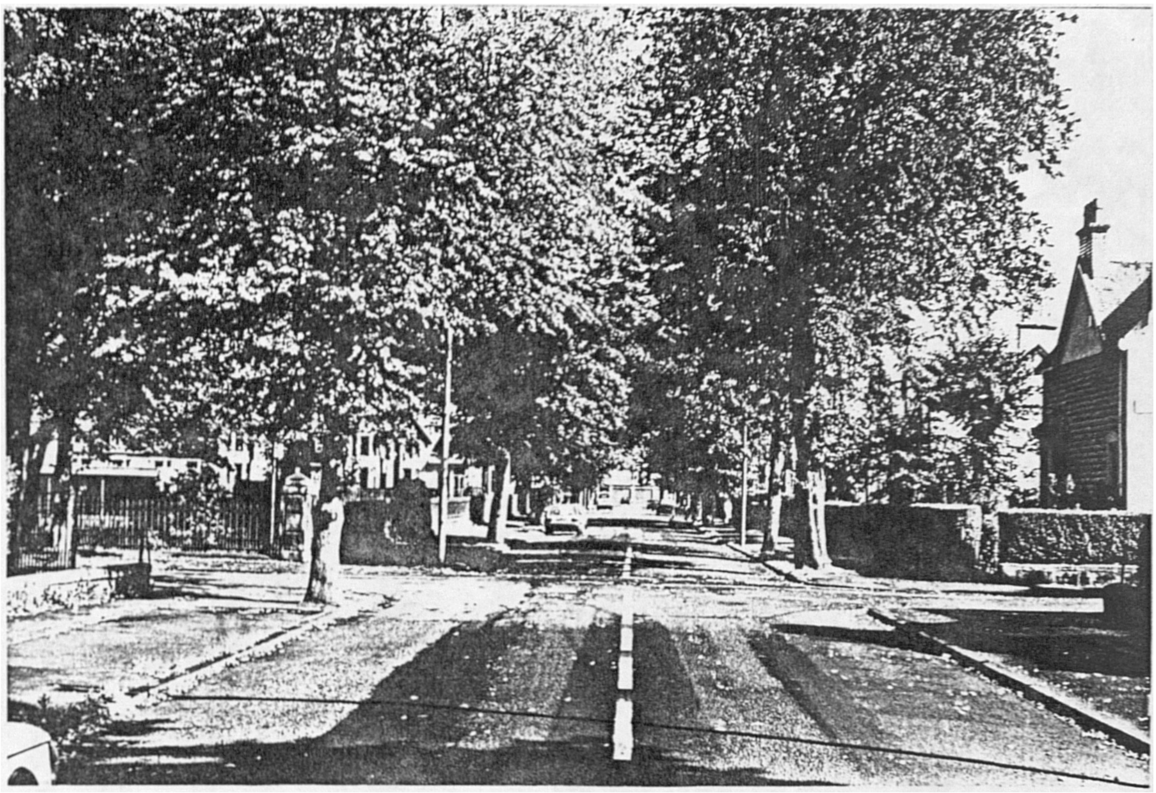


Figure 7.2. The junction used for both the recognition and construction tasks.

The experimental assistant was a male road safety officer from the Strathclyde Regional Council, Glasgow. His duty was to stand watch over the child and intercede when he thought the child was being exposed to danger. Otherwise, he made his presence as unobtrusive as possible, and did not interfere in the normal running of the experiment.

Each child completed an example of the recognition and construction tasks in areas not included in the main experiment to ensure their full understanding of the tasks. The child was carefully guarded to each task situation by the experimenter. The task situations were all at one side of the road which ensured that no road crossings were made during the experiment.

In the recognition task the child was positioned at each pre-selected location (for the recognition tasks bend, junction, obstructive obstacles and parked cars) and was instructed to state whether it was safe or dangerous to cross the road from there. They were in addition, asked to justify their identifications (see also 7.2.2.1; Chapter 7).

With the construction tasks, the child was stationed close to each of the pre-selected road crossing locations of bends, obstructive obstacles and junctions. At each road situation the child was asked to choose a route he or she considered safest (for him or her) to cross the road to a specific destination. The child registered his or her response by pointing towards the direction he or she perceived was the safest route, and also explained why the particular route was chosen.

The experimenter basing on already prepared plans by the road safety officers (see 7.2.2.3; Chapter 7) scored the children's responses as they pointed towards the direction they considered as the safest to cross the road. The justifications advanced for the choice of safe routes by the children were tape-recorded with their permission and these were later content examined.

7.3 Results

7.3.1 Recognition task

In the recognition task, a child could score in the range of 0 to 2 on each of the 4 safe and the 4 dangerous sites to cross the road. A child's score in the range of 0 to 2 for each of the recognition tasks was the combined score of the identification of a road crossing site as safe or dangerous, and the reasons assigned for it. Table 7.1 shows the mean correct recognitions for the road crossing sites of safe and dangerous by age.

Table 7.1: Mean correct recognitions of safe and dangerous sites to cross the road by age (Maximum possible score = 8).

	Age (Years)	
Road crossing Sites	5	7
Safe	8	8
Dangerous	4.17	5

A 2 (age: 5 and 7 year-olds) x 2 (road crossing site: safe and dangerous) two-way analysis of variance (ANOVA) with repeated measures on the last factor was calculated. Age was between subject variable and road crossing sites were within subject variables.

In the ANOVA no statistically relaible main effect of age was established ($F(1,22) = 0.31$, n.s.), but there was a significant main effect of road crossing sites ($F(1,22) = 21.42, p<0.001$). The mean correct recognitions for safe was (8), and for dangerous was (4.59) implying that the children detected more correct identifications of safe than dangerous places to cross the road. There was, however, no interaction between age and correct recognitions of the road crossing sites.

7.3.1.1 The effect of road crossing locations of parked car, obstructive obstacles, junction and bend on the correct perceptions of dangerous sites to cross the road.

The idea behind this analysis was to find out which of these road crossing situations afforded the children more correct identifications of dangerous sites to cross the road. Table 7.2 indicates the number of children who scored correctly or incorrectly by age.

Table 7.2: Number of children perceiving correctly or incorrectly on each of the 4 dangerous sites to cross the road by age

		Number who scored correctly by age		Number who scored wrongly by age	
	Age (Years	5	7	5	7
Road crossing situations	parked car	5	7	7	5
	obstructive obstacles	7	8	5	4
	junction	7	8	5	4
	bend	6	7	6	5

The data upon which the analysis was based consisted of (1) for each child who scored correctly and (0) for each child who scored incorrectly under each of the 4 road crossing situations (see Table 7.2). The piecemeal nature of the data required that we employed a non-parametric test for analysing it. A Cochran Q test was used, and this did not reveal any significant variations in the effect of road crossing situations on the responses to the identifications of dangerous sites to cross the road ($Q(3) = 7.36, p > 0.05$).

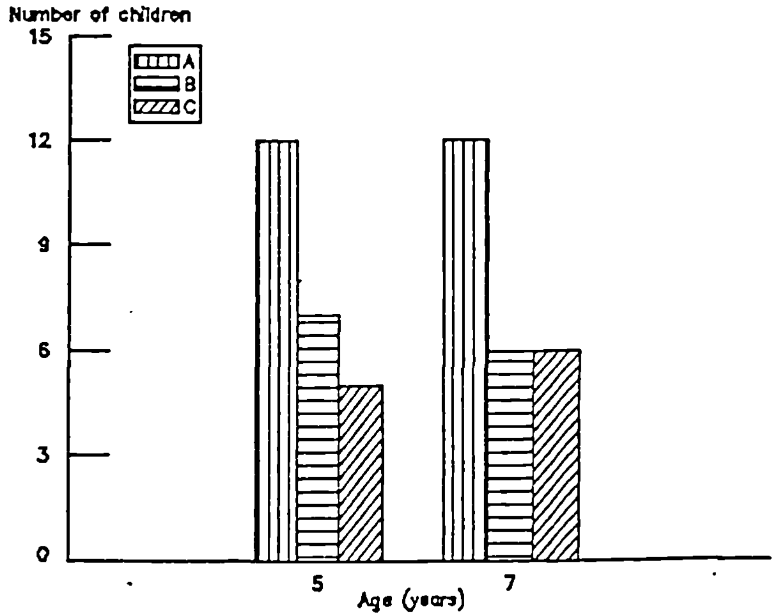
7.3.1.2 Qualitative analysis of the explanations given for the responses to the recognition tasks

The justifications the children assigned for their perceptions were content examined for each age group. This showed a trend which concurred the earlier explanations given by the 5 and 7 year-olds under Experiments 1, 2 and 3. In these three earlier experiments 5 and 7 year-olds mostly identified a road crossing site as safe when there were no cars on the road, and as dangerous when there were cars on the road. This distinction was also established in the natural road environment. However, in the natural traffic situation some of the safe sites to cross the road were interpreted as dangerous because of the movement of cars on the road at the time of the experiment. After deliberations with the road safety officers such responses were scored as correct. It was argued here that, no road crossing site could be safe when there were cars on the roads close to it. Figures 7.3 (a-d) show the pattern of explanations to the recognition of safe locations to cross the road. These showed the total number of children in each age group who gave correct justifications, and the proportions basing on either the absence or presence of cars on the road.

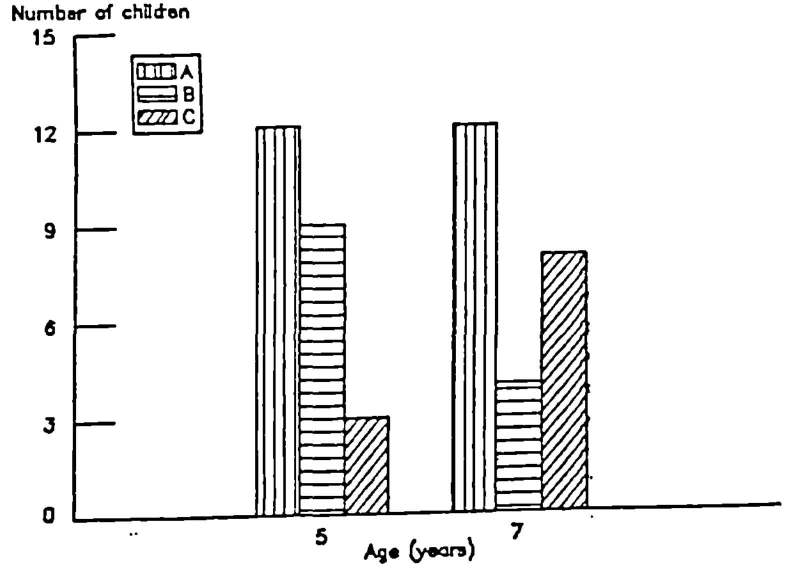
Figures 7.4 (a-d) indicate the pattern of explanations to the identification of dangerous sites to cross the road. These show the total correct explanations, the number basing on the presence of cars on the road to estimate danger, and the proportion who had their

Figures 7.3 (a - d). Numbers of children under each age group advancing the different explanations in the recognition of safe sites to cross the road (A = total number of children with correct explanation; B = number of children who relied on the absence of cars on the roads to perceive safety; C = number of children who based on presence of cars on the roads to perceive the safe road crossing situations as dangerous).

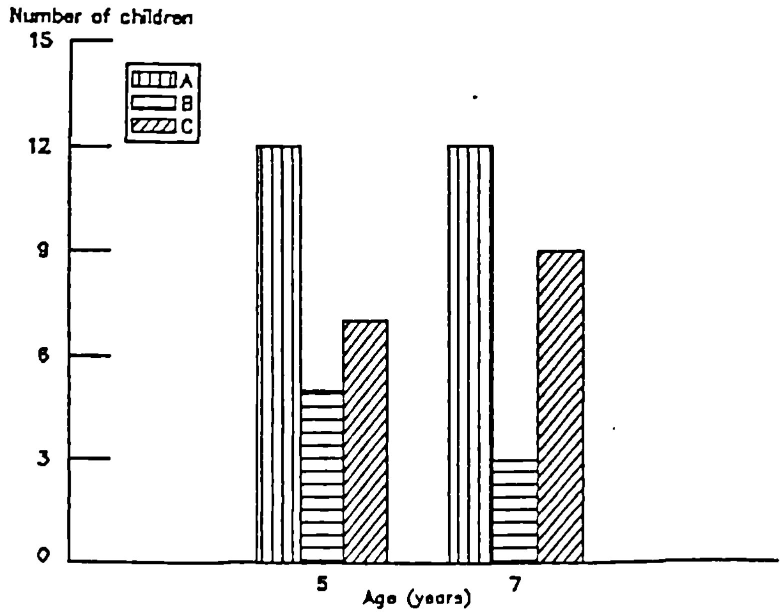
a : Standing away from a parked car



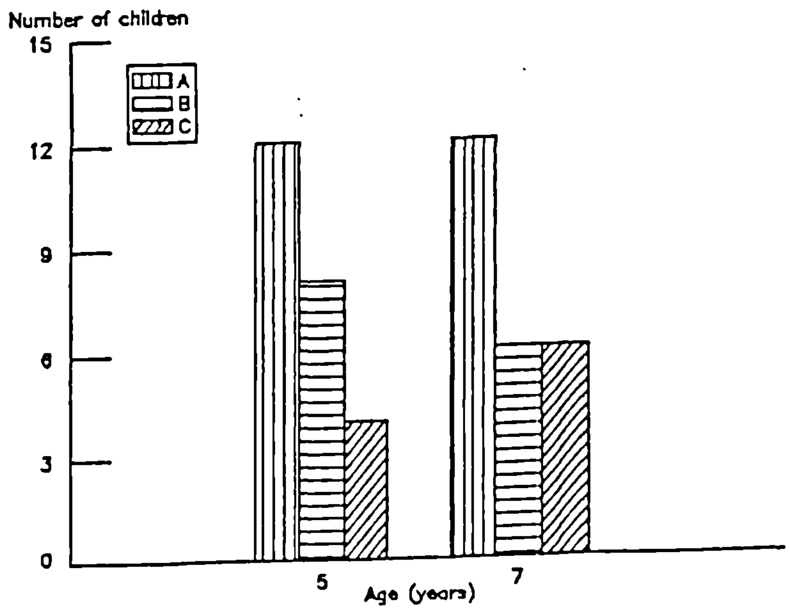
b : Standing away from obstructive obstacles



c : Standing away from a junction



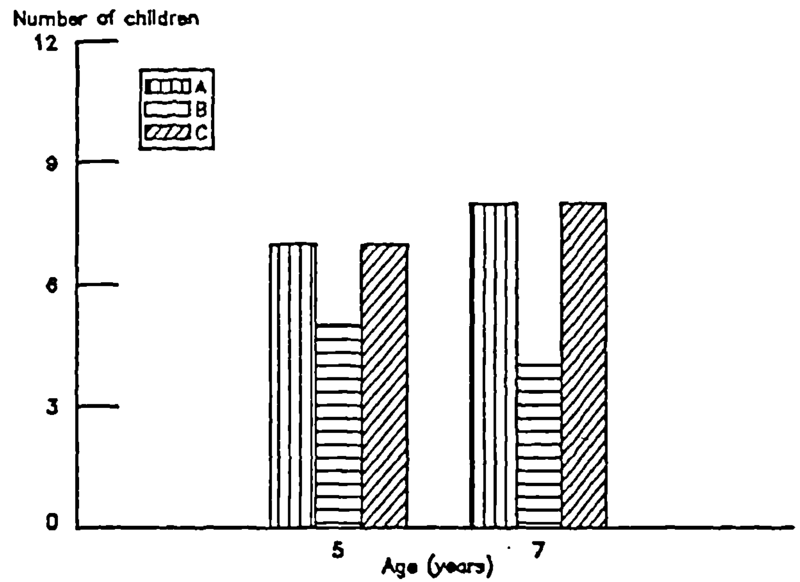
d : Standing away from a bend



Figures 7.4 (a - d). Children in each age group who gave the different explanations under the recognition of dangerous places to cross the road (A = total number of children with correct explanation; B = number of children who wrongly based on the absence of cars on the road to estimate danger; C = number of children who relied on the presence of cars on the road to perceive danger).

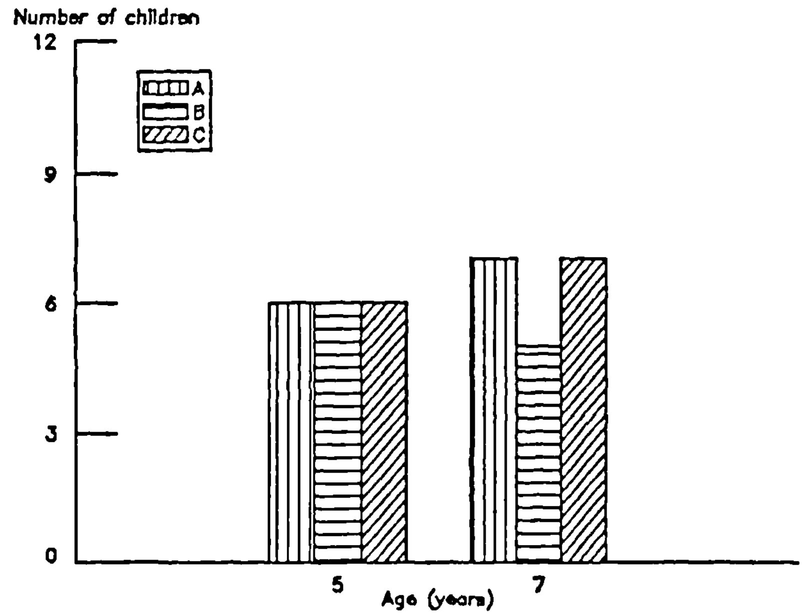
a : Standing in-between parked cars

b : Standing close to obstructive obstacles



c : Standing at a junction

d : Standing at a bend



explanations adjudged wrong because they based on the absence of cars on the roads.

It was established from the overall pattern of the reasoning behind the children's identification on the recognition tasks that, for 5 and 7 year-olds, the major referent in perceiving safety and danger in traffic is cars. The verbalisations given here were similar to those advanced under Experiments 1, 2 and 3 (see appendix 1 for examples of the safe road crossing situations, and appendix 2 for examples under the dangerous road crossing situations).

7.3.2 Construction Task

A 2 (age: 5 and 7 year-olds) x 3 (road crossing locations: obstructive obstacles (line of large trees), junction and bend) ANOVA with repeated measures on road crossing situations were calculated. Age was between subjects variable while road crossing sites were within subjects variables. A child's score on each of the road crossing locations consisted of a combined score of his or her constructed safe route and the reasons adduced for the chosen safe route in the range of 1 to 8. Table 7.3 shows the mean responses on each road crossing site by age.

Table 7.3: Mean responses on each road crossing situation by age (Maximum possible score =8).

Age (Years)	Obstructive obstacles	Junction	Bend
5	3.25	5.33	3.50
7	3.75	5.58	4.08

In the ANOVA no significant main effect emerged for age. A significant effect was, however, established for road crossing situations ($F(2,44) = 27.16, p<0.001$). The overall good performance at the junction than at the bend and obstructive obstacles must have contributed to the observed main effect of road crossing situations (see Table 7.3).

A later extra data assessment revealed that the overall superior selection of safe routes at the junction over the bend and the obstructive obstacles might have been caused by the inequalities in the scale-values of the shortest and most direct route. While the junction had a score of (3) for its shortest and most direct route, the bend and obstructive obstacles both had a score of (1). Since there was the tendency for the children to select the shortest and most direct route as the safest, more so when there were no cars on the roads, (see Figures 7.5 (a-c)) this partially explained the disparities in the performance at the junction, bend and obstructive obstacles.

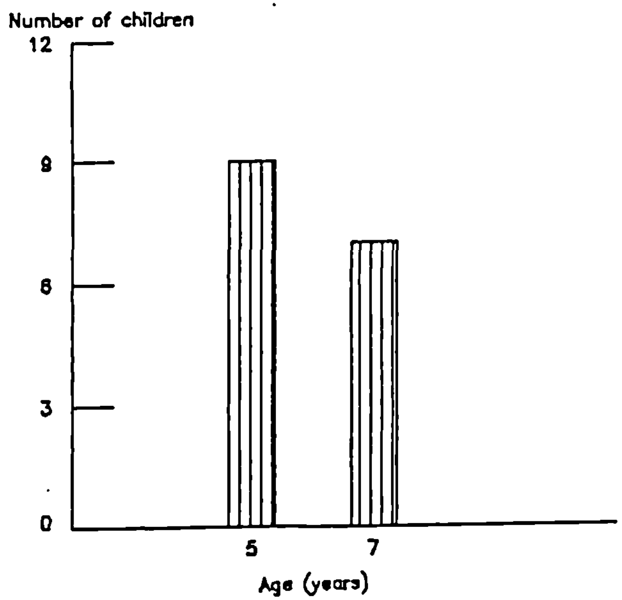
7.3.2.1 Qualitative assessment of the explanations given for the responses to the constructed safe routes.

Content examination of the justifications given for the chosen safe routes were undertaken. These were assessed on the basis of how far they ensured a safe crossing of the road on a 4-point scale of (1) - very unsafe to (4) - very safe. Details of the explanations falling under each of the 4-point scale are given under scoring (see 3.3.2; Chapter 3). These explanations are shown in Figures 7.6 (a-c), (with examples given under appendix 3).

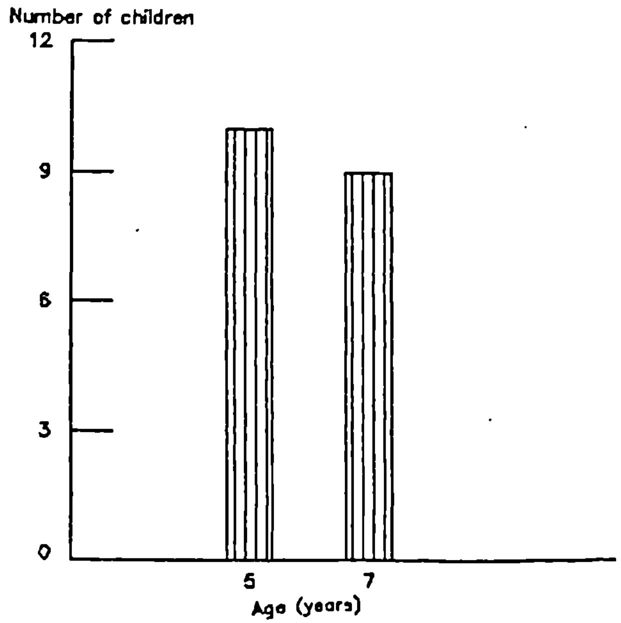
It can be observed from the figures that the explanations assigned to the constructed safe routes by the 5 and 7 year-olds were comparable. The two age groups were mostly influenced by cars in choosing routes they considered safe to cross the road. They exhibited a lack of

Figures 7.5 (a-c). Numbers of children selecting the shortest and most direct route as the safest in the construction task.

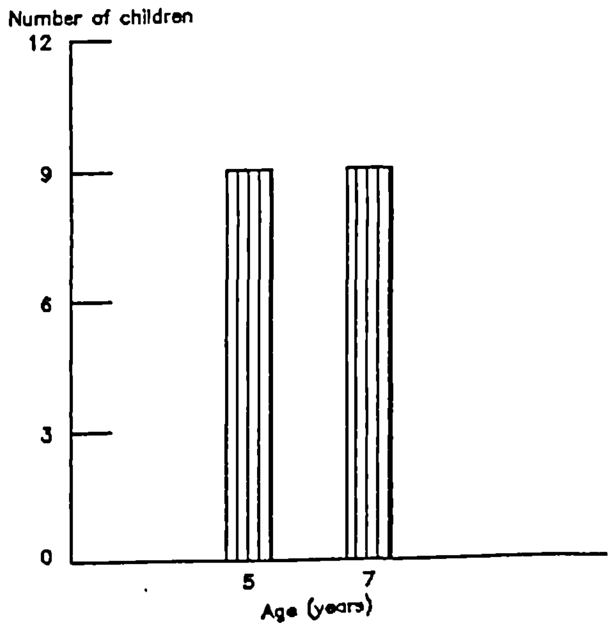
a : Crossing the road near obstructive obstacles



b : Crossing the road from a junction



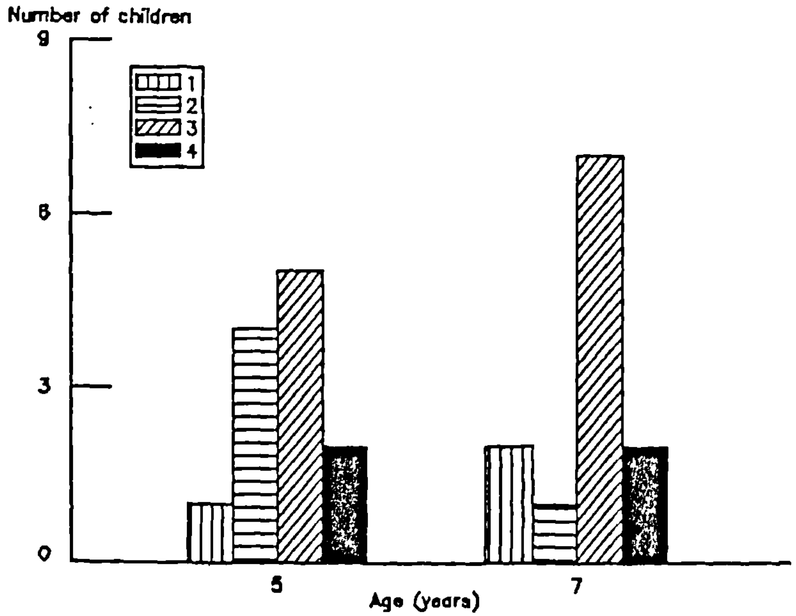
c : Crossing the road from a bend



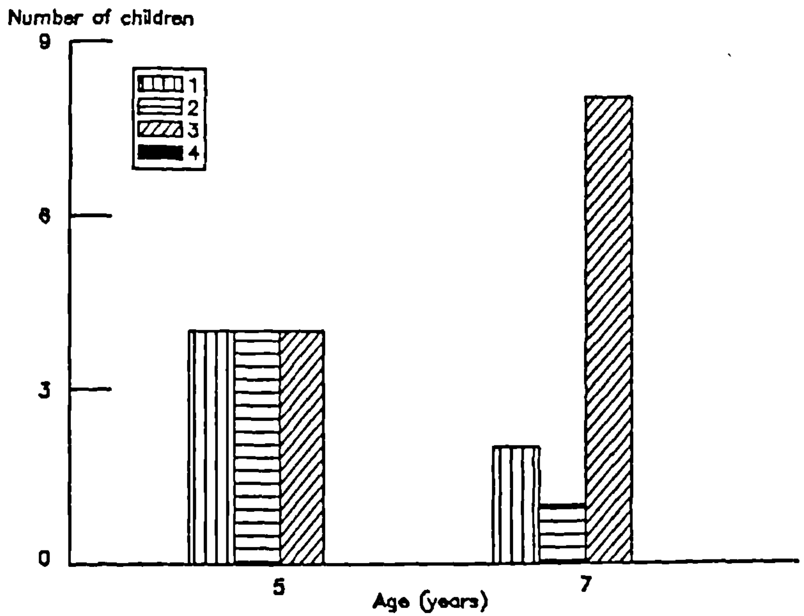
Figures 7.6 (a-c). Numbers of children who gave the different justifications under the construction task (4 = explanation safeguarding maximum road safety with a mention of the important road landmark in the crossing situation; 3 = explanation which guarantees safety but with no mention of the road feature prominent in the crossing site; 2 = explanation with a reference to the road traffic situation but not guaranteeing safety; 1 = irrelevant explanation not ensuring safety with no mention of the road traffic situation).

a : Crossing the road near obstructive obstacles

b : Crossing the road from a junction



c : Crossing the road from a bend



awareness of prominent road featural characteristics also needed for the selection of safe routes by which to cross the road.

7.4 Discussion

7.4.1 Recognition Tasks

The children's responses to the recognition task did not vary significantly from what had already been established under Experiments 1, 2 and 3. Their main referent for identifying safety and danger on the roads was cars. Every road crossing site was perceived safe once there were no cars on the roads, and all road crossing sites were dangerous when cars were on the roads. Armed with this dual mode of perceiving safety and danger, the 5 and 7 year-olds were not able to work out that even without cars, crossing roads near obstructive obstacles, bends, junctions or parked cars could be potentially dangerous.

In the actual road traffic situation, it was found very difficult to obtain an absolutely safe, and their equivalent, dangerous road crossing site for the recognition tasks. This was partly attributable to the lack of control over the presence and absence of cars on the roads near the tasks. Perhaps, such a control over the movement of traffic on the roads could have been achieved by blocking the road during the experiment to create a street situation (Rothengatter, 1981a). In the past, this had been mainly done for safety reasons. But since we had an experienced road safety officer to ensure the safety of the children, we reasoned that such a blockade was not necessary. In any case the blocking of vehicles would have attenuated the results and subsequently the main purpose of the study - how children identify safety and danger in the natural traffic situation. Further, the children throughout the experiment never entered the actual roadway, making such precautions unnecessary.

Alternatively also, we could have assessed how safe or dangerous a site was on the basis of the gap between the vehicles on the roads and the road crossing sites where the child was positioned; but this was not considered in the present experiment. This could be built into a future experiment.

7.4.2 Construction Tasks

Overall, it was observed that the children's responses to the construction task were underlined by two basic principles; if cars are moving on the roads do not cross the road, and if cars are not around use the shortest and most direct route to cross the road. However, they did not take into account relevant road features such as bends, junctions, parked cars and other obstacles by the roadside which are also needed for the selection of safe routes to cross the road.

7.4.3 The effect of road environmental features on children's responses to the recognition and construction tasks.

The road environmental features in the recognition and construction tasks' influence on the children's responses was evaluated (see 7.3.1.1 and 7.3.2). In the recognition task no significant effect was recorded for the effect of road environmental features.

In the construction tasks, however, the junction was seen to have afforded the children more safe constructed routes. And this finding appeared to have been due to the higher score assigned to the shortest and most direct route at the junction than the bend and obstructive obstacles (see Figures 7.5 (a-c)).

7.4.4 Conclusions

Our foregoing results from the natural road situation gave support to our argument that for 5 and 7 year-olds the major basis of identifying safety and danger on the roads is cars - and their awareness of the role of other important road landmarks in such perceptions is very minimal.

CHAPTER 8

EXPERIMENT 5

TRAINING CHILDREN AGED 5 AND 7 YEARS ON HOW TO SELECT SAFE SITES AND ROUTES TO CROSS THE ROAD.

8.1 INTRODUCTION

Children are at the greatest risk in the road traffic environment. They are involved in more auto-pedestrian collisions than any other age group of road users. This worrying situation is clearly confirmed by the accident statistics (see Chapter 1). Several researchers (David, et al., 1986a, b; Vinje, 1981; Sandels, 1975; Salvatore, 1974; Foot, 1985; Brown, 1980) have delineated factors which make children the most vulnerable pedestrians (see Chapter 2).

Our own experiments examined children's ability to discriminate between safe and dangerous sites and routes to cross the road, seen as flaws within children's road safety education; and also probably contributing to the high incidence of child pedestrian accidents.

Additionally, our experiments were to evaluate the feasibility of using a table-top model of road traffic situations in road safety researches with children. It is the table-top model and its usefulness in road safety education of children we shall again address here. Throughout the running of the experiments, it was observed that the children totally enjoyed recording their responses on the table-top model. For one thing, not only was it far more interesting and practicable to the children, it also differed from the conventional mode of road safety training which in most cases involve periodic talks from the police and road safety officers with children as passive listeners. With the table-top model, however, the children were more actively involved. They helped set up the situations in-between tasks. They also manipulated the dolls on the table-top model in movements similar to what are normally negotiated by pedestrians in the actual roadway.

The keen interest displayed by the children to the table-top model encouraged us to undertake an exploratory study to investigate its potential as a possible training tool for their road safety education.

8.1.1 Background analyses to the training programme

Most road safety education of children has failed to inculcate in children skills for safe pedestrian behaviour, and thus help prevent or reduce accidents to children as pedestrians (Rothengatter, 1981c; Singh, 1982). Among the factors contributing to this failure is the general lack of organised approach in their design and implementation (Rothengatter, 1984; Van der Molen, Rothengatter and Vinje, 1981; Grayson and Howarth, 1982), and also the failure to specify either the theoretical or empirical basis employed to achieve the objectives of the training. We shall now discuss these two variables and how they were used in our training.

On the basis of our background assessments (see Experiments 1, 2, 3 and 4), it was decided that the age groups to be trained should be 5 and 7 year-olds. The training was to educate the children in choosing safe places to cross the road; and in discriminating dangerous sites such as obstacles obscuring vision; and the avoidance of complex road networks such as junctions and bends. These chosen objectives incorporated locations in the roadway which are commonly used by children, but are unfortunately hardly stressed in their road safety education (see also 2.4; Chapter 2).

Our background analyses which resulted in the formulation of the training programme tied in with Grayson and Howarth's (1982) review that pedestrian safety programmes to be effective must pass through the sequence of;

(a) Define the objectives to be achieved - to train children develop the skill of selecting safe sites and routes to cross the road; and in particular to acquire the ability to recognise dangerous sites such as obstacles obscuring vision and the avoidance of complex road networks such as bends and junctions *when deciding where to cross the road.**

(b) Investigate the resources available to achieve the objectives - assessed through a series of interrelated experiments (see Experiments 1, 2, 3 and 4) whether children understand the mechanisms involved in responding to table-top model based road safety questions. And more importantly, the exact nature of their understanding.*

(c) Devise and implement a strategy whereby the resources can be used to achieve the objective - trained children on the table-top model employing a dual research strategy of small-group approach and the application of behaviour modification principles.*

(d) Evaluate the effectiveness of the strategy in terms of the degree to which it achieves the objectives - ascertained whether the children has acquired the requisite skills (see (a) above) by testing them on photographic tasks based on the normal traffic situation.*

*indicates our assessments which formed the core of the training programme.

Regarding the theoretical basis upon which a training programme might be expected to achieve some measure of success a number of authors (Reading, 1973; Rothengatter, 1981a, c; Dueker, 1975a, b; Page, Iwata and Neef, 1976) have considered training from the point of view of behaviour modification principles. These behaviour modification principles are usually modelled after Bandura's (1977) social learning theory.

We shall now review the literature on the basic principles within the social learning theory, their relevance to road safety researches involving children, and how they will be used in our training programme. Social learning - learning by observing another's behaviour, forms the central theme of Bandura's (1977) theory of modelling. He proposed that through observation children learn a multitude of brand new social responses. By storing these observed responses in their memories in the form of mental images and other symbolic representations new patterns of social behaviour are acquired by children. Social learning will, however, not occur if the child is too young to have the cognitive abilities essential to reproduce a model's activities, if not motivated to remember the modelled activities, and if there is a lack of the necessary motor abilities needed for the reproduction of the modelled skill. As children grow up, they also learn to discriminate between things they observe which are relevant for them to perform and others which are not (Perry and Bussey, 1984).

Social learning can, however, occur and be maintained without any obvious reinforcers. This is different from associative or instrumental learning which proposes that children must both perform and be given a reinforcement for a particular response to be acquired.

Although not a requirement, reinforcement can, however, play an important role in social learning. Children's imitative performance has, for example, been observed to be influenced by the outcome of imitating (Perry and Bussey, 1984).

Social learning principles have also been employed to help children cope with a variety of social deficiences. Children extremely fearful of dogs were cured after watching a peer model exhibit more fear provoking interactions with a dog (Bandura, Grusec and Menlove, 1967); and also children afraid of dental surgery exhibited reduced fear arousal both before and after surgical operations after being shown film of a peer model coping with circumstances similar to their own (Melamed and Siegel, 1975).

Several studies have demonstrated the use of social learning principles with other species. Dachshund puppies will learn to pull a food cart soon after they have seen other puppies do it, more than if they have never observed such behaviour (Adler and Adler, 1977). Rats also discover the best route through a door by observing rat 'leaders' who initially discovered the route (Konospasky and Teledgy, 1977). Naive mice also learn to copulate soon after watching other mice do it (Hayashi and Kimura, 1976).

Although social learning principles has resulted in an understanding of the instructional nature of everyday human activities and interactions, its impact on traffic education has been very minimal (Rothengatter, 1981c). Yet it is becoming increasingly clear that behaviour modification techniques play a key role in the successful design and administration of training schemes for young children (Rothengatter, 1981a; Reading, 1973; Dueker, 1975a, b). Behaviour modification is here, defined as 'the application of systematic reward and correction procedures' (Rothengatter, 1981a, p.2577). Typically, the rewards are given for a display of the correct behaviour, and wrong responses are corrected through explicit feedback. This feedback normally involves the demonstration of the desirable behaviour to the child by the trainer.

Reading (1973), for example, employed behaviour modification principles in a traffic training programme involving children aged up to 12 years. The children were systematically rewarded when they exhibited the appropriate crossing behaviour demonstrated to them at a number of intersections near their school. The reward took the form of words such as 'that was a good job of crossing the street'; by giving the child a piece of candy; and a good pedestrian certificate. The results showed acquisition of the required traffic behaviour. It was, however, not ascertained whether the acquired behaviour stabilised after the termination of the training programme.

Dueker (1975a, b) also used behaviour modification techniques in three experiments to teach children in the 5-9 year group safe road crossing behaviour. He, during the training, gave a road safety badge and certificate to the children for showing the correct pedestrian behaviour. Overall, a net reduction in unsafe road crossing behaviour was achieved.

Page _et al_., (1976) also used behaviour modification principles to train retarded persons on how to cross the road at intersections with or without pedestrian lights. Subjects manipulated a doll, following instructions from the experimenter. 'Correct responses were followed by social reinforcements in the form of descriptive praise (e.g. 'Good job, you had the doll go to the corner to cross'). Incorrect responses were followed by explicit feedback as to why the response was inappropriate' (Page, et al., 1976, p.435). The results using a multiple-baseline design across both subjects and behaviours indicated that after receiving classroom training on the skills, each subject showed the appropriate pedestrian skills under city traffic conditions.

It is, however, yet to be established whether behaviour modification procedures can be successfully used in conjunction with table-top models for the road safety training of children. The present training therefore assessed this.

8.2 Aims of training

Children were trained in pairs on the table-top model on how to select safe sites and routes to cross the road at junctions, parked cars, hedges and bends utilising behaviour modification principles.

The general objective was to let children know the importance of crossing the road at a clear site where they will see all the roads clearly; to enable them detect oncoming cars; and also allow drivers to see them. The specific objectives for the training were following from the general objectives stated as;

- how to recognise road environmental features which made road crsossing both difficult and dangerous,
- how to select safe sites at such environmental features, that is, stand away from them, and at a place where they can see the roads clearly, and
- how to select safe road crossing routes at these road environmental features, that is, cross away from them and at a place where they can have a good view of all the roads.

In choosing these three specific objectives we took into consideration factors such as feasibility with the age groups concerned, and the existing empirical evidence. It was decided, for example, to instruct the children to recognise these features first, since without such a recognition it is doubtful if the training will achieve the desired results, especially when it comes to a later extrapolation to the real traffic situation. Also evidence from our four earlier experiments showed that children aged 5 and 7 years may not be good at this identification themselves, since they dwelt on cars only in their responses. In selecting these three basic aims of recognition, stand-away and cross-away as feasible educational objectives, we were also guided by Van der Molen, Rothengatter and Vinje's (1981) assessment that traffic training objective should ensure that;

(a) the child selects those traffic situations that are optimally safe, and

(b) the child behaves in traffic situations in a way resulting in optimal safety.

The existing theoretical evidence also portrays a confusing situation about how best to instruct children at junctions and parked cars. For example, while in some countries children are encouraged to cross at junctions because vehicle speeds are slower there, others discourage it because it is complex for both pedestrians and drivers (Grayson, 1981). Concerning parked cars also, while traditional views enjoin the child to cross away from parked cars because his small stature will restrict both his view of oncoming vehicles and the driver's view of it, others maintain that children should be trained to treat the edge of the parked car as a kerb, since this reduces the total road width to cross and thereby the time during which the child is exposed to risk (Grayson, 1981).

We, however, maintain that children aged 5 and 7 years are still too young to appreciate the complexities involved in crossing at junctions, beside bends, in-between parked cars and near hedges, and that the best training objective is to train them to cross well away from them to get an adequate view of the road to detect oncoming cars. This stand is reinforced by Foot, Chapman and Wade's (1982) conclusion that children should be taught to identify those crossing situations in which under no circumstances should they even attempt to cross the road except in the custody of an adult or an experienced road user.

The feasibility of the three main objectives was also endorsed by Vinje (1981) who delineated recognising parts of the road, route planning and selection of a safe place to cross and a safe place to stand, as feasible road safety educational objectives for children in the 2-7 year age group.

8.3 Method

8.3.1 Subjects

Two groups of children, recruited from two separate schools in Glasgow, served as subjects. Care was taken to ensure that the two schools chosen had comparable road environmental features in their nearby vicinity. This was necessary to guarantee as far as possible a similar experience in the road traffic situation for the children in the two schools. The children in one of the schools served as control (no training) group, and the children from the other school the experimental (training) group. The children were assigned to an experimental or control group on the basis of school attendance since it was likely that 'diffusion or imitation of treatment may threaten internal validity if children attending the same school receive different treatments' (Rothengatter, 1984, p.151). This view was concurred by Cook and Campbell (1979) when they stressed that 'when treatments involve informational programs and when the various experimental (and control) groups can communicate with each other, respondents in one treatment group may learn the information intended for others. The experiment may, therefore, become invalid because there are no planned differences between experimental and control groups' (p.54).

It was, however, ensured that children chosen from one school were of parallel ability to those selected from the other school. This was done by including only children with comparable scores on the pre-training test in the two samples.

8 boys and 8 girls each were chosen from the two age groups of 5 and 7 years in the two selected schools to serve as subjects. The mean ages were; control group (5 years 6 months and 7 years 5 months); experimental group (5 years 5 months and 7 years 6 months).

8.3.2 Setting

The training was carried out in a room in the school attended by the children. The table-top model of road traffic situations was placed on a large table (specially chosen to suit the heights of the children). Chairs were placed beside the table for the E and the child.

The table-top model was rebuilt for the training. This new table-top model was different from the previous one (which formed the methodological base for Experiments 1, 2, and 3, see Figure 3.1; Chapter 3) in one significant way. It did not have a zebra crossing (see Figure 8.1). The zebra crossing was excluded because in Experiments 1, 2 and 3, the children showed sufficient knowledge of it as a safe road crossing site and route (see also Ampofo-Boateng, 1986). Our new table-top model also made prominent the road landmarks such as bends, junctions and hedges) which were to feature in the training.

8.3.3 Procedure

8.3.3.1 The evaluation tasks

Prior to the training the children in both the control and experimental groups were tested in the areas to be trained. These involved discriminating between safe and dangerous sites, and the determination of safest route to cross the road - using photographs of the normal traffic situation. The photographs were taken using a 5 year-old boy and a 7 year-old girl as model pedestrians in the various road crossing situations. The photographs were carefully taken with the camera aimed from behind the children as far as possible. This arrangement was to help maintain as far as possible the same perspective for the subjects and the child pedestrian in the photograph (see also Chapter 5). An example of this is shown in Figure 8.2 which is a task-situation in the recognition of dangerous sites to cross the road featuring a complex road environmental feature - a junction.

The evaluation tasks incorporated landmarks in the roadway which differed substantially from those used in the actual training. For example, there was a large kiosk close to where a child was about to cross the road (see Figure 8.3) in one of the photographs. This was one of the task-situations for the recognition of dangerous sites to cross the road. This situation, though quite different

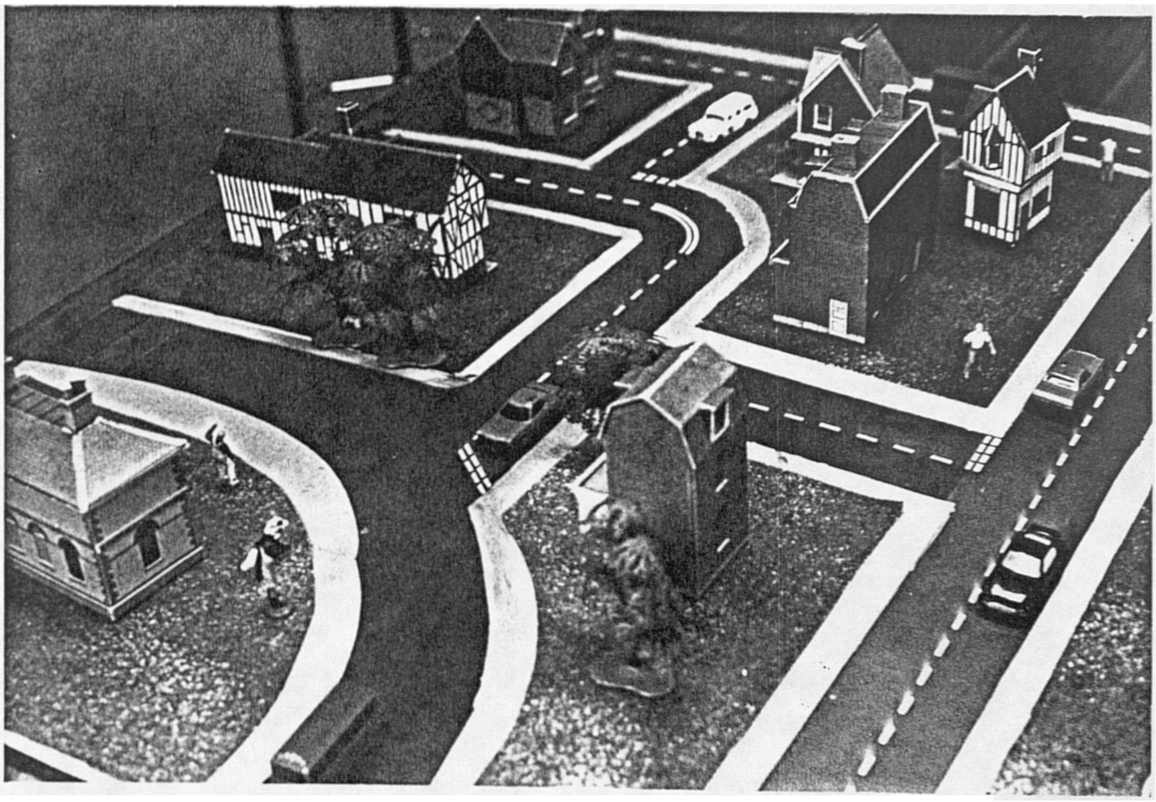


Figure 8.1. The rebuilt table-top model of road traffic situations used for the training.

Figure 8.2. The road crossing site at the junction used in the recognition task.

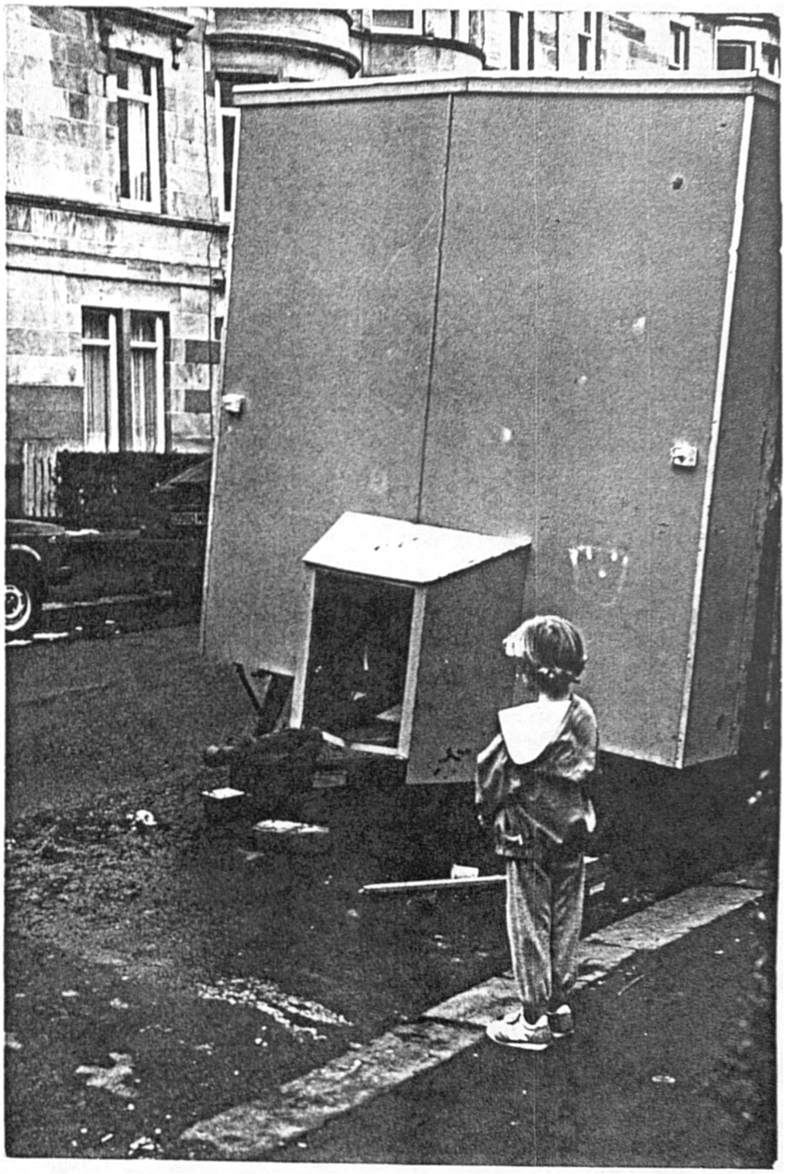


Figure 8.3. The road crossing site near the large kiosk used in the recognition task.

from crossing in-between parked cars (a training situation), nonetheless depicted the same basic principle that it was unsafe to cross the road from an obstacle large enough to obscure vision.

The scores on this test served as baseline measures for assessing improvement scores after the training. Both the control and experimental groups were administered this test <u>one week</u> before the training commenced.

The evaluation tasks consisted of <u>recognition</u> and <u>construction</u>. The testing of the children on these tasks was conducted in a room in their school. All furniture was removed from the room except a table and two chairs which provided seating for the experiment. In the recognition task the photographs were each carefully placed on the part of the table closest to the child. The task of the child was to state in each case whether it was safe or dangerous for the child-pedestrian to cross the road from where he or she was standing. The child was also instructed to explain his or her identifications. Both responses were recorded by the experimenter.

In the <u>construction task</u>, however, children were instructed to select safe routes for the child-pedestrian to cross the road to his or her destination. They recorded their chosen safe routes on the photographs with a blunt stick. To avoid any marks being made on the photographs, the experimenter carefully fitted transparencies over them before the child was made to indicate his or her selected safe route on it.

Under both the recognition and construction tasks, the experimenter carefully placed the photograph in front of the child ensuring, as far as possible, that both the child and the model-pedestrian in the task-situations had the same view of the roadway.

Each child completed 8 recognition tasks made up of 4 safe and their equally matched 4 dangerous road crossing sites (at bends, junctions, beside a large truck and kiosk), and 4 construction tasks (at a bend, junction, near a parked car and a refuse box) to a different order of presentation.

8.3.3.2 The training

The children were trained in groups of 2 at a time for each age group. Each pair of children were of the same sex - as a control for any possible sex influence. The idea behind training in groups was to make the training sessions game-like and less formal. It was also intended to use the peer-presence and interaction to facilitate learning and sustain interest. The E, however, had to explain to the children that the training sessions were not meant to test individual abilities. This was to eliminate fears of giving wrong responses, and to get them sufficiently relaxed and forthcoming.

The training involved two each of the road situations at a time. The junction and bend (road structures) were administered together and the hedge and parked car (obstacles) were also presented together. Training involving each pair of road situations (or features) were alternated on consecutive days. The training covered a 2-week period, with 5 training sessions lasting between 15-25 minutes for each pair of road situations. Each training session incorporated the broad general outline of;

(1) Recognition Stage:

Here the E asked the children to say which specific road situation to be trained, on the table-top model was called. E told the children what it was if they were unable to name it.

(2) Demonstration and group discussion stage:

Next the E showed the pair of children a doll and invited them to give it a name. E then informed them that the doll wanted to select a safe site and route to cross the road from an area (which is as (1) above) to a particular destination. While the children watched, E moved the doll and stopped it at a safe site first, before moving it through a safe route across the road to its destination.

E then asked the children why they thought the chosen site and route were safe. After listening to the views expressed by the children, the E explained to them why a chosen site and route were safe. For example, concerning <u>parked cars</u>, the explanation was; it is always safe to stand away from parked cars to see all the roads clearly before you cross the road. If you stand too close to the parked cars, they will block your view and you cannot see on-coming cars.

(3) <u>Trial Sessions</u>:

At this stage a child was asked by the E to move the doll to the already identified or taught safe road crossing site and route in (2), explaining why he thought they were the safest. The E then asked the other child to say whether the chosen site and route were safe. If errors were made by both children the E showed them where the safe sites and routes were. The first child was then made to go through the movements again, with the E offering verbal praise each time a child indulged the doll in the correct training routines. A child who was able to complete correctly all the training steps, which involved the dual identifications of safe site and route to cross the road, was rewarded with a road safety gift.

Having a first attempt at going through the training rudiments was alternated for the individual children (within each pair) when a new crossing situation was introduced.

(4) Evaluation Stage:

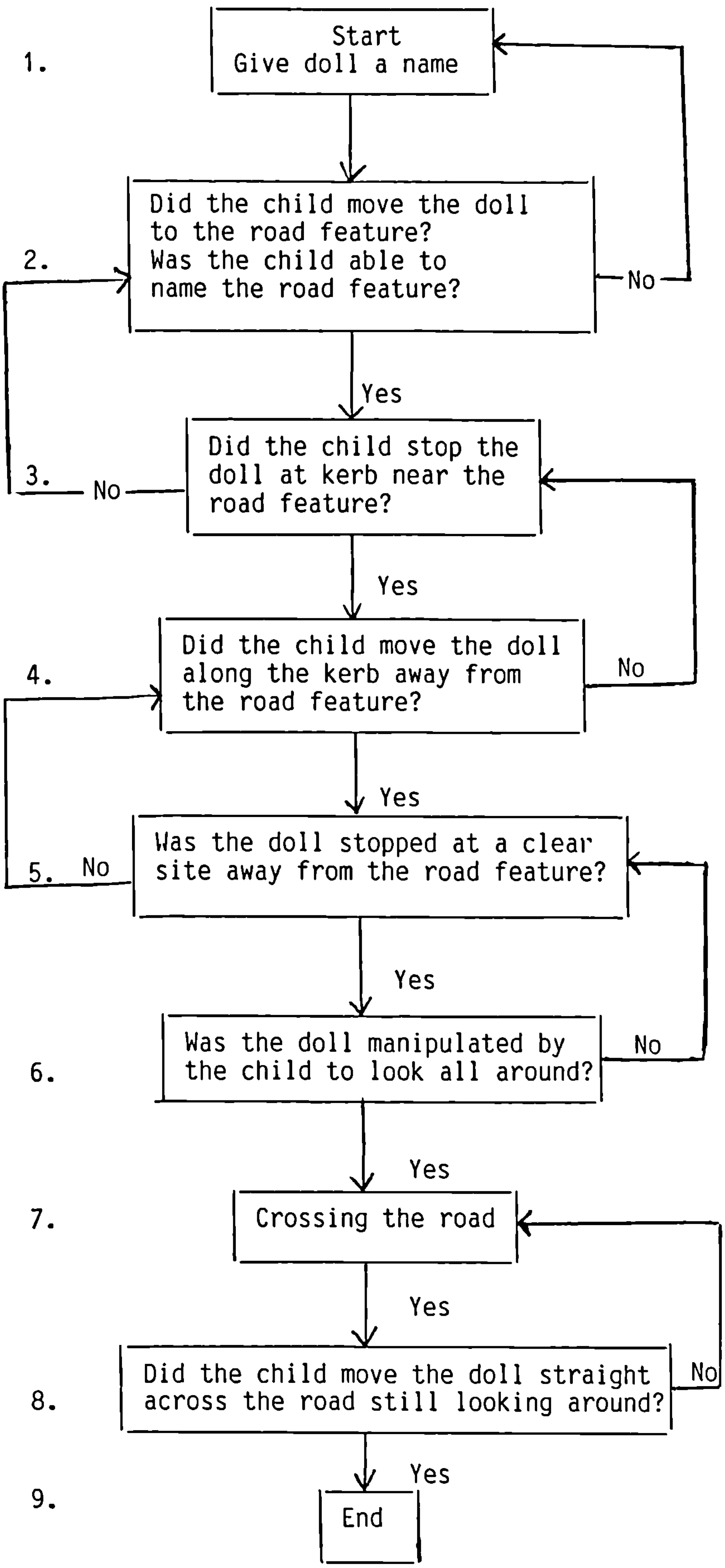
Each child now went through (3) alone and the E observed and scored it as discreetly as possible in order not to alert the child that he was being tested. These scores were examined only as a measure of the effectiveness of the programme itself and was, therefore, not reported.

The above 4-training outlines were further operationalised into 9-training steps (see appendix 4 for details of, and Figure 8.4 for a schematic presentation of the 9-programme steps), which each child was made to go through as he manipulated the doll in the road crossing activities. The 9-training steps also made it easier for the E to closely monitor each child's level of understanding of the training routines, and other relevant movements essential for a successful crossing of the road.

(5) Final Evaluation:

The children in the control and experimental groups were again tested on photographic tasks 1 week, and 4 weeks after the termination of the training. This was to assess the effectiveness of the training scheme and the relative stability of the acquired skill.

Figure 8.4: Schematic presentation of the 9-programme steps



8.4 Scoring

The scoring of the photographic tasks for evaluating the effectiveness of the training scheme was done differently for the recognition and the construction tasks. The performance of the experimental group was compared with that of the control group to find out if the former gained from the training programme.

For reasons of absenteeism or illness 4 each of the subjects in the experimental and control groups could not complete all the 3 evaluation test sessions. Their responses were subsequently excluded from the final data on which the statistical assessments were based.

The maximum possible score attainable on each of the recognition tasks was 2. This represented a combined score of the correct perception of a road crossing site as either safe or dangerous (scored (1) for correct and (0) for wrong responses); and the advancement of correct explanation for the identification (scored (1) relevant explanation and (0) irrelevant explanation). A child who was earlier unable to achieve this score but subsequently obtained it when a comparison was made between both pre-training (P.T.) and the first post training (F.P.T.) tests; and between P.T. and second post training (S.P.T.) was observed as having improved upon his or her performance in each case. This data was analysed to assess whether the experimental group's improvement scores (comparing both P.T. and F.P.T; and P.T. and S.P.T.) were significantly better than those of the control group.

The maximum possible score a child could attain on each of the construction tasks was 8. This consisted of a combination of child's score for the constructed safe route (scored on a 4-point scale of very unsafe (1) to very safe (4)), and the explanation given for it (also scored on a 4-point scale of irrelevant explanation (1) to relevant explanation (1)).

For the purposes of statistical assessment the difference between a child's score on P.T. and F.P.T. for each road crossing situation was calculated. These served as improvement scores for the child. Similarly, the difference in each child's scores on P.T. and S.P.T. for the individual road crossing situations was extracted and was used as an improvement score between the two testing sessions.

The improvement scores for the children on both the P.T. and F.P.T., and the P.T. and S.P.T. comparisons were each subjected to statistical analysis to find out whether the experimental group improved significantly better than the control group.

The determination of a good and bad answer was carried out for the perceived safe and dangerous road crossing sites and the explanations given for them (recognition tasks); and the selected safe routes and the explanations advanced for the constructed safe routes (construction tasks) with the assistance of a team of 4 road safety officers. They evaluated the task-situations individually for both the recognition and construction tasks before they all met to collate their evaluations. Only assessments which attracted universal agreement amongst the 4 road safety officers were included in the final pool for scoring the children's responses (see also 3.3; Chapter 3).

8.5 Results

The limited nature of the data required that we combined the responses of the 5 and 7 year-olds in the experimental group, and compared it with the combined scores of the 5 and 7 year-olds in the control group. This arrangement was maintained for both the recognition and the construction tasks. Overall, also, the 5 and 7 year-olds in the experimental group had comparable results, and so were the responses of the 5 and 7 year-olds in the control group. This ensured that the combined scores for the two age groups in the experimental and the control groups were not likely to lead to the attenuation of any age differences which would have emerged in the results.

8.5.1 Recognition task

8.5.1.1 Recognition of dangerous sites to cross the road

Table 8.1 shows the number of children who improved or did not improve upon their performance between the baseline scores and the first and second post-training tests respectively on the identification of dangerous sites to cross the road. The fragmentary nature of the data (see Table 8.1) required that we used non-parametric test - chi-square - for analysing it.

At the junction the trained group improved significantly more than the control group, and this was the same for the comparison between P.T. and F.P.T., and between P.T. and S.P.T. ($X^2(1) = 4.29, p<0.05$). At the bend significant gains in improvement of the experimental group over the control group was recorded on the comparison between P.T. and F.P.T. ($X^2(1) = 4.29, p<0.05$) but not on P.T. and S.P.T. ($X^2(1) = 3.28, p=0.06$, n.s.). With the dangerous road crossing situation featuring crossing from beside a large truck the children who were trained improved on both the P.T. and F.P.T. ($X^2(1) = 4.67, p<0.05$) and P.T. and S.P.T. ($X^2(1) = 4.79, p<0.05$) comparisons than the control group. The number of children who improved upon their performance on the road crossing site involving crossing from beside a large truck was better for the experimental

Table 8.1: Number of children improving or not improving their performance on the recognition of dangerous sites to cross the road between the pre-training; and the first post-training test (F.P.T.), and the second post-training test (S.P.T.)

	Control group								Experimental group							
Age (Years)	5				7				5				7			
	Improved FPT	SPT	Not Improved FPT	SPT	Improved FPT	SPT	Not Improved FPT	SPT	Improved FPT	SPT	Not Improved FPT	SPT	Improved FPT	SPT	Not Improved FPT	SPT
Junction	1	0	13	14	3	4	11	10	4	3	10	11	8	9	6	5
Bend	1	0	13	14	3	4	11	10	4	3	10	11	8	8	6	6
Large Truck	3	2	11	12	5	5	9	9	7	7	7	7	9	8	5	6
Kiosk	1	0	13	14	4	3	10	11	7	6	7	8	7	9	7	5
	6	2	50	54	15	16	41	40	22	19	34	37	32	34	24	22

than the control group when P.T. was compared with F.P.T. ($X^2(1) = 5.1, p<0.05$) and P.T. and S.P.T. ($X^2(1) = 9.91, p<0.005$).

8.5.1.2 Recognition of dangerous locations to cross the road - an assessment of explanations

The children's comprehension of the training scheme was further reinforced by the observed improvements in the underlying reasons given to justify their answers. There was a marked improvement of the trained group over the control when P.T. was compared with F.P.T. and S.P.T. (see Figures 8.5 (a-d)) for the identification of dangerous sites by which to cross the road.

An example of the 'appropriate' reasoning was given by Diane, for the dangerous road crossing location featuring the bend.

Diane (Age: 5 years 6 months)

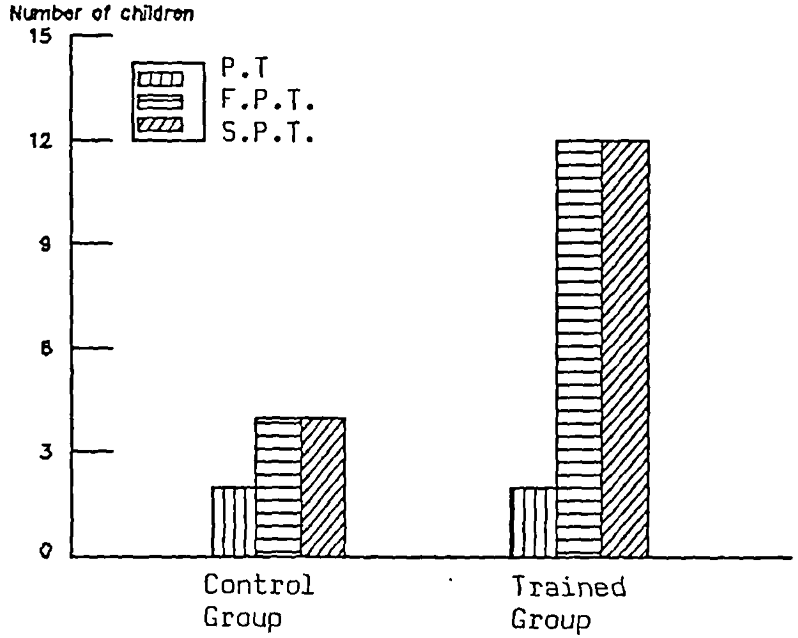
Not Safe: Because there is a corner and a car may be coming round which he cannot see.

The gains in enrichment of the explanations approximated those given by 9 and 11 year-olds (see appendix 2). This enhancement in the justifications was also achieved by some of the 5 year-olds. Overall, therefore, there was a shift from fixation on cars to reasoning which incorporated other salient features in the road traffic situation in the trained group.

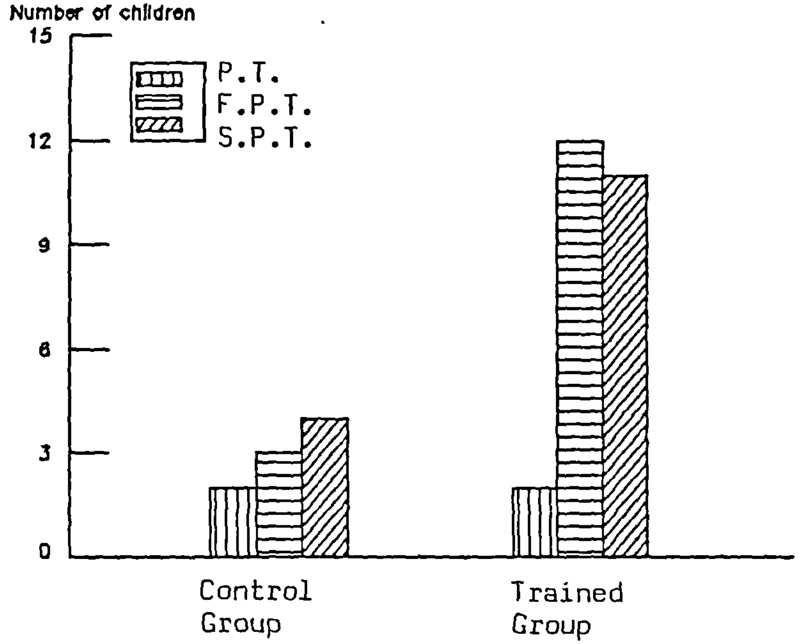
8.5.1.3 Identification of safe locations to cross the road

The determination of safe sites by which to cross the road did not indicate any significant variations when the no-training and the trained group were compared across the three testing sessions (P.T., Figures 8.5 (a - d). Numbers of children in the trained and control groups who based on the significant road featural characteristics in the road crossing situations to perceive danger when P.T. was compared with F.P.T. and S.P.T.

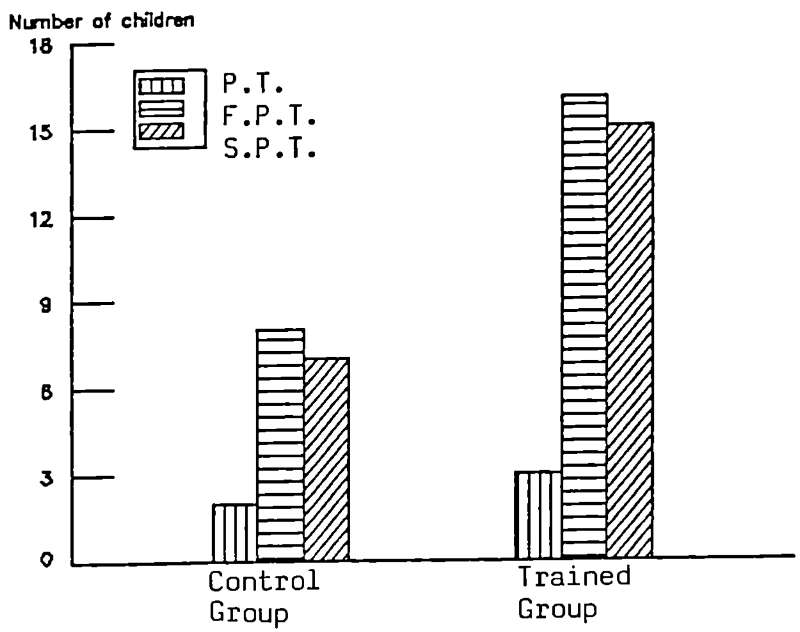
a : Standing at a junction



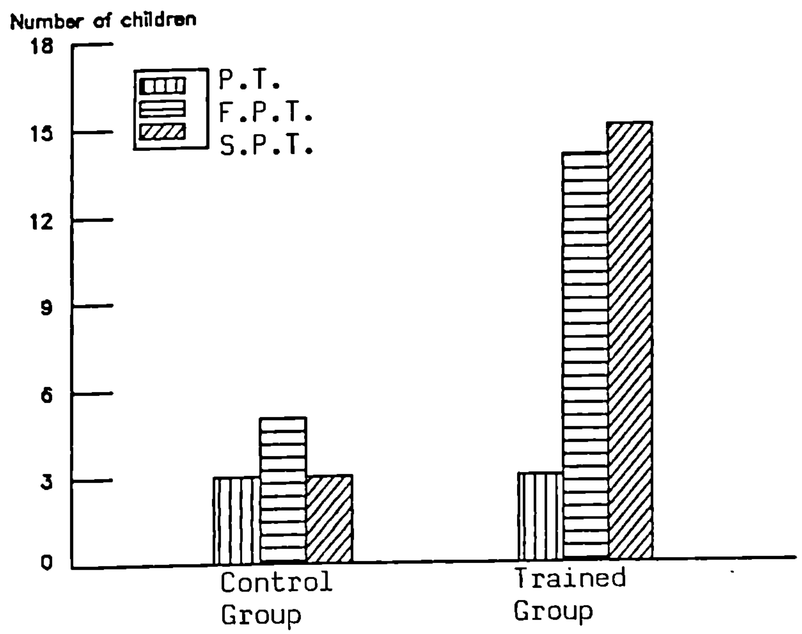
b : Standing at a bend



c : Standing close to a large truck



d : Standing close to a large kiosk



F.P.T., and S.P.T. The data on this was therefore considered not worth reporting.

An assessment of the explanations behind the selected safe sites, however, revealed significant gains by the experimental over the control group across the two post-training tests. These were plotted graphically for the four road crossing situations (see Figure 8.6 (a-d). From the figures it is clear that the experimental group after the training became more aware of relevant road features essential for identifying safe sites from where one can cross the road.

A typical explanation showing the appropriate road sense was given by Tracey, for the safe road crossing situation featuring standing away from a large refuse box.

Tracey (age: 7 years 6 months)

Safe: Because there are no cars coming, and he can see the roads, because he is not standing beside anything.

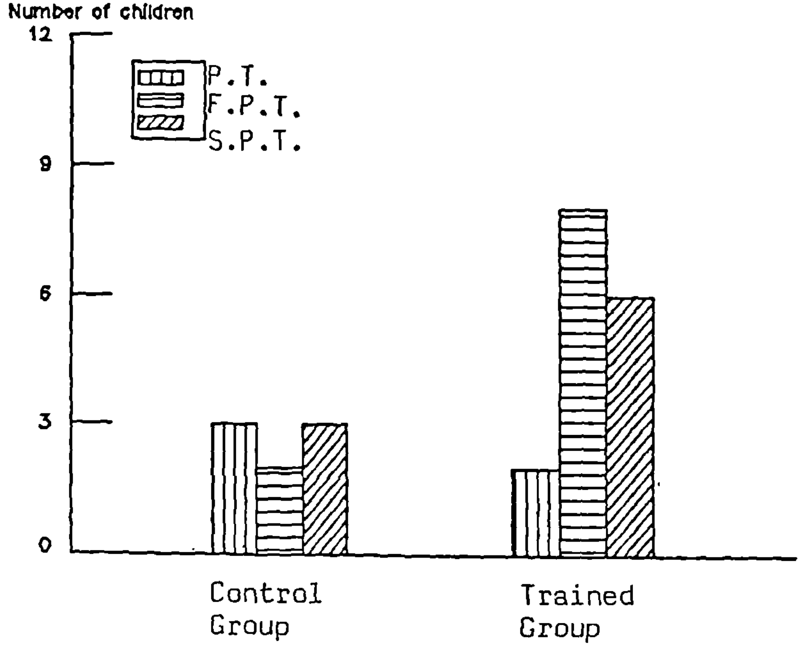
These responses advanced by the experimental group after the training were comparable to those achieved by the 9 and especially the 11 year-olds in the earlier experiments (see appendix 1).

8.5.1.4 Conclusion - children's explanations given for their responses to the recognition and task.

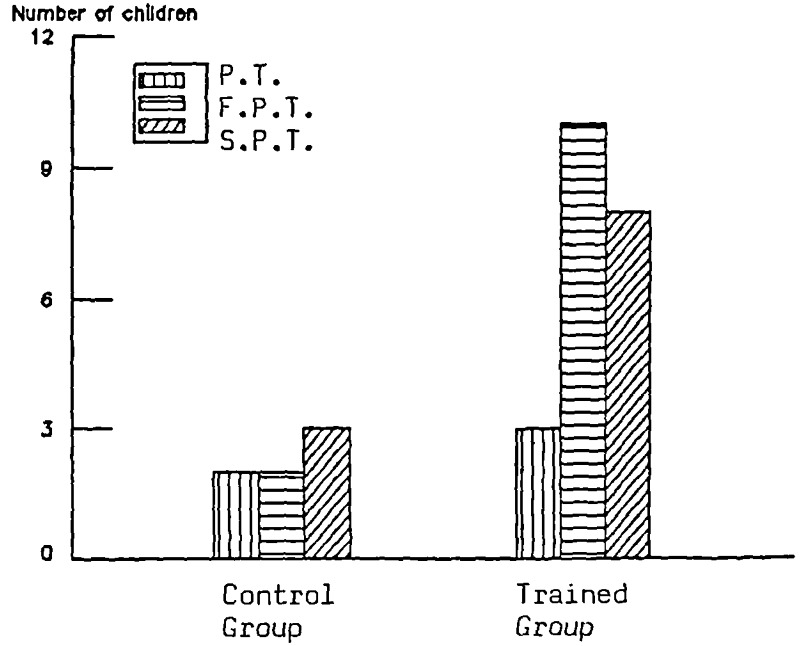
From the evidence we have been considering, it is clear that the experimental group's explanations under both the safe and dangerous tasks improved significantly after the training. The control group, however, maintained the same limited verbalisations

Figures 8.6 (a - d). Numbers of children in the trained and control groups who based on the relevant landmarks in the road crossing locations to estimate safety when P.T. was compared with F.P.T. and S.P.T.

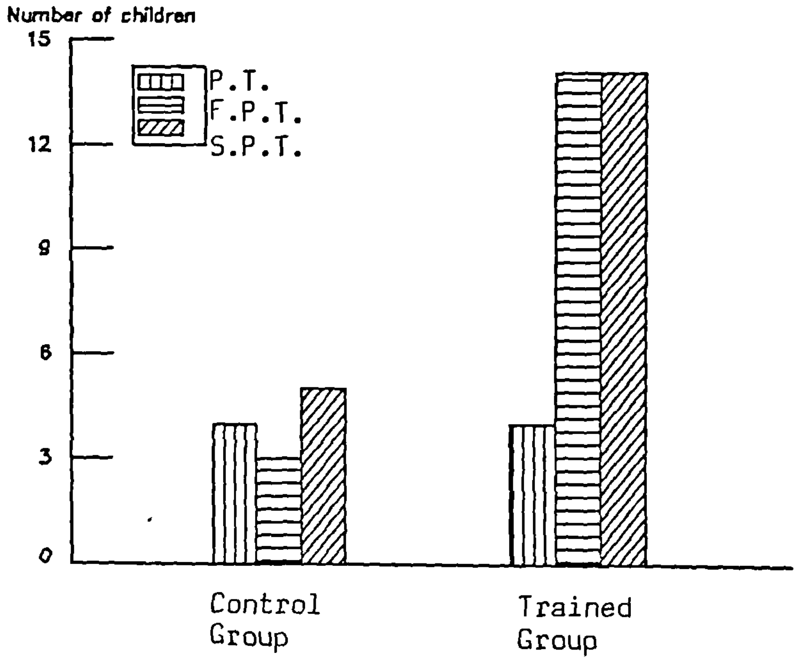
a : Standing away from a junction



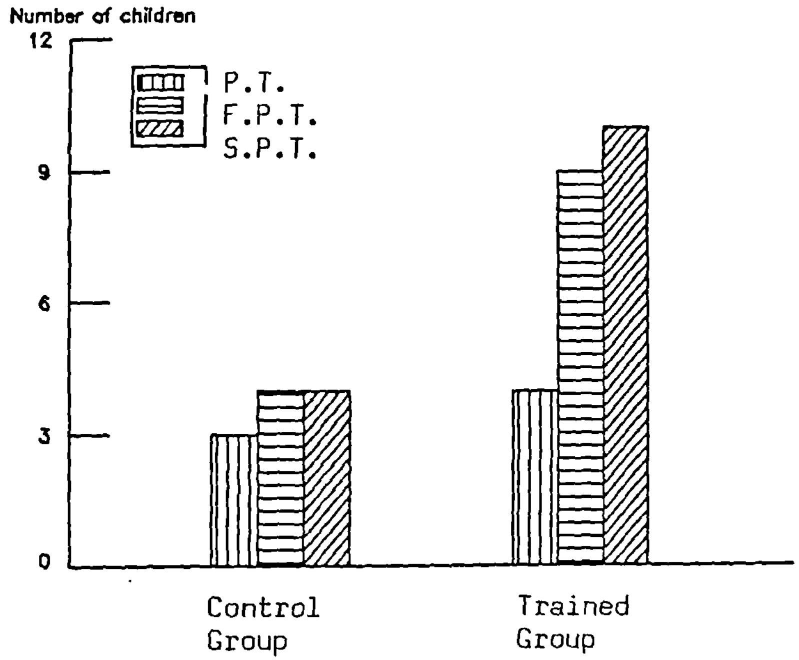
b : Standing away from a bend



c : Standing away from a parked car



d : Standing away from a large box



across the three testing sessions. The fact that the 5 and 7 year-olds' explanations were far more fluent following the training, also indicated that young children are not unduly handicapped verbally when responding to task-situations involving the perception of safety and danger on the road (see Experiments 1, 2, 3 and 4). On the contrary, it seems likely that the simple explanations given in earlier experiments show that children in such situations advance explanations they conceive to be 'adequate' for perceiving safety and danger on the road.

8.5.2 Construction task

8.5.2.1 Comparing the improvement scores between P.T. and F.P.T. on the construction task

Improvement scores for the constructed safe routes between P.T. and F.P.T. were computed for each child in the range of -8 to 8 for each road crossing situation (see also 8.4 - Scoring). These results were subjected to a three-way analysis of variance (ANOVA). Table 8.2 gives the mean improvement score for each age group under each crossing location. The three-way ANOVA involved 2 (age: 5 and 7 year-olds) x 2 (training: control and trained groups) x 4 (road crossing site: bend, junction, parked car and refuse box) with repeated measures on road crossing sites. Age and training were between subject variables and road crossing situations were within subject variables. This showed a significant effect of age ($F(1,223) = 9.69, p<0.01$) and a significant difference between the control and trained groups ($F(1,223) = 70.04, p<0.001$) with means of (0.65) for the control and (2.90) for the experimental group. This indicated a superior performance by the trained over the control group.

There was also a significant differential effect of the road crossing situations on the improvement scores ($F(3,223) = 9.30, p<0.001$), indicating more constructed safe routes from the parked car and refuse box than the bend and junction (see Table 8.2)

Table 8.2: Mean differences between improvement scores for P.T. and F.P.T. for the different road crossing situations.

	Control				Trained			
Age (Years)	Bend	Junc-tion	Parked car	Refuse box	Bend	Junc-tion	Parked car	Refuse box
5	0.5	0.5	0.79	0.29	2.0	2.0	3.14	2.79
7	1.21	0.57	1.14	1.21	2.93	2.71	4.21	4.86

P.T. - Pre-training test. F.P.T. - First post-training test.

There was also a significant interaction between training and road crossing locations ($F(3,223) = 5.85, p<0.01$). There was, however, no statistically significant interaction between age and road crossing situations; or age, training and road crossing situations.

8.5.2.2 Comparing the improvement scores between P.T. and S.P.T. on the construction task

Improvement scores between P.T. and S.P.T. were also subjected to statistical assessment. The overall improvement score a child could achieve under each road crossing location was in the range of

-8 to 8 (see also 8.4 - scoring). Table 8.3 separates out the mean improvement scores for each age group. A 2 (age: 5 and 7 year-olds) x 2 (training: control and trained groups) x 4 (road crossing site: bend, junction, parked car and refuse box) ANOVA with repeated measures on the last factor was calculated based on this data.

There was a marginally significant effect of age ($F(1,223) = 5.13, p<0.05$). There was a highly significant main effect of training ($F(1,223) = 55.48, p<0.001$) with mean improvements of 2.90 (for trained) and 0.65 (for control) showing a superior improvement between P.T. and S.P.T. by the trained over the control group.

Table 8.3: Mean differences between improvement scores for P.T. and S.P.T. for the different road crossing situations.

	Control				Trained			
Age (Years)	Bend	Junction	Parked car	Refuse box	Bend	Junction	Parked car	Refuse box
5	0.5	0.36	0.36	0.5	2.36	2.07	2.86	2.43
7	0.93	0.5	1.21	0.86	2.57	3.14	3.71	4.07

P.T. = Pre-training test. S.P.T. = Second post-training test.

There was also a significant effect of road crossing locations on the improvements in the chosen safe routes by which to cross the road ($F(3,223) = 4.06, p<0.01$) with the parked car and refuse box permitting slightly more safe routes than the bend and junction (see Table 8.3). There were, however, no interactions of age and road crossing locations; training and road crossing locations; and age, training and road crossing locations.

8.5.2.3 Explanations given for the chosen safe routes on the construction task.

The reasoning behind the children's choice of safest route by which to cross the road was qualitatively assessed. Overall, these explanations showed that the children in the experimental group advanced more cogent reasoning that ensured the safe use of the roads than the control group. They, for example, achieved a substantial number of 'category 3' responses (see appendix 3 for examples of such explanations) than the control group.

The number of children in the trained group who attained the highest level of justification over the control group when P.T. was compared with both F.P.T. and S.P.T. was also substantial (see Figures 8.7 (a-d)). This highest level of explanation classified as a 'category 4' response involves taking into consideration relevant road landmarks which are crucial for the selection of safe routes to cross the road (see also 3.3; Chapter 3). This observation was also encouraging because it demonstrated unequivocally the experimental group's grasp of the rudiments of the training. More importantly also, these highest level justifications advanced by the experimental group after the training, were comparable to those given by the 9 and 11 year-olds in our previous experiments (see appendix 3). An example of such high level of reasoning was the one given by David for the construction task featuring the junction.

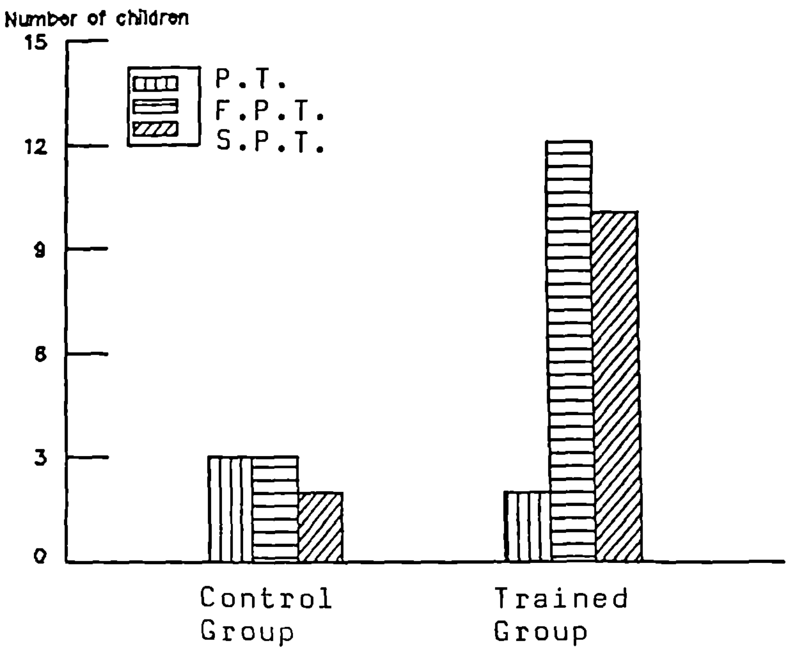
David (age: 7 years 4 months)

Score of 4

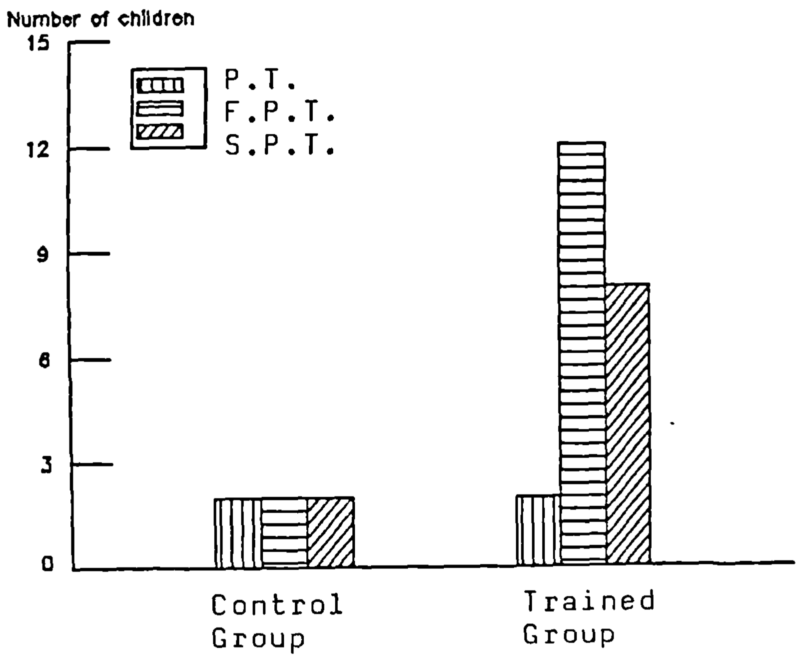
It is the best way. There is no car coming.
It is away from the corners and there is
nothing blocking his view.

Figures 8.7 (a - d). Numbers of children in the trained and control groups who gave explanations which took into account the relevant road features in the road crossing sites to construct the safe routes when P.T. was compared with F.P.T. and S.P.T.

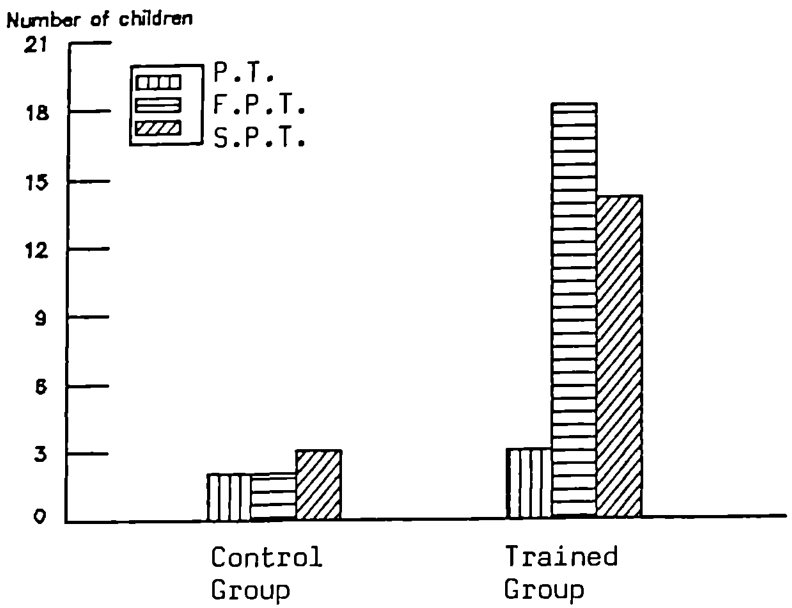
a : Crossing the road from a bend



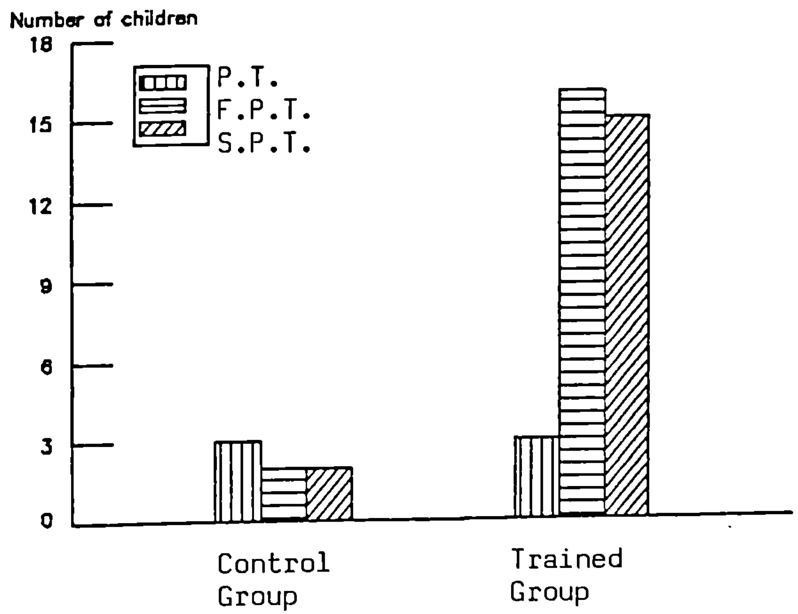
b : Crossing the road from a junction



c : Crossing the road close to a parked car



d : Crossing the road close to a refuse box



8.6 DISCUSSION

Observing the pairs of children completing the training routines complementing each others efforts was interesting and encouraging. They totally enjoyed themselves and they gave it their hundred percent effort and attention. This high degree of attentiveness and interest shown by the children must have been caused by several important factors built into the training scheme. These were;

- the 'game-like' approach to road safety training we adopted,
- clarity of the training instructions
- the verbal reinforcements for the reproduction of the correct training procedures
- the correction of incorrect responses through explicit display of the correct responses, and
- the administration of training rewards of road safety, pens, rules, stickers and badges.

All the above points are recommended for future road safety training involving children.

Our training steps, above everything else, also presented to the children something they normally do themselves when crossing the road. And this might have subtly aided them to exhibit such a high level of understanding of the training procedure. This was particularly observed through the care with which the children held onto the doll making sure it 'obeyed' all the training rudiments. They also showed clearly their great concern to see the doll-pedestrian safe to its destination. They 'stopped the doll on the pavement near the road crossing situation. They made sure it remained on the pavement as they 'walked' it away from the road feature to a site where it had a good view of all the roads. And, in finally taking it across the road, they made sure it 'obeyed' all the training routines essential for a safe road crossing. The children did this in a manner almost as if they were involved in the road crossing themselves. And why not!, since for the first time they were in a situation where they could display their traffic sense in a realistic way without any fear of being knocked down by a car. This success was achieved even by the 5 year-olds who did not differ significantly from the 7 year-olds on the F.P.T. and S.P.T. This was an interesting result, in as much as it showed that if children find road safety training interesting and practicable, then they are well able to follow the training instructions and procedures.

The keeness the children exhibited might have also been facilitated by the small group approach we used. The children enjoyed the challenge of learning in the presence of a peer. This must have been due to their being made aware prior to the training-proper that it was not a test to get them sufficiently relaxed.

The small group approach also had an advantage over the conventional mode of road safety training, which normally involved teaching a whole class of children. In such a case, it is normally impossible to identify individual children who are not understanding and give them extra clarification. Our involvement of only pairs of children, made it easier to detect and help children who were not benefiting from the training. This has support in Preston's (1980a) assertion that weaknesses in the road safety training was one of the possible reasons for the ineffectiveness of the Green Cross Code. She documented that it was very easy, for example, for a road safety officer talking to a class of children to feel satisfied with the results without knowing if he is failing to make some important point clear. This unfortunate situation exists because 'the brighter, livelier children will respond and show interest. But this, especially in teaching something as important as road safety, is not sufficient. The message must reach every child, even, and perhaps especially, the child who seems a bit dim, and slightly deaf from chronic catarrh' (p.3). There is, therefore, a need for a shift from this traditional whole class approach to a small group approach.

The evaluation tasks for our training, though involving a set of carefully taken photographs were still anticipated to pose difficulties to the children in a rather important psychological way. For one thing, it involved the children having to make a transition from the table-top model, a three-dimensional display, to the two-dimensional photographs. Our insistence in using the photographs was, however, influenced by our earlier success with photographic tasks in Experiment 2 (see Chapter 5). And the fact that the children could transfer to a considerable extent what was taught them by means of the table-top model to the photographic tasks, also confirmed their understanding of the training processes.

In emphasising the ease with which the children understood and enjoyed the training, however, we are not detracting from the original aim of our training. It was in all totality an exploratory one designed to assess the training potential of the table-top model and our principles for the training. In this exploratory role we were 'somehow' successful. We, however, did not, for example, assess whether the trained children will show the same gains in the actual road traffic situation. This is recommended for a future study.

The road crossing situations also had differential effect on the trained group's rate of improvement. For example, the trained group exhibited more gains in improvement at parked car and the refuse box, but not at the junction and bend on the construction task. The 5 year-olds also improved better at the road crossing sites of a large truck and close to a large kiosk than at the bend on junction on the recognition task. The 7 year-olds, however, achieved the same degree of improvement across all the road crossing situations in the recognition task. The lack of equal success at the bend and the junction might have been caused by either the time-span, the degree of abstractness in them or a combination of the two. Perhaps, it was indeed too much to expect significant changes across all the four road crossing situations in a training programme lasting for only two weeks. We were, however, initially optimistic that the children would cope well, since the basic training processes were comparable across all the road crossing situations. So, perhaps this optimism was inadequate, and the task of remembering the salient points in all these four crossing situations was a load too heavy for the memory of the children. They therefore failed to 'recall' equally well at the bend and junction. An extended training period is therefore needed to evaluate this. A training covering a long period of time is, however, bound to pose problems and must be tackled with care. It can be disruptive of school work, for example, if not carefully incorporated in the normal school routine. Will this be possible? A research to find an answer to this, is therefore required to help structure children's road safety education in schools (see also general discussion section).

Alternatively, the training scheme may have failed to chalk the anticipated success at the bend and junction because of their complexities. The bend and junction are abstract compared to the more concrete parked cars and hedge which were also training situations. The children consequently gained more on the crossing situations of large truck and close to a kiosk (for the dangerous recognition task) and the parked car and refuse box (for the construction task) than the bend and junction. While the bend and junction, therefore needed a high level of 'induction to concretise' the large truck, the kiosk, the parked car and the refuse box did not. We are still hopeful, however, that an extended training programme devoting extra time and emphasis to the bend and the junction may eventually achieve the desired objectives.

Even with the bend and junction the experimental group were still statistically better in their improvements than the control group.

In a way also, our findings may further explain why cars, a more 'real thing' served as the major referent for the 5 and 7 year-olds in estimating safety and danger on the roads. Clearly we see a linkage here, between our earlier results for Experiments 1, 2, 3, 4 and our training results.

CHAPTER 9

GENERAL DISCUSSION

9.1 PREAMBLE TO GENERAL DISCUSSION

The difficulties involved in pedestrian research were clearly highlighted by Reading (1973) in his statement that 'somewhere, in the maze of concrete and asphalt, the pedestrian is becoming a lost and forgotten man. The neglect does not stem from ignorance of a problem, but from its complexity. Engineered protection and control of the pedestrian is a difficult procedure due to the pedestrian's complete mobility and ingenuity. Vehicles lend themselves well to channelization and control because of the physical limitations to their movement. Not so the pedestrian! His desired lines of travel carry him into conflict zones with vehicles at many locations. Physical barriers, separating vehicular and pedestrian traffic, only seem to challenge the intellect and cunning of the pedestrian until paths around, under, over or through the barriers are found' (p.14).

The above assertion of Reading is significant to our present findings in several ways. It therefore provided a useful framework within which major aspects of our present results were assessed. Reading's observation made more than a decade ago and concerning pedestrian behaviour in the Salt Lake City, Utah, in the United States, is unfortunately the case in most countries to-day. The 'ingenious' pedestrian will indeed avoid using a pedestrian facility if only to shorten the distance he will want to cover to his destination. The disturbing factor is also the realisation that these 'so-called' safe pedestrian crossing locations may not be available in critical zones where auto-pedestrian accidents tend to congregate. With the child pedestrian the most involved in auto-pedestrian collisions this appears to be the case (see also pages 40-44) And, it was indeed the observation that pedestrian facilities and also countermeasures (and especially the Green Cross Code) may both not be covering all the critical zones where 'knowledge' is required for the safe use of the roads by children which formed the central theme of the thesis.

The above observed problems, among other things, were found to exist because of deficiencies in the compilation of accident statistics, which subsequently failed to delineate critical areas for child pedestrian research. This worrying observation can equally be blamed on the whole nature of child-pedestrian research, and especially in the area of perception of danger.

The general discussion therefore offered both broad and specific suggestions spanning a wide spectrum of relevant but neglected factors which are needed to direct child pedestrian research. These findings which we now discuss came out of the preceding experiments.

9.2 Recognition of safe and dangerous sites to cross the road

The major findings of the foregoing experiments, concerning the recognition tasks were as follows:

(1) Children aged 5 and 7 years relied on the presence of cars on the roads to determine dangerous road crossing sites. Corollarily, they also relied on the absence of cars on the roads to judge safe road crossing locations. They were overall unaware of other significant road environmental features which are equally essential for the determination of safety and danger on the roads. Using this 'simple-rule' of the presence and absence of cars on the roads, they failed to detect that crossing the road from sites where vision may be obstructed by obstacles, and at locations where one had to contend with cars coming from so many directions could be

potentially dangerous even without cars on the roads. Indeed, in many cases, the road-situation may be most dangerous when no cars are visible on the roads (for example, sharp bends, brows of hills, etc.). This seems to have completely escaped the notice of the Green Cross Code (see also 2.4; Chapter 2).

(2) The 9, and especially the 11 year-olds, however, relied on cars and also other relevant road environmental features such as obstacles (parked cars and hedges) occluding vision, road markings (including give-ways and dead-ends), intersecting roads and bends to perceive safe and dangerous sites by which to cross the road.

(3) There was no evidence to support the view that the higher pedestrian accident rates of boys than girls may be due to the boys inability to identify safe and dangerous crossing sites and routes at the same level of efficiency as the girls.

(4) With the exception of the zebra crossing which afforded a good recognition both as safe and as a dangerous crossing site across the 4 age groups tested, there were vagaries in the effect of the bend, junction and parked cars on the results (see 9.5 on the effect of road environmental features for detailed assessment).

The above findings regarding the 5 and 7 year-olds are supportive of Sandels (1975) conclusion that children appear to fixate on elements within the traffic environment as a whole and hence tend to perceive discrete and independent events, and also Rothengatter's (1984) statement 'specific errors in a number of well-defined situations contribute to the majority of traffic accidents involving children' (p.147). Such 'inadequate' notions of safety and danger may also partially explain why a 10 year-old child performs on average about 3 times as many street crossings a day as a 5 year-old;

nonetheless the total accident rate of 10 year-olds is about half that of 5 year-olds (Howarth, Routledge and Repetto-Wright, 1974).

9.3 Construction of safe routes by which to cross the road

The general pattern of the results under the construction task was overall a replica of what was obtained under the recognition task. The 5 and 7 year-olds were significantly inferior to the 9 and 11 year-olds in their choice of safe routes to cross the road. Again, the 5 and 7 year-olds were observed to be bad at this because of their tendency to use the presence and absence of cars on the roads to perceive the safest route by which to cross the road. They also tended to select the shortest and most direct route as the safest, particularly so when there were no cars visible on the roads.

The 9 and 11 year-olds relied additionally on relevant road environmental features in deciding where it was safe to walk across the road. They were also more inclined to choose longer routes, often to avoid obstacles blocking vision, intersecting roads and bends.

No significant sex effect was observed. Again, it was difficult to earmark clearly the effect of the road environmental features on the constructed routes. The zebra crossing, however, overall was perceived as affording the children more safe road crossing routes (see also 9.5 on the effect of road environmental features).

Under both the recognition and construction tasks all the 4 age groups understood and found interesting the principles involved in completing the tasks on the table-top model of road traffic situations (see 9.6 on methodological issues for detailed analyses).

The constructional tasks results also have significance in forging an interface between educational and engineering measures to prevent or reduce child pedestrian accidents. Such a lead has been provided by O'Connor (1986) who is attempting a minimisation of 'conflict between vehicles, pedestrians and cyclists, by creating safer routes by which children can travel to and from school' (p.4). His measures additionally, 'seeks to develop an effective tangible approach to child road casualties, supplementing the work of educationalists by concentrating on low cost engineering schemes which are already available in Britain' (p.4). The scheme is still in its planning stages and it is yet to be made operative. We, by our present results are, however, of the conviction that such schemes can only be successful if they incorporate the exact nature of children's notions about 'safer routes' in their design. Getting at such notions, can only be achieved in rigorous experimental studies similar to what we employed here. Our suggestion gains support in an OECD (1970) report which concluded that every measure aiming at an improvement of the adaptation between pedestrians and vehicle traffic must be preceded by a thorough knowledge of the causes of lack of adaptation which can only be gained through the study of the subject - the behaviour of the pedestrian.

9.4 The Green Cross Code and other road safety educational countermeasures

The results have implications for the formulation of road safety educational countermeasures and more importantly the Green Cross Code. The Green Cross Code does not instruct the child in detail on how to select a safe site and route to cross the road. Children aged 5 and 7 years (the peak age of pedestrian accidents, Van der Molen, 1981) are also not good at this themselves. These must be seen as shortcomings of the code. These observed limitations could be due to the child not remembering the injunctions of the code, the teaching being faulty or the code itself being too complicated for the children to understand (England, 1976; Preston, 1980). Whatever the reason, and which was not obvious from the present results, we suggest that children in the 5-7 year age group need extra and careful teaching in other critical areas neglected by the code. This becomes even more important when one considers our view that they do not possess the 'requisite skill' or 'know how' for the selection of safe sites and routes by which to cross the road.

The importance of the choice of a safe site and route to cross the road, is also, unfortunately, not seen as priority areas by those in charge of children's road safety education. Parents, teachers, road safety officers and the police asked to indicate which three most important rules children should be taught about road crossing, stated stopping, looking and listening in the Green Cross Code as the most important. They relegated the need to cross at a place where visibility was good and where there were no parked cars to a secondary level of importance (Foot, Chapman and Wade, 1982). The present research suggests that any future designing of road safety educational countermeasures for children should instruct them carefully on how to select safe crossing sites and routes. More importantly also, non-protected crossing sites in areas such as bends, junctions, hedges and parked cars should be emphasised, as they appear to be available on roads commonly used by children. This has support in Foot, Chapman and Wade's (1982) conclusion that 'perhaps if we are able to teach children anything, it should be at the very least to recognise those crossing situations in which, under no circumstances, should they attempt to cross the road unless in the custody of an adult or a sophisticated road user', (p.33).

Our evidence that there may be structural flaws within the Green Cross Code is further reinforced by the observational studies of Grayson (1975a) which found children as conforming more to the dictates of the Green Cross Code than adults. Yet, children in Britain still continue to top the list of pedestrian casualties (Road Accidents Great Britain, 1985). The code needs an overhaul through more studies reminiscent of what we employed here, to find out the reasons for its ineffectiveness.

The Department of Transport, the Scottish Development Department, the Welsh Office, the Department of the Environment (Northern Ireland) and the Central Office of Information (1980) have advised the reduction of the code to stop, look, listen, for children aged 5-6 years. Parents are instructed to teach their children these three main points of the Green Cross Code, since they concede that children aged 5-6 years are not able to manage all what the code says. It is, however, doubtful whether these 3 words can aid the children to negotiate the roads safely. And there is evidence from Fisk and Cliffe (1975) in a study involving 86 children aged between 5 years 5 months and 8 years 4 months to confirm this doubt. They observed that the concepts safe, near, all round, straight in relation to roads were devoid of meaning to children of infant school age. They suggested that these concepts need to be built up steadily before children can appreciate their meaning in the context of a line in the Green Cross Code. They also emphasised the need for the development of 'practical methods' for teaching the Green Cross Code to children (see also page 34). In this instance we believe our table-top model could prove particularly useful as it affords a practical and game-like approach to road safety training of children (see Chapter 8).

9.5 Effect of road environmental features on the responses to the recognition and construction tasks.

Determining the relative difficulty posed by the various road environmental features to the children was in most cases very difficult to ascertain. However, under the recognition of dangerous sites to cross the road in Experiment 1, it was established clearly that children aged 5 and 7 years could not perceive crossing in-between parked cars and close to hedges as potentially dangerous. This was mainly due to the 'immature' manner by which they determine safety and danger on the road. They did this by relying exclusively on the presence and absence of cars on the road. Overall also, the parked car and hedge was poorly perceived as a dangerous road crossing site than the junction, bend and zebra crossing in Experiment 1. Experiment 2 eliminated cars on the roads near all the task-situations for the identification of dangerous sites to cross the road with a view of making the road crossing situations as comparable as possible. More importantly also, it was to enhance the verbalisation of the 5 and 7 year-olds. The results showed the children as achieving better identifications at the parked car, hedge, junction and zebra crossing than at the bend. Again, Experiment 3 eliminated cars from the roads near all the dangerous recognition tasks, nonetheless the bend was once again poorly perceived as a dangerous road crossing site, than the parked car, hedge, junction and zebra crossing. Comparable results were, however, achieved under the parked car, junction, bend and obstructive obstacles in the real traffic study in Experiment 4.

From the above evidence it could be concluded tentatively that the bend, parked car and hedge pose the greatest difficulty to children in identifying dangerous road crossing sites. It should, however, be borne in mind that the effects of the road environmental features in such selections is greatly influenced by the age of the child. Children aged 5 and 7 years, for example, perceived wrongly any dangerous road crossing site as safe when there were no cars on the roads (see Experiments 1, 2, 3 and 4). This indicated clearly that they had minimal knowledge of important road landmarks and features and their role in the determination of dangerous road crossing sites. However, 9 and 11 year-olds demonstrated their awareness of other important road featural characteristics in such perceptions by using them as referents to arrive at their identifications.

No discernible road environmental features effect was, however, established in the results on the identification of safe sites to cross the road.

In the construction tasks it was initially impossible to offer reasons for the apparent difficulty the children, overall, had in selecting safe routes at the bend and junction to the same level of efficiency as the hedge and zebra crossing in Experiment 1. Perhaps, one can argue that the zebra crossing is a highly emphasised safe crossing place and hence the children's great success in constructing safe routes there. A study involving 612 children aged between 7 and 11 years confirmed this, when over 70 percent of 7 to 8 year-olds identified a zebra crossing from a photograph. This percentage even increased with the age groups of children studied (Firth, 1979). It is also equally reasonable to suppose that the observed results might have been due to the more complex features at the bend and junction, also reminiscent of the normal road traffic situation. The difficulty in isolating for study specific road features such as junctions and bends is further shown by how different countries perceive them as pedestrian crossing sites. Grayson (1981) has exemplified the different positions regarding crossing at junctions and near parked cars by children (see page 167).

Results from Experiment 2, however, compounded our interpretation of the vagaries in the environmental features effect advanced for Experiment 1. For in Experiment 2, the junction and the zebra crossing rather afforded the children more safe constructed routes. Again, the results for the zebra crossing was understandable but the good results at the hedge were difficult to explain. A post-hoc examination of the results under Experiment 2, however, helped establish an ancillary rule the 5 and 7 year-olds additionally used in choosing safe routes and this explained the differential findings. Aside of traffic it was found that the 5 and 7 year olds had the tendency to mostly select the shortest and most direct route as the safest. And since the scale-value for the shortest and most direct route were not the same across the construction tasks for Experiments 1 and 2, this appeared to have partially, accounted for the variances in the results. So, when these vagaries in the scale-values were controlled under Experiment 3, comparable results were obtained under the hedge, bend and parked cars, but the zebra crossing was still the best perceived.

The good performance at the junction than at the bend and near the obstructive obstacles in the real traffic study (Experiment 4) was also due to the fact that the junction had its shortest and most direct route as the safest (see Figures 7.5 (a-c); Chapter 7) this partially explained the better performance at the junction than the bend and obstructive obstacles.

9.6 Methodological issues

9.6.1 The two tasks of recognition and construction and other finer points of methodology.

The recognition task required a specific response from the children, a simple determination of a road crossing site as safe or dangerous and explaining why they thought so. The construction task on the other hand required a complex response mode from the children - a dual judgement of a safe crossing site and a subsequent determination of safe crossing routes (though the former was neither systematically assessed nor statistically analysed). Also, while in the recognition tasks the children 'passively' judged the locations as either safe or dangerous and justified it, the construction tasks required the children to be more active and also required the application of extensive road safety principles in constructing the safe routes. The fact that comparable underlying explanations were obtained for these two different task approaches, provided an internal validation for them.

What goes on in children's minds as they tackle items in a typical perception of safety and danger tasks must not be taken for granted. But unfortunately, researchers in the area have neglected conducting such an assessment (Sheehy and Chapman, 1985a; David *et al*., 1986a, b; Martin and Heimstra, 1973; Grieve and Williams, 1985). From our preceding experiments we suggest that such justifications must form an integral part of such researches and and more importantly as means of uncovering the underlying reasons behind children's responses. Without such analyses, for example, it would have been very difficult for us to get a genuine and realistic interpretation of our results.

In our experiments, we employed a number of strategies for the registration of the children's responses to the construction tasks. In the past, researchers have obtained such responses from children, by instructing them to record their responses on arbitrary scales they can hardly understand (see for example, Martin and Heimstra, 1973; Sheehy and Chapman, 1985a). Such a handicap will undoubtedly cast doubt on the results being reflective of the children's actual conceptualisations about safety and danger. In our Experiment 1, therefore, the children's responses to the construction task were recorded on the schematic drawing of the traffic mat (see Figure 3.2) by the Experimenter. Experiment 2 used different coloured lines to indicate the scales. All that was required from the children was the choice of which of the lines they considered represented the safest route. Experiment 3, used a combination of these two approaches. Experiments 4. called upon the children to point towards the direction they considered as safest route for them to cross the road between two specific points. These approaches were observed to have clearly circumvented any problems the children might have otherwise encountered in registering their responses, and are recommended for future researches.

9.6.2 The table-top model of road traffic situations - a critique.

No area of psychological investigation is likely to pose such a major problem of finding an appropriate methodology as a road safety research involving children. This problem exists because of the difficulty in carrying out the research in the actual road traffic environment (see page 27). Researchers have over the years, therefore,attempted the devise of alternate safer methods for children's road safety researches. This has led to a proliferation of methods, for example, questionnaire (Fisk and Cliffe, 1975), stories (Firth, 1975), video recordings and pictures (Antaki, et al., drawings (David, et al., 1986a, b), photographs (Martin and Heimstra, 1973; Grieve and Williams, 1985) and table-top models (Firth, 1973b) (see also pages 36-39 for a review).

The above methods all differ markedly from what confronts children in the actual traffic system. And the question usually posed is: how far do results from such 'caricatural methods' actually represent what the children will otherwise have given as answers if the research had been conducted in the real road traffic situation. Sheehy and Chapman (1984) affirmed this doubt when they criticised Sandels' (1975) laboratory experiments for their artificiality. David, et al., (1986a) have also cautioned that results from the laboratory only explain a fraction of what children's real road behaviour is. While we do accept without question that researchers want to uncover principles that apply in real-life setting as well as the laboratory, we, however, stress that researchers who discourage laboratory experiments because of their artificiality may be doing the art of research a great disservice (Perry and Bussey, 1984). As Bandura (1978) has observed, experiments should be judged not in terms of their physical resemblance to situations in real life, but on the extent to which they identify the important determinants and processes of change, and the explanatory and predictive power of their results.

Considering the above evidence we do concede that problems abound in the use of the table-top model in researches with children.

These problems are, however, not insurmountable, and can indeed be circumvented through careful experimental design. Are we therefore to discourage this line of research because of methodological pitfalls? The answer must be no. In this we are encouraged by Firth's (1980) conclusion that 'pedestrian research, although still a fairly new field in scientific terms, is now 30 years old but so far has not succeeded in answering the original question: pedestrian accidents are still a major accident problem. What do we know about them and what can be done? This is why 'still' was included rather than omitted. To draw an analogy with medicine, if accidents are thought of as a disease, we would all like to find the cure. Medicine, though, has often found clues to such problems by chance, far removed from the obvious line of research; or alternatively, maybe accidents cannot be reduced. Even if this were the case, the field of study is in itself worthwhile, if only to increase our knowledge of the world in which we live. It would therefore be a pity if this knowledge is limited because of methodological problems and misguided orientation' (p.353).

Most of these 'doubts' about the relative effectiveness of these road safety research methods probably exist because of a lack of proper care in their design and administration. We have shown by our present research strategies that such careful methodological design can be achieved. From our results, therefore, we challenge this notion of 'artificiality' which has often tended to 'cripple' the desire for innovative approaches in methodology in child-pedestrian research. We used the table-top model in a carefully designed series of interrelated studies. Each of these studies was to test out several critical factors which we conceived may be potential variables in posing problems for the children in understanding the processes involved in registering their responses. One of the experiments confirmed these findings in the 'real road' situation. Methodological approaches as employed in our present studies are what we need to test out the feasibility of most of these 'hastily condemned methods' in road safety researches with children.

Our table-top model also provided the evidence that if we are able to accurately measure children's limited views about safety and danger in the roadway then we will have to do it in controlled experiments where all pertinent variables could be effectively controlled and manipulated. This is also an area where the table-top model gains advantage over real traffic study. This point was clearly highlighted in our real road traffic studies where control over critical variables was difficult to achieve. What should, however, be borne in mind is the further enhancement of the ecological validity of our table-top model researches by designing them to involve settings, occasions, roles and activities which resemble the real traffic situations (see also Weisz, 1978; Cochran and Brassard, 1979). It is, also, not all types of child pedestrian behaviour that can be conveniently studied in the actual traffic and this calls for the use of other methods. An OECD (1970) report clearly made this distinction when it stated that to determine objective characteristics such as walking speeds, number of people, age, etc., it is necessary to observe actual traffic situations. While, to 'assess subjective factors (for example personal risk), the behaviour must be studied by creating an artificial experimental situation, although then there is the problem of transferability of such results to real situation' (page 11). But this problem of transferability as we have observed, could be solved through careful research designs.

Our table-top models were also carefully constructed and they provided a more comprehensive view of the real traffic situation than earlier ones. Boyle's (1973) table-top model included only a junction, Page, et al's., (1976) model consisted of intersections with or without model pedestrian and traffic lights, and Firth's (1973b) model included only a zebra crossing. Page, et al's., model also had another flaw, it drew or pasted the cardboard houses, cars, trees and people on the table-top model. Children have been observed to have comprehension problems with such drawings. And though this has not been systematically examined in the mentally handicapped population, it is highly probable that the constructional approach used by Page, et al., must have posed conceptual problems to their subjects and subsequently confounded their results.

Aside of the children's understanding and enjoyment of the tasks based on the table-top model already emphasised, it also had the potential as a training tool. In our exploratory training some measure of success was achieved with the model. The failure of the training scheme to achieve marked improvements in the children's conceptions about safe sites and routes by which to cross the road, was neither due to the children not cognitively understanding the training instructions, nor their finding the training activities uninteresting. On the contrary, it might have possibly been caused by the duration of the training (see page 198 for a detailed discussion). To achieve the desired training objectives future training of this type should shift from 'sporadic', to a sustained training over a long period of time. In doing this, there may be the need for the experimenter to do the initial training and later involve both teachers and parents as trainers, since they are with the children for most part of the day. It would be also desirable incorporating such training schemes into the school curriculum especially in the United Kingdom where a recent survey has 'established that nearly two-thirds of schools had no structured road safety teaching programme. Almost all (98 percent) had no guidelines for staff and only a few had a teacher designated as being responsible for road safety education' (Singh, 1986, p.1). Also, educating parents on what and how they ought to teach their children road safety is essential since 'the fact remains that many parents do not always know what or how to teach, no matter how seriously they take their responsibility for teaching their children pedestrian safety. They may not always appear to understand that a child's ability to appreciate training and put it to effective use varies with age, temperament and mental attitudes' (Singh, 1982, p.74).

What is needed now, is therefore an intensive research effort to assess the usability of the table-top model into conducting investigations into other aspects of children's road safety knowledge and behaviour. In attempting this, there may be the need for slight modifications of our table-top model to accommodate any variables not originally considered. For example, to permit an assessment of vehicular speed and distance and children's ability to discriminate between safe and dangerous locations and routes to cross the road, there may be the need to modify the model in a manner that will permit the movement of cars on the roads.

9.6.3 Piagetian formulations on spatial perceptual inference ability of children

Some researchers have expressed doubts about children's understanding of the mechanisms involved in registering their responses on the table-top model (Boyle, 1973; Rothengatter, 1981a, c). These doubts of comprehension usually emanate from the Piagetian formulations on the percept inference abilities of children. Boyle (1973) recognised such a need and actually stated that, at the outset of his research he had Piaget's views in mind. However, the nature of these views and their significance to his study were not explicit. Boyle, in his concluding comments also 'tentatively' pegged the lowest age limit when children were able to understand what was taught them by table-top models at 6½ years.

Our series of experiments, following from the above evidence was designed taking into consideration the conceptual difficulties children might encounter with them. Experiment 1 relied on familiarity of the materials used for building the table-top model, and also the completion of examples of the experimental tasks with the children prior to the study proper. Familiarity with task materials and clarity of experimental instructions have all been proved to enhance perceptual inference abilities in young children (Cox, 1980; Donaldson, 1978; Hughes and Donaldson, 1984; Borke, 1984).

Experiments 2 and 3 took the anticipated difficulties children might have with the tasks in a more controlled design. In both experiments, the experimental set-up was manipulated in such a way that the children enjoyed the same perspective as the doll-pedestrian. These arrangements were observed to have circumvented any spatial percept inference difficulties the children would have otherwise encountered with the tasks. The task arrangement employed by us has empirical support from Light and Nix (1983). Their research was inspired by the work of Kielgast (1971) and Liben and Belknap (1981).

Kielgast, for example, concluded that the children in the Piagetian three mountains task were most frequently tested in a position which enabled them to have a particularly good view of the array - one that minimised the occlusion of one object by another. The child's apparent preference for pictures showing his own view may therefore reflect only a preference for a good view of the array. Using this as a frame of reference Light and Nix (1983) conducted a study involving 40 children aged between 4 and 6 years with a mean age of 5.2 years on how their 'own view' versus 'good view' of an array affected their performance on a perspective-taking task. They found that the children did not show any bias toward their own view when it was a poor one. However, when they themselves had a good view of the objects, they chose their own rather than another equally good view. The children were therefore more inclined to select their own view and attribute it to the doll when they had a good view of the array than when they had a poor one. With both the child and the doll-pedestrian having the same good view in our tasks, all the perceptual inference problems the children would have possibly had with the tasks were eradicated in Experiments 2 and 3 (see also Chapters 5 and 6).

Experiment 4 required the children to assess the task-situations from their own point of view. There was therefore no anticipated difficulties in the registration of their responses. The fact that comparable underlying explanations were obtained under all these different methodological arrangements enabled us to conclude that the children did not have comprehension problems in the task in the manner posited by Piaget and Inhelder (1956).

Above everything else, the motives and intentions of the doll-pedestrian and task-situations used in our experiments were entirely comprehensible even to the 5 year-olds. Selecting safe sites and routes for the doll-pedestrian to cross the road, for example, were tasks which made human sense. They required the children to act in ways which were in accord with certain very basic human purposes and interactions and which have been observed to enhance spatial percept inference capabilities of children (Donaldson, 1978). The task-situations and processes employed by us, therefore, contrasted with the more mundane Piagetian 'mountains task' which is "abstract in a psychologically very important sense: in the sense that it is abstracted from all basic human purposes and feelings and endeavours" (Donaldson, 1978, p.24). The materials included in our table-top model, were also materials which provided easily discriminable cues to aid the children visualise the doll-pedestrian's perspective. Our set-up, therefore, provided more cues for young children to identify, remember and assist them in denoting the doll-pedestrian's perspective than the "essentially similar configurations such as Piaget and Inhelder's three mountains task" (Borke, 1984, p.258).

In conclusion the observed pattern of children's responses in the identification of safe and dangerous sites and routes to cross the road were not artefacts of the task situations and experimental arrangements employed by us. We remained convinced, therefore, that the children and even the 5 year-olds were not handicapped methodologically in the registration of their responses.

9.6.4 Perception of danger

The findings from our experiments are also important for research into the nature of young children's perception of danger. And indeed, the world is recognised to be full of home and outside-the-home dangers which threaten the life of people both old and young

(Lowrance, 1980). Young children are, however, at the greatest risk since they are not 'mature' enough to detect all such dangers. It becomes crucial therefore that for any young child to survive he should be made aware of the kinds of objects that are likely to be dangerous; things which move rapidly towards him, things that are hot (Vernon, 1962).

Strangely, however, this very important aspect of the child's survival had been little researched. Gibson (1964) was one of the first to call attention to this when he stated that: ....'the degree to which children of different ages do or do not identify the common dangers of their environment is almost unknown' (p.303). The need for more research into the way children understand danger in their environment becomes even more important if one considers the significant role people's inadequate assessment of environmental dangers play in the causation of accidents. Nelson (1972), for example, saw the avoidance of accidental injuries as involving the appreciation by people of the hazards of everyday activity and the awareness of human limitation. Mitchell(1972) also concluded that protection from environmental dangers is one of the prime needs of the young child who is at risk because of his inability to recognise the dangers and he is unable to cope with those that are unavoidable.

Children's inability to assess and evade potential dangers in their environment must therefore be seen as a contributory factor to their high accident rates. Adults appear to realise this since they normally keep very young children under constant supervision to avoid danger. With increasing age, however, children acquire greater mobility and independence. They explore the environment and play with objects within it. This high level of locomotion and curiosity makes direct and frequent adult supervision impossible to achieve. Unfortunately also, certain locations, objects and events in the environment are potentially dangerous, implying that children in the course of their activities will unavoidably come into contact with varying types of danger (Gibson, 1964; Grieve and Williams, 1985).

Acquisition of language and walking should therefore signify the start of a planned training scheme to instruct or train children to acquire skills to cope with dangers within their environment. Getting precise knowledge of the dangers children of different ages are exposed to in their environment should be the ideal starting point of such an education. Accident statistics should, for example, be analysed to obtain an accurate picture of the type of accidents which happen to children. Children's day to day activities in their environment should also be monitored to assess whether their high accident rates could be due to deficiencies in detection or inadequate interaction with dangers within their environment. These assessments will reveal what children do or do not know about dangers within their environment. This will in turn, indicate which areas education is required.

And, it was here that our present experiments proved useful. They provided the evidence that children possess 'some knowledge' about safety and danger, even if they were insufficient to guarantee maximum safety. These observations were important in directing child pedestrian research. Our evidence from the recognition tasks showed for example that 5 and 7 year-olds were particularly bad. They relied on the presence and absence of cars on the roads to determine safety and danger. They were consequently unaware of the danger in crossing the road from and across locations where vision was blocked by obstacles such as parked cars and hedges.

In the <u>construction tasks</u> also, it was additionally observed that the 5 and 7 year-olds, in the absence of cars on the roads, tended to choose the shortest and most direct route as the safest. In the selection of the safest route by which to cross the road, it makes human sense to choose the shortest and most direct route. It avoids the pedestrian going through a longer route which will have subsequently increased his exposure to danger; and additionally, his being made to contend with many conflicts from the likely flow of traffic from different directions. On the negative side, however, the shortest and most direct route in the roadway may not necessarily be the safest. It may be close to parked cars and hedges which will imply an obstruction of vision to permit an early detection of approaching cars for evasive action to be undertaken by the pedestrian. It may also be at a junction where aside of contending with so many intersecting roads there is the concomitant necessity of having to look right, left and right again and also behind to detect oncoming cars.

The findings reported above focussed on what children already knew, and what they did not know about specific aspects of danger in the traffic environment. This will undoubtedly make it easier to develop a training programme to train them to acquire the correct skills of discrimination. This has support in Grieve and Williams' (1985) research conclusion that if children 'can perceive some dangers then they are not wholly lacking in the concept of danger. Their relatively poor performance overall, would therefore appear due to their ignorance of dangers inherent in particular contexts, about which they need to be taught. This may not be so difficult as might be supposed, for they already possess an understanding of the concept of danger' (p.390). Such analyses of children's conceptions about safety and danger will indeed enable us to psychologically introduce training programmes suitable for the various age levels of the children and also assist parents in their training tasks (Schioldborg, 1979).

The observations we have been considering also underlie the need for a shift in emphasis from children are bad or heedless in traffic to finding out the exact nature of their strengths and weaknesses in traffic. It will also serve as cautionary guide for researchers to be critical of conclusions such as the one made by Sandels (1975) that below the age of approximately 10 years children do not possess the sensory and cognitive capabilities to deal with modern traffic.

Our results are also vital for driver training. They pointed out distinctly those areas of the traffic environment where the child pedestrian may be perceptually masked, and thus fail to meet drivers' expectations and attention (Brown, 1980). We suggest that these deficiencies in child-pedestrians road behaviour must be made known to drivers in training. This becomes even more important when we consider Brown's (1980) conclusion that the behaviour of young drivers and child pedestrians are mutually incompatible. And also, Howarth and Lightburns' (1980) conclusion after observational studies involving interactions between over 640 child pedestrians and drivers on the roads that, it is ironic that it is usually the child who is considered heedless and irresponsible whenever an accident occurs. They stressed further that the driver was the more likely to be the irresponsible one. They established that once a car and the pedestrian came on the collision course it was usually the child pedestrian who was likely to take some form of avoiding action such as stopping or accelerating out of the vehicles path (see also page 22). They additionally observed that no driver was seen to anticipate an accident with a child until it was almost too late to prevent it.

9.6.5 Compilation of accident statistics

The present investigations also indicate clearly that we must improve the gathering of data for accident statistics if only to help delineate areas where research are needed. Presently accident statistics mostly incorporate only absolute figures with why the accident happened not adequately covered. Our theme for our series of experiments was only made clear after conducting extra analyses of raw data for accident statistics. This involved looking for the underlying reasons for accidents from maps, charts and isolated citations in the literature for accidents. And it was only then that we were able to realise, for example, that child pedestrian accidents in the Strathclyde Region tended to congregate at 'unmanned areas' such as bends, junctions and beside obstacles especially parked cars. Data collecting tools for accident statistics should be expanded to cover not just spatial and physical context for accidents, but also recollections, reasons and expectations offered by victims and witnesses (Sheehy and Chapman, 1984). Detailed information about an accident can indeed be obtained from the accident victims themselves (see for example, Sheehy and Chapman, 1985b). In most cases, however, they only manage a distorted recall of what actually happened, especially when the person sustains serious injuries and mental shock. Information obtained from accident victims must therefore be collaborated with findings from an immediate observation of the scene of the accident. The immediacy in the observation is very important since it is likely that those involved may be tempted to, for example, change the position of cars to avoid prosecution; or the cars may be moved away to ease the flow of traffic to avoid another accident. Interviews with people who witnessed the accident must also be undertaken. These three measures; the accident victims account, assessment of the scene of the accident, and witnesses testimony can then be compared and contrasted to get an accurate picture of why and how the accident happened.

Pedestrian accident statistics should also detail out the locations with the highest concentration of accidents and why the trend exists. It should, for example, include a breakdown in the number of accidents occurring at specific road areas such as bends, junctions, close to hedges, beside parked cars, at the brow of hills, at zebra and pelican crossings. It must also include the age groups and sex of children having the greatest proportion of accidents at these sites. The frequency of accidents happening near such areas as schools, homes and city centres must also be recorded. As much as possible, precipitating factors such as, behaviour leading to the accident, as for example, playing on the street, running across the road, emerging on to the road in areas where vision was occluded by obstacles must be included in the statistics, again taking into account the age and sex of the victims.

It is only by recording accurately pedestrian accidents that researchers can obtain precise baseline measures to direct and also evaluate the validity and reliability of their research conclusions.

Internationally also, accident statistical comparisons are difficult because of different standards of reporting accidents in the various countries (see also page 13). This makes it difficult to reconcile causal factors in the occurrence of accidents worldwide. We suggest the standardisation in international recording of accidents are important if only to permit the pursuit of a unified international effort to halt the high incidence of child auto-pedestrian collisions.

9.6.6 Format for child pedestrian research

The organisation of the present experiments also provided an important model for child pedestrian research. We successfully employed the three measures of accident statistical reviews, methodological development involving the table-top model, and obtrusive observation of real traffic behaviour, on how children aged 5, 7, 9 and 11 year-olds discriminate between safe and dangerous crossing sites and routes, to cross the road.

The accident statistical survey was useful. It gave us an insight into which areas child pedestrian research was needed. The methodological assessment helped us to evaluate critical variables likely to hinder children's understanding of the tasks on the table-top model. Our experimental studies enabled us to examine the feasibility of the table-top model in researches with children. The table-top model was also not arbitrarily chosen. On the contrary, it was selected after a survey of the methods used in road safety researches with children. The obtrusive behavioural studies, also contributed in helping us establish whether the reasons the children gave on the table-top model, were exactly the ideas they possessed when they moved on the real roads. Without these three analyses it would have been difficult to get a clear direction for our experiments.

These three schemes should form the main format for further experiments to investigate the exact nature of young children's 'limited' views about safety and danger in traffic. At this stage, however, we are still in the dark as to whether the model will be a suitable guide for research into other aspects of children's traffic knowedge and behaviour. This line of research is therefore recommended. This will help establish our research approach as a permanent guide for child pedestrian researches. This we hope will help breakdown the complexities involved in auto-pedestrian accident research (Reading, 1973) and also assist in the provision of a solution to the high incidence of auto-pedestrian collisions.

9.7 Cross cultural studies

One area of research where cross-cultural comparisons have not been considered seriously is child pedestrian research. Efforts in this area have so far been limited to a comparison of trends in accident statistics of various countries and the making of deductive conclusions about how similar or different they were on variables such as age and sex (see for example, Older and Grayson, 1976; Foot, Chapman and Wade, 1982; Darlington, 1982). They only occasionally make reference to the underlying behaviour which might have resulted in the accidents. So far, however, it is still unknown how children of entirely different cultural backgrounds will react to typical perception of danger tasks of the road traffic situations. Perhaps, such studies will enable us draw worldwide inferences about what actually goes on in children's minds when they negotiate the roads.

A mention of third world countries also usually 'evokes a variety of responses such as acute shortages of food, currency problems, political instability, poor standards of living and unemployment levels far worse than Britain. With such a host of more pressing problems road accidents in the third world though not less traumatic than disease and national disasters, are not always thought of in the same context' (Darlington, 1982, p.7). Encouraging cross-cultural research therefore appears to offer the only positive way of drawing attention to the seriousness of pedestrian accidents in these other parts of the world.

9.8 General conclusion

In conclusion, we would like to emphasise that 'roads are one of the most precious assets that we have. From time immemorial roads have been the principal channel of communication for people, goods and ideas' (Leger, 1981, p.16). Roads, however, have their negative effect on people. The accidents which frequently occur on them result in serious injuries and death. And despite all the preventive measures which have been initiated, road accidents to children, for example, are still as tragically high as ever (Leger, 1981; Plomteux, 1981).

The good thing, however, is that the dismal performance of countermeasures can be improved if their design is preceded by carefully planned experiments. Such experiments must be 'directed in particular at the causes and circumstances of accidents which are a first requirement for an effective road safety policy'(Plomteux, 1981, p.33).

With young children this appears to be particularly crucial, and this receives support in Martin and Heimstra's (1973) conclusion that if countermeasures which require active participation by young children are to be designed effectively, then we need more information on children's ability to perceive and interprete risky or hazardous situations in their environment (see also 9.6.4). Moreover, such experiments are also important if one considers the assertion that of all the steps that can be taken to prevent road accidents, the education of young people should be seen as the foundation stone of a general road safety policy (Plomteux, 1981).

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APPENDICES

APPENDIX 1

Examples of the explanations to the recognition of safe road crossing places

1. Standing away from a parked car

An explanation making reference to road features

Sandra (age: 11 years 3 months).

"Safe. Because there's quite a long distance between him and both the parked car and the corner. He can therefore see if cars are coming."

A response, making no reference to road features

Dougie (age: 5 years 2 months).

"Safe. Because there are no cars coming."

2. Standing away from a hedge.

Explanations making reference to road features.

Mark (age: 11 years 2 months).

"Safe. Because there are no bushes near her and she can see what is coming. Cars have to stop at the corners too to give way because there's a main road in front of them. This gives her a better chance to cross the road."

Owen (age: 9 years 4 months).

"Safe. There are no parked cars and no trees to block her way and she can see the cars coming along the roads".

A response making no reference to road features

"Safe. There are no cars coming along the road. If cars were coming along the road it would'nt be safe for her to cross."

3. Standing away from a junction

Responses making reference to important road landmarks.

Allison (age: 11 years 6 months).

"Safe. No cars about, no parked cars, and he can see safely. He can also see all the corners safely."

Dar (age: 9 years 4 months).

"Safe. He has a good view of the roads as he's far away from the corners".

A reponse making no reference to relevant road landmarks

Sussie (age: 5 years 5 months).

"Safe. There are no cars passing to knock him down."

4. Standing away from a bend

Responses making reference to important road features

Amy (age: 7 years 6 months)

"Safe. There are no cars on the road and he can also see round the corners."

Fiona (age: 9 years 2 months).

"Safe. Because there is no traffic on the roads. There are no trees, no parked cars and he can see round about him because he's far from the bend."

An explanation making no reference to relevant road features

Harvey (age: 7 years 4 months).

"Safe. Because there are no motors coming."

5. Standing near a zebra crossing

Responses making reference to road features

John (age: 7 years)

"Safe. There are no cars coming and she can cross because there is a zebra crossing. Cars stop there for people to cross."

Laura (age: 9 years 5 months).

"Safe. Because there is a zebra crossing and the cars are to stop at it. But she must still look and listen for cars."

A response making no reference to road features

Alexis (age: 5 years).

"Safe. There are no cars coming to knock her down."

APPENDIX 2

Examples of the justifications to the recognition of dangerous sites to cross the road.

1. Standing in-between two parked cars

Responses making reference to important road features

Pamela (age: 9 years 7 months).

"Not safe. Because he wouldn't be able to see properly if cars are coming from each side of the road, as the parked cars are beside him blocking his view."

Laura (age: 9 years 5 months).

"Not safe. He can't see either side of the bend because of the parked cars and he can't see cars coming from the other side of the road."

Bobby (age: 11 years 6 months).

"Not safe. Because there are two parked cars beside him and he'll not be able to see across the road. He'll get knocked down if he crosses the road there."

Responses making no reference to relevant road landmarks

Amanda (age: 5 years 5 months).

"Safe. I think so, because the two cars are just parked and can't knock him down. No cars are moving to knock him down."

David (age: 7 years 2 months).

"Safe. Because the two cars are not moving and no cars are coming."

2. Standing very close to a hedge

Responses making reference to road features

Brian (age: 9 years 8 months).

"Not safe. Because the trees are blocking her view to see if there are any cars coming round the corner."

Donna (age: 11 years 10 months).

"Not safe. Because of the trees. She's standing right beside the trees, if a car is coming she can't see it and she'll get knocked down."

An explanation making no reference to relevant road features

Rowley (age: 7 years 5 months).

"Safe. Because no cars are coming."

3. Standing at a junction

Responses making reference to significant road features

Sara (age: 9 years 1 month).

"Not safe. Trees and hedges are on the way and he can't see cars coming round the corner."

James (age: 11 years).

"Not safe. Cars are coming round the corner and he can't see them because it's a corner and it's also blocked by trees."

Responses making no reference to relevant road features

Kenny (age: 5 years 4 months)

"Not safe. A van is coming that way, if he crosses he's going to get crashed."

Erica (age: 7 years).

"Not safe. Because there's a car coming."

4. Standing close to a bend

Responses making reference to road features

Bill (age: 9 years 6 months).

"Not safe. The tree and the bend are blinding him and he'll not see the car coming on the road."

Kenny (age: 7 years 5 months).

"Not safe. Because it is a corner and he can't see round the corner. A car is also coming."

A justification making no reference to important landmarks in the crossing situation

Karen (age: 7 years 3 months).

"Not safe. There's a car coming and he'll get knocked down if he crosses the road."

5. Standing at a zebra crossing with cars already on it

Responses making reference to significant road landmarks in the crossing site.

Tony (age: 9 years 2 months).

"Not safe. The cars are already on the zebra crossing and she has to wait until they go away before she crosses."

Diane (age: 11 years 4 months).

"Not safe. Zebra crossing is a safe place to cross the road, but she can't cross now because there are cars already on it."

A response making no reference to relevant road features in the crossing location

Linda (age: 5 years 5 months).

"Not safe. Because the two cars are there she'll get knocked down."

APPENDIX 3

Examples of the 4 categorisations of the verbal responses to the construction tasks

1. At the Hedge

Score of 4

Paul (age: 11 years 3 months).

"It's the best way as there are no cars coming and she can see clearly around because she's far away from the bushes."

Score of 3

Calum (age: 9 years 6 months).

"There are no car coming but must look and make sure no cars are coming and not just cross the road."

Score of 2

Pat (age: 7 years 4 months).

"No cars coming or going that way."

Dan (age: 5 years 6 months).

"There's no car coming that way to kill her."

Score of 1

Amanda (age: 5 years 3 months).

"She's the nurse of the church, so she can cross the road."

2. At the Junction

Score of 4

Chris (age: 11 years 2 months).

"Because if she had taken the straight walk the car could've come to hit her. The trees are in the way and it is a corner too. She can't see the driver and the driver can't see her."

Score of 3

Jean (age: 9 years 9 months).

"Can see well around and so see any cars coming on the roads by going that way. But she must still look and listen as she crosses."

Score of 2

Martin (age 7 years 7 months).

"The car is not there so she can cross over."

Score of 1

Rowley (age: 7 years 5 months).

"Because it's safer."

Caroline (age: 5 years 4 months)

"It's the best place to cross because she likes it."

3. At the Bend

Score of 4

Sandra (age: 11 years 8 months).

"If he went the other way he couldn't see if cars were coming because of the trees and also it's a bend."

Anna (age: 9 years).

"He can see the cars properly from here as he'll be well off the trees and the bend."

Score of 3

Peter (age: 7 years 1 month).

"Because he can see right down the road and most of the roads there and will be able to see cars coming. But he must wait for the car to go by and cross over."

Score of 2

Elaine (age: 7 years 5 months).

"Because the cars can't go over there."

Score of 1

Jimmy (age: 7 years 4 months).

"Because I think it's safer for him."

4. At the Zebra Crossing

Score of 4

Marion (age: 11 years 6 months).

"Because it's a zebra crossing and cars stop when they see someone is about to cross the road. But he must wait till all the cars stop and he could cross the road."

Score of 3

Ben (age: 9 years 4 months).

"Because there are no cars coming and he has a clear view of the roads over there. But he must be careful as he crosses."

Score of 2

Joe (age: 7 years 3 months).

"Because the green car will not come this way."

Score of 1

Ann-Marie (age: 5 years 3 months).

"That is the house he can live in it."

Geo (age: 5 years 5 months).

"Because eh! the car eh! I don't know.

APPENDIX 4

DETAIL OUTLINE OF THE TRAINING PROGRAMME

PRELIMINARY STAGE

1. Recognising the road feature

During a prelininary stage the experimenter (E) had a general discussion with each pair of children on the specific road features which was to be used in the training. Other relevant objects and surrounding road landmarks were also discussed.

2. Naming the doll-pedestrian

E picks up the doll to be used as pedestrian in the training and invites children to give it a name.

3. Aim of Training

E explains carefully to children that the doll wants to cross the road from ----- to ----- and they are to choose a safe site and route for it to cross the road.

4. Trial

E asks children to watch as he goes through the 9 programme steps shown diagrammatically in Figure 8.4.

THE PROGRAMME

Step 1 Here the E picks up the named doll.

Step 2 E moves the doll to the area near the specific road feature where the doll is to cross the road. E discusses with children what the specific road feature is.

Step 3 E moves the doll to a stop at the kerb near the road feature in (2); after listening to children's views on the importance of stopping at the kerb before crossing, E explains to the children that it is always very safe to stop at the kerb and see whether it is safe before crossing the road.

Step 4 E moves the doll away from the road feature in (3) along the kerb. E discusses with children the importance of such movement; that is, in looking for a safe place to cross the road it is always safer to walk on the kerb.

Step 5 E stops the doll at a clear site away from the road feature. E discusses with children the importance of standing away from the road feature; to see all the roads clearly; to see all roads where cars can come; to give drivers chance to see you.

Step 6 E goes through the movement of making the doll look all around. E discusses with children that it is important to look all around you to see if there are any cars coming before you cross. If cars are coming you should let them pass before crossing.

Step 7 E starts to move the doll across the road.

Step 8 E moves the doll straight across the road still looking around. E explains to children that it is better to walk (and not run) across the road, and that one should still look around to see if cars are coming.

Step 9 End.