Risk and safety on the roads: the older pedestrian

AA Foundation for Road Safety Research

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AA Foundation for Road Safety Research

UNIVERSITY OF
NEWCASTLE UPON TYNE

Rees Jeffreys Road Fund

Ross Silcock Partnership

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Note: The Literature Survey and Technical Annex relating to this report are available from the AA Foundation for Road Safety Research, Norfolk House, Priestley Road, Basingstoke, Hampshire RG24 9NY.

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Accident
An incident involving personal injury occurring on the public highway (including footways) in which one or more road vehicles and pedestrians may be involved.

AH4 test
A psychological test in two parts: (i) verbal and numerical reasoning and (ii) spatial relationships.

BBC DRIVE series
BBC TV series of six programmes on road safety aimed at younger drivers and first shown in early 1994.

Casualty
A person killed or injured in an accident. Casualties are subdivided into killed, seriously injured and slightly injured.

Correlation coefficient *(Pearson's r)*
A measure of how the level of one variable (y) varies, in a linear fashion, with the level of another particular variable (x). A correlation coefficient can vary between +1 and –1 and when r is equal to either value, then one variable is perfectly predicted by the other. A zero or near zero value indicates a null relationship.

d-prime
An index of sensitivity derived from Signal Detection Theory and measured in standard deviation units. Here it is applied to the judgement of relatively faster and slower vehicle speeds: the higher the value of d-prime, the better the discrimination.

Factor analysis
A method for investigating a set of defined variables (or responses) gathered from a set of individuals to examine whether they form a sub-set of linear dimensions. Each individual's responses on the variable set may subsequently be summarised according to scores on these underlying dimensions or factors.

Factors identified in text
The following are brief definitions of factors identified in Chapters 3 – 6:

Concerns f1	–	personal concern or anxiety about crossing the road;
Concerns f2	–	general concern about social and environmental issues;
Discourage f1	–	personal discomfort as a pedestrian;
Discourage f2	–	cost and inconvenience as a pedestrian;
Discourage f3	–	fear of crime or being out late as a pedestrian;
Discourage f4	–	varied concerns affecting going out, including care of others;
Feelings f1	–	nervousness, slowness, tendency to follow others;
Feelings f2	–	enjoys the challenge of crossing the road, opportunistic;
Feelings f3	–	unable to predict traffic flow and tending to avoid junctions;
Feelings f4	–	similar to Feelings f2 but with less connotation of risk;
Feelings f5	–	similar to Feelings f1 but emphasising reliance on others;
FN1	–	variable related to the compensation for distance in speed/distance judgement;
FN2	–	variable related to the compensation for speed in speed/distance judgement;
Health f1	–	poor level of fitness, vision and balance linked to falls;
Health f2	–	good level of fitness and balance not related to other sensory abilities;
Lastd	–	time elapsed since respondent had last driven and including no experience;
Meanaa	–	average absolute error in making the simple time of arrival judgement;
Nearmiss f1	–	attribution as driver's or cyclist's fault;
Nearmiss f2	–	attribution to complexity or uncertainty of the situation;
Nearmiss f3	–	attribution to pedestrian's own error of judgement;
Nearmiss f4	–	attribution to pedestrian's own failure of attention;
Xcriterion	–	measure of confidence in making faster/slower judgements.

Fatal accident
One in which at least one person dies within 30 days from injuries sustained in an accident.

Meta-analysis
Statistical technique whereby sets of independent studies in a particular research area are aggregated and compared.

NEAR
North East Age Research volunteer panel.

Near misses
Subjective reports by respondents about occasions when they felt they were close to being involved in an accident.

Older people
Individuals who have reached the age specified in the text though the definition can vary considerably across different studies; the term is sometimes used synonymously with people of pensionable age, currently 60 for women and 65 for men.

Road classification
The subdivision into strategic roads (motorways and A-class roads) and secondary or minor roads (B-class, C-class or unclassified roads).

Serious accident
One in which at least one person is seriously injured but no person is killed.

Serious injury
An injury in which a person is detained in hospital for medical treatment for a range of conditions such as concussion, fractures, lacerations and shock and including injuries causing death 30 or more days after the accident.

Severity
As applied to an accident refers to the severity of the most seriously injured casualty (fatal, serious or slight).

Signal detection theory
Theory developed from the analysis of an observer's ability to detect faint visual signals, such as on a radar screen, and widely applied to the assessment of other perceptual and cognitive abilities.

Significance levels
The levels quoted in the text indicate the level of probability that a relationship would occur by chance. Thus, if a significance level is quoted as $p<0.001$, only once on a thousand similar occasions should such a result be expected as a chance event.

Slight accident
One in which at least one person is slightly injured but no person is killed or seriously injured.

Slight injury
One in which a casualty receives an injury of a minor character, such as a sprain, bruise or cut.

Tailgating
Close following at speed of one vehicle by another that increases the risk of rear-end collisions.

Traffic calming
Variety of engineering techniques, such as chicanes or road humps, designed to reduce the speed of traffic.

Traffic conflict techniques
Set of principles and measures to analyse interaction between road users that is likely to cause an accident.

The AA Foundation for Road Safety Research

The AA Foundation for Road Safety Research was formed by The Automobile Association in December 1986 as part of its continuing efforts in the road safety field as a major contribution to European Road Safety Year.

Registered as a charity (number 295573), the objectives of the Foundation are:

To carry out, or procure, research into all factors affecting the safe use of public roads;

To promote and encourage the safe use of public roads by all classes of road users through the circulation of advice, information and knowledge gained from research; and

To conceive, develop, and implement programmes and courses of action designated to improve road safety, these to include the carrying out of any projects or programmes intended to educate young children or others in the safe use of public roads.

Control of the Foundation is vested in a Council of Management under the chairmanship of Kenneth Faircloth OBE with day to day activity being the responsibility of the Foundation Management Committee. The Research Advisory Group, members of which include academics, road safety practitioners and health and transport industry professionals, recommends topics worthy of research to the Management Committee.

Sponsors

Support for the Foundation's research programme is encouraged through sponsorship from companies and other bodies that have a concern for and interest in road safety. The Foundation continues to seek sponsors in order to ensure its research programme can continue beyond the year 2000. Since 1986, the Foundation has enjoyed sponsorship from many companies; those supporting our activities in 1995 are:

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And the following insurance companies:

AGF, Bishopsgate, Commercial Union, Corinthian Policies at Lloyd's, Cornhill, Drake, Eagle Star, Economic, Gan, Guardian, ITT London & Edinburgh, Norman, Orion Personal, Provincial and St Paul International.

Rees Jeffreys Road Fund

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Executive summary

Introduction

In Britain 33% of those killed on the roads are pedestrians, a total of 1241 people in 1993.

One in ten road casualties are older people, of whom a quarter are pedestrians, and 50% of all pedestrian deaths in Great Britain involve people aged 60 years and over. Older people are also over represented in the fatal and serious injury data which may reflect their reduced ability to withstand crash forces and to recuperate as much as the severity of the impact itself.

Most pedestrian accidents involving older people occur in daylight, in fine weather, and in familiar surroundings: women over 65 are involved in more pedestrian accidents than men. Indeed, both analysis of accident data and empirical studies taking account of the distance walked and roads crossed, suggest that older women within this group (75 and over) are up to two and a half more at risk than males in the same age range. Although accidents involving pedestrians most often occur when the pedestrian is on the nearside of the road, with older people accidents are more likely when the pedestrian is on the far side. This may implicate faulty judgement of speed and distance in relation to an individual's ability to take rapid evasive action.

The overall aims of the study, carried out at the University of Newcastle upon Tyne, were to gain a better understanding of the problems faced by the older pedestrian and to recommend ways of alleviating such problems. Four separate phases of the work were specified:

(a) to collect information by interview and questionnaire that would provide a broad picture of pedestrian activity in relation to the differing lifestyles adopted by older people;

(b) to observe older pedestrians crossing the road at sites identified as presenting difficulties;

(c) to devise and test experimental measures of older people's judgement of speed and distance;

(d) to link together data from the above phases leading to the recommendations.

Scope of the study

It was possible for the Research Services Section, City of Newcastle upon Tyne, to provide from census data a listing of enumeration districts in which about 25% of the local population were estimated to be over 65 years of age. This information encompassed 43 districts with a population of 57,501; this included 18,843 people in the age group. Sampling procedures were directed towards those areas where there was a higher concentration of elderly residents with varied types of housing, such as owner occupied, private rental, housing association, or council rental. This approach yielded clusters of enumeration districts, which differed in representing distinct geographical localities and environments but were all located within short travelling distance of the City Centre. In the event the four areas selected as representative were Barrack Road, Benwell, Halls Estate and North Heaton. (See Figure I.2.)

Observation of crossing behaviour took place close to two of the interview areas and participants in the judgement of speed and distance study came from a wider area of Newcastle that overlapped with the interview areas: they also provided questionnaire data that was a subset of the interview information. The choice of city itself followed from the research being directed from the University of Newcastle upon Tyne. Whilst cities differ in many respects, the choice of areas was deliberately intended to be representative of the conditions faced by older pedestrians on many urban main and residential roads.

Over a period of sixteen months the following main stages of work were undertaken:

- ★ a literature review of available information and discussions with other researchers involved in similar fields;
- ★ definition of appropriate residential areas in discussion with City officials and collation of respective accident data;
- ★ a structured interview with 215 residents from the four areas which formed the main source of information on journeys, lifestyle, attitudes to and experience as a pedestrian;
- ★ supplementary evidence on attitudes and experience from 181 postal questionnaires;
- ★ 415 observations of road crossing by older and younger pedestrians at two sites close to interview areas, one with and the other without pedestrian crossing facilities;
- ★ video filming of one location, varying the speed of the vehicle and the stopping distance, and then obtaining 181 respondents' estimations of arrival time and ratings of their confidence in faster and slower judgements;
- ★ analysis and interpretation of the results of the surveys, leading to this report.

Main findings

(a) Interview data

The majority of those interviewed claimed to go out, whether locally or further, on most days and this would involve some walking in or near traffic. Those who reported going out less often than once a week because of extreme frailty or handicap were not interviewed. Overall, about 75% of journeys entailed using the bus or travelling by foot. 17% of men's journeys and 12% of women's journeys involved driving or being driven in a private car. Driving experience was strongly related to social area and gender. Less than a quarter of the males interviewed reported that they had never driven, this proportion remaining roughly consistent across areas. However, none of the women interviewed in one area had ever held a driving licence and more than three quarters in another area had never driven.

Shopping or looking round shops comprised the majority of outings, marginally less for males than females, and representing two out of every three trips out: a common destination was the city centre. 50% of journeys implicated crossing at least once in a high street or city centre environment. Additionally, 62% of journeys implicated crossing other local, district or primary distributor roads.

The proportion of individuals who suffered moderate or very much discomfort walking any distance also increased with age. Of the younger females (65–74 years), 29% suffered moderate or very much discomfort. In the middle age group (75–84 years) the proportion increased to 44% and in the older group this increased to 46% of the respondents. The data for men were comparable. Sense of balance was also acknowledged as an ability that could no longer be taken for granted.

Of greatest general concern or anxiety were violent crime and house theft. Comparatively low in the ranking of concerns was, as a pedestrian, having to compete with traffic to cross the road, or the maintenance of a good local transport system. Traffic accidents appeared to rank similarly with provisions in the Health Service, of less concern than traffic speeding in residential streets, which in turn was of less concern than the state of the pavements.

Factor analysis suggested two main areas of concern: (a) the amount of traffic; as a pedestrian having to compete with traffic to cross the road; traffic speeding in residential or shopping areas; the state of the pavements; and traffic accidents; and (b) provisions in the health service; international events and conflicts; standards of education; changes in the environment due to pollution; and, marginally, the maintenance of a good local transport system. These two factors therefore appear to represent concern or anxiety about road and pavement safety and other more global concerns.

Anxiety about being out late and concern about violence and crime were clearly offered as restrictions, particularly by women. Informally, respondents (particularly female respondents) would offer that they would never be out after dark, or never unaccompanied. Apart from the weather, poor health and walking discomfort or difficulty, other issues such as the traffic, cost of public transport or the state of the pavements did not seem common restrictions or discouragements with regard to the decision to leave the house for some journey.

Data from another survey group who had also taken a verbal and numerical reasoning test supplemented the interview data and suggested that concentration skills are an additional feature which can significantly contribute to the ways older people cope with the road environment. A decline in such ability in the senior years is commonplace, although not universal, and may represent itself in terms of difficulty in dividing attentional resources between formal signals and interacting events within the road environment so that there is either confusion or simply one or other may be ignored.

(b) Observational data

The observations were categorised in terms of the place and direction of crossing at each site and further in terms of potentially unsafe behaviour. Not surprisingly, the safest places to cross were either via traffic islands or via a pedestrian crossing. Older people were disproportionately represented in the potentially unsafe crossings and in the area of most concern (between flats and a bus stop) they were at more than twice the risk of their counterparts using the pedestrian crossing. While the method of observation did not allow the same precision on age as the Newcastle accident figures, which show twice the expected risk per capita to older females, the parallel is striking. This is more so because the older males do not exhibit differences between uncontrolled and controlled crossings, just as their accident proneness as pedestrians does not seem to increase with age.

Insofar as it was possible to characterise potentially unsafe behaviour, two elements emerged. The first is essentially similar to the 'failure to yield' in the Leeds Urban Accident study that was identified as the most frequent cause of accidents. The second set of behaviours were more complex but could be typified by care, even extreme caution, in crossing the first half of the road but without considering the outcome for the second half. Extreme instances resulted in older people stranded mid-way across the road in a state of virtual panic to reach the other side.

(c) Experimental data

The initial task involved pressing a button the moment a car (travelling at a different speed on each trial) reached a traffic cone. In reality, precision at this task requires anticipating the moment before it occurs. Using the average absolute error across trials as the dependent variable, accurate anticipation was found to be related to verbal and numerical reasoning ability and driving experience. The higher ability group were more accurate than the lower ability group and those with driving experience were better than those without such experience, but there was no independent effect for age or gender.

Task two was a more complex version of task one, ie estimating arrival time of the oncoming car at various speeds which was blanked either 20 or 60 metres before the cone. It is in principle possible to estimate the time to arrival of the vehicle at the cone from the rate of increase of the image prior to the moment of blanking. Moreover, it is a common assumption that individuals are capable of projecting perceptual information of this sort to anticipate a predicted arrival time. From the results, two variables were computed by least squares regression: (a) an index of distance such that a value of unity would represent a perfect compensation for distance, regardless of whether overall time estimates were long or short; and (b) an index of speed such that a value of minus one would represent perfect compensation for relative speed. The average index for distance suggested that distance was an effective cue but there was no evidence to indicate that individuals were able to make a reliable compound judgement from speed and distance information and speed differences were consistently under-weighted.

Of course the pedestrian's decision-making in real life is affected by many stimuli that cannot be adequately represented by video sequences. These include as examples of potentially negative effects background noise and distraction, and as offering potentially useful information the visual cues to depth that are not available in two-dimensional videotapes. Such counteracting influences are difficult to evaluate but, in the light of the interview evidence, may be less significant than other aspects of managing attentional resources. One great advantage in the laboratory, provided the demands are not excessive, is that the older person can focus attention wholly to the task in hand, with little difficulty in making the response. In contrast, when actually crossing the road, the requirements of walking sufficiently quickly can compete for the available cognitive capacity. This competition will be even more pronounced if the pedestrian has physical disabilities or a generally reduced level of functioning.

Thus it seems that distance itself is the only criterion that gives a reasonably sound base for estimating the time remaining to cross and it is probable that in real circumstances individuals will provide themselves with feedback by monitoring changes against expectation and their own progress. The combined failure of initial judgement (made more likely by sensory loss with age) and failure to accommodate or modify behaviour to avoid a developing incident (made more likely by physical and intellectual impairment), mean that in traffic (particularly where speed is excessive, the flow system is complex, or where it is assumed that the pedestrian can grasp novel signals or rules) there are several interacting sources of threat to the older pedestrian.

Applications of the research

The findings can be considered in the light of existing work and in terms of specific practical ways in which older people may be helped. Additionally, techniques that can further advance understanding of the complex interaction between people, vehicles and their surroundings are specified.

(a) Drivers paying more attention to older pedestrians

High rates of pedestrian accidents may be explained in part by drivers paying little attention to pedestrians in their assessment of risk on the road. This problem emerged strongly from several aspects of an earlier AA Foundation report by the authors. Summarising their results, the drivers' perception of risk ratings did not correlate with pedestrian accidents, and the regression model explaining variation in risk ratings did not even include level of pedestrian activity as a variable. Video ratings of perceived risk from the driver's perspective did not reveal pedestrian activity as a motivating attribute and this was reinforced by the pedestrian walks where drivers' ratings differed from those of non-drivers. Given that about a quarter of all road casualties in this country are pedestrians, these sources of misperception are important to correct.

However, the analysis of attitudes in the Carthy *et al.* study suggests that there are some groups of drivers who are likely to respond favourably to better or more comprehensive information (the community oriented) and to rules (the order oriented), but that the self oriented and youth oriented groups offer less likelihood of success from information alone and can react obstructively to explicit constraints. So, even if it is agreed that drivers need to take on more responsibility, the balance between changing attitudes, enforcement and unobtrusive guidance will be difficult to strike.

A direct application would be to extend the recent campaign directed at younger drivers who are over-represented in the accident statistics, as are older pedestrians. One of the central features of the BBC DRIVE series of six programmes in early 1994 was to try and inculcate a greater sense of responsibility and to spell out graphically the tragic costs of momentary bad driving. Similar attempts in Spain have portrayed the ways in which the various long-term consequences of an accident can wreck people's lives. There seems little doubt that powerful immediate effects can be achieved, although the nature of back-up, repetition and the

appropriate intervals still needs to be defined. One specific possibility would be to simulate the problems of older people when crossing the road eg restricted hearing and vision, physical limitations in walking, difficulties in judging speed and distance aimed not only at providing advice for the older person but also at making drivers more aware of their problems as pedestrians, especially crossing to and from bus stops.

The specification of limits can also play a part in changing attitudes. The recent use of 20mph limits in certain areas has introduced the notion of a more finely graded set of speed restrictions that may gradually become accepted. Widening the category of knowledge relating to pedestrians required as part of a revised driving test could focus more attention on the pedestrian perspective.

More appealing, if sufficient ingenuity can be applied to the problem, is to influence driver behaviour and driving habits without obtruding directly on their attention. A variety of engineering techniques are already in use, collectively termed traffic calming, but most are restrictive rather than persuasive. However, the growing need to make use of measures which are environmentally acceptable (as well as effective in reducing vehicle speeds) has lead to more subtlety. For example, using different surfaces to create a perception of a narrower carriageway; landscape treatments to create an illusion of a calmer environment; and conscious decisions to improve conditions for pedestrians by using regularly spaced refuges, both to narrow the running carriageway and to break road crossing into two parts, can all be effective. Care must be taken to ensure that problems are not simply relocated, although this possibility can often be avoided by adopting a comprehensive, urban safety management approach.

(b) Educational materials and publicity

The review of the literature indicates that the reasons for pedestrian accidents involving older people are interrelated. Broadly speaking, the interaction is between factors such as sensory deficiencies, slow information processing, lack of driving experience, failure to anticipate outcomes and inability to take evasive action. Although they are more cautious than younger adults in their behaviour, their compensatory behaviours are not necessarily safe. Indeed, it is very difficult to predict how an older person who does not understand the principles underlying traffic movement will behave in a road setting that involves complex choice. The examples in the observational study of initial caution followed by subsequent indecision or panic reaction provide graphic illustrations.

It has been argued that behavioural factors, especially social norms, are playing an increasingly larger role in traffic safety and that intervention programmes should be aimed at altering human behaviour and attitudes. Whilst there has been some research into driving courses for older drivers, little has been available for pedestrians. A WHO report suggested that road safety intervention programmes should look at local data for each area and address those specific problems. This may apply particularly when complex new road junctions are built, which make greatest information processing demands and thus pose greatest problems to older people. Specific interventions should also concentrate on the areas where older people often go, eg local shopping areas, as confirmed by the interview data.

Before designing a road safety intervention programme, it is necessary not only to identify the crucial behaviours to be targeted, but also to assess whether the target group is capable of performing these behaviours. The latter may be important for older people as the behavioural repertoire declines with age, mostly as a result of physical changes. However, they are a heterogeneous population and therefore it will be difficult to design a programme appropriate for the capabilities of a large group. Given that there are at least some common difficulties, say in performing a rapid assessment of a situation, it is important that programmes address issues of how to maximise the available information, for example, avoiding obstacles which screen the traffic and thus improving the chances of making a safe judgement. Finding a means of conveying that unexpected events can occur, such as vehicles overtaking, reversing, going faster than expected etc., may improve anticipation and lessen the unrealistic expectations that some non-drivers seem to hold.

Road safety programmes for older people may encounter specific problems that are not found in other programmes. It is difficult with habits developed over many years to try to change behaviour. Some older people may insist that, as they have been crossing roads for many years without having had an accident, there is no need to learn new strategies. A negative reaction may also mask concern over mastering new information so any techniques to assist assimilation of the material can be crucial. Thus important pieces of information may have to be repeated several times, and cue cards with the essential pieces of information on them which the audience can keep, may accompany a video or talk. This will act as a memory aid, and thus is likely to improve compliance.

Direct information about safe crossing procedure is not the only way in which attempts have been made to improve road safety among older people. Studies have found that older people do not report any decline in their vision and hearing, despite objective measurements suggesting the contrary. However, once they are informed of their deterioration, they make appropriate compensatory behaviours, such as wearing glasses more often and taking more care at unfamiliar or complex junctions. This suggests that, if given appropriate feedback that is specific to a certain difficulty, older people can make self-initiated compensatory adjustments. Further research is needed to assess whether these self-initiated adjustments are associated with decreased accident rate and whether they are maintained in the long term.

However, there is a fundamental reason to look beyond educational solutions directed at older people. While, for the older population as a whole, there are potential benefits associated with some form of road safety education, especially in the area of risk perception, this approach seems very unlikely to attract or be effective with the group that all aspects of our analysis show to be the most vulnerable, namely women over 75, who are in the average or lower ranges of cognitive ability. Indeed, it could be argued that they are likely to profit least from this type of intervention and that we need to formulate solutions with this sub-group of older pedestrians particularly in mind. In the longer term, the increase in the proportion of women with driving experience may help to offset their potential risks as pedestrians later in life but any such effects are not likely to become evident until some twenty years from now.

(c) Reappraising pedestrian crossings

One set of observations involved a simple crossing facility that allowed pedestrians to stop the flow of traffic and there were no contingent relationships elsewhere. While there were instances of potentially unsafe behaviour observed, there was no implication that these resulted from failure to understand the sequence of events. Pelican crossings on district distributors have been shown to be associated with half the pedestrian casualty rates (per 100 million crossings) compared with no facility. However, the distinction between the local and the district distributor may not be critical bearing in mind that much road crossing relates directly or indirectly (by catching buses) to shopping. Questions about possible differences in layout and complexity of pedestrian crossings may also arise.

As part of planning for the observation phase and in order to elucidate references made by interviewees, a number of more complex pedestrian crossings in the City Centre were visited and observed. Two broad conclusions can be drawn: (a) that many older people do not understand the sequence of traffic movements, such as an all green phase for pedestrians to cross and (b) that in a state of uncertainty, reactions are very variable and may result, eg in (i) following others; (ii) going elsewhere to cross; and (iii) trying to anticipate a break in the traffic independently of the appropriate phase to cross.

The overall problem seems yet another example of those who determine the rules and understand the relevant principles (of traffic flow in this case) assuming that users will base their behaviour on those same rules. Our evidence suggests rather that older people with difficulties in dividing their attentional resources will either ignore complex information or choose to avoid places where they feel uncertain. Taking the example of when a traffic signal will change, it may be possible to display a 'countdown to cross' that would encourage people to wait and increase confidence about when to cross among the anxious and unsure.

Alternatively, where it is physically practicable, older people are likely to be more at ease and willing to accept a narrowed crossing place or a place where traffic is consistently slower (near a road hump or similar traffic calming measure).

(d) Crossing the road in two stages

Most roads carry traffic travelling in two directions. With any appreciable volume of traffic this further compounds the difficulty of judging when it is safe to cross. It is accepted engineering practice, when seeking to provide assistance to pedestrians wishing to cross a busy road, that a refuge or traffic island is of considerable benefit. The rationale is straightforward; by providing a (relatively) safe place between the two directions of traffic, crossing the road can be undertaken in two stages, with attention focused in only one direction at a time. The need for such refuges applies with more force in places where the main group of people crossing are likely to have attentional difficulties.

A related problem is that nearly all pedestrians choose to take the shortest route from A to B (for very clear reasons if they have difficulty in walking) and it is often not practicable to locate the refuges on that part of the route. Barriers can be used to divert, or to force, the pedestrians to cross where the refuge is provided but, in their absence, many people can be observed crossing within sight of, but not at, the refuge. One of the sites observed provides a case in point. In order to have used that refuge, many of those crossing to the bus stop would have had to divert from their minimum distance path. None did, even when they were obviously unsure about the crossing judgement, especially in relation to the second half of the road. More care needs to be given to understanding pedestrian routes when locating refuges or traffic islands which can fulfil this function. This is particularly important at junctions, where traffic movements are complex and where many pedestrians are likely to cross.

(e) Barriers in communication

The pervasive difficulty in seeing the world from a different viewpoint than one's own, in this case, road use solely as a pedestrian over many years, has generated well intentioned but unhelpful interventions. Despite lack of evidence, it is safe to assume that those involved in road safety initiatives possess driving experience, ie they have had to meet levels of performance and knowledge in order to pass their test and have continued to accumulate substantial experience about the dynamics of interaction on the road from that standpoint.

Further, the authors have previously shown that drivers assess risk as pedestrians differently from non-drivers. In other words, such processes become so ingrained that it becomes extremely difficult to view the road from a different perspective. The vocabulary of the two groups to describe commonplace events differs both in range and complexity. With some interviewees in the study it was obvious that the level of analysis required to respond to the questionnaire (even after repetition and rephrasing) went well beyond their normal consideration of pedestrian behaviour. Thus effective communication with the target group cannot be assumed and, as a first step, consulting on a local basis about problematic locations with panels of older pedestrians who have never driven would be worthwhile. Similarly, there is a need to clarify the bases on which decisions to cross are taken. The evidence from the video experiments suggests that distance is likely to be the most effective criterion and it may be possible to develop simple forms of advice on that dimension (having taken account of walking pace, traffic speed and road width).

(f) Traffic conflict techniques

It remains controversial whether traffic conflicts are satisfactory surrogates for accidents but from a subjective impression we have little doubt that some of the potentially unsafe crossings observed at the two sites could have lead to accidents given one or two more concurrent events, such as increased speed of vehicles or limiting of sight distance by buses. Most of the accumulated evidence relates to vehicle-only accidents but recently studies in Sweden have included applications relevant to pedestrian accidents. Current development can reduce costs

by making the observation and conflict scoring processes automatic. The aim is to produce a PC-card for processing co-ordinate data from a video recorded sequence and the system should allow for the selection of different types of conflict and detailed analysis of the various components.

Conclusion

From the foregoing it seems beyond question that the needs of older people as pedestrians are not being adequately met and that, as their numbers in the population increase, better solutions will have to be found unless their quality of life is to be further eroded. Whilst there is little comparative data for past years, the very low numbers in absolute terms of old people who go out after dark speaks for itself and there were numerous examples in the interview data of deliberate self-restriction. Moreover, this applies in relatively safe areas as well as the potentially dangerous ones.

One solution, which has support in the USA, is to create housing precincts solely for the elderly where it is possible to pay particular attention to their needs and to remove them from the problems encountered in typical urban environments. However, there currently seems to be resistance by many who feel that the price of isolation from other age groups would be too high to pay. Less radical solutions centre on improved information, traffic calming or similar engineering measures and placing more responsibility on drivers. However, there is also a need to offset the distortion of information about the incidence of crime and theft that is currently prevalent in the media which may be leading older people to restrict their lifestyles unnecessarily. The role of local councils and the police could be usefully increased in this context, both in disseminating information and facilitating group activities.

However, the outlook is not all unrelieved gloom. Individual examples serve to make the point that old age is not necessarily associated with decline and restriction. There were plenty of instances of men and women leading active lives and pursuing their interests (athletics, bowling, church activities, exercise, social clubs). These activities served to offset any natural tendency to stay indoors and, indeed, it was these people who showed least concern about being out in the evening. Nor was it that they were entirely free from disabilities (visual difficulties, raised blood pressure, arthritis were all mentioned) but these were given little prominence compared with getting on with their lives. Driving, or having driven until well after retirement, was frequently cited as a reason for confidence on the roads but the more significant factor was the presence of strong interests.

In the laboratory study also there were striking examples. In the task involving judgements of faster/slower, perfect performance required 16 responses of faster when actually faster (and the rest slower) with differences in some trials of only 5mph. One participant made only one error (a level that most of the students who assisted in pilot studies did not achieve) and several others were only a little worse in the accuracy of their judgements.

Thus, in conclusion, there is cause for optimism in that there are people in our studies well into their 80s who do not experience substantial limitations on their lives and whose level of functioning has remained undiminished for practical purposes over several decades. They do not find crossing the road any more problematic than most of us and they serve as an example of energy and enthusiasm for life that more of their peers might in future emulate.

Chapter 1 What is this study about?

1.1 Introduction

In Britain 33% of those killed on the roads are pedestrians, a total of 1241 people in 1993.

One in ten road casualties are older people, of whom a quarter are pedestrians, and 50% of all pedestrian deaths in Great Britain involve people aged 60 years and over (Department of Transport, 1994). Older people are also over represented in the fatal and serious injury data. In the recent study by Ward *et al.* (1994) 57% of injuries were in this category which may reflect their reduced ability to withstand crash forces and to recuperate as much as the severity of the impact itself.

Women over 65 are involved in more pedestrian accidents than men. Chapman *et al.* (1982) suggest that this is because there are more women than men in this age group, while men might actually have a higher casualty rate than women. However, when account is taken of the distance walked and roads crossed (Ward *et al.* 1994), older women are about two and a half times more at risk than males in the same age range. Whether this ratio will continue at the current level or dramatically fall in the next generation or two poses important practical issues related to targeting pedestrian safety messages. Many more of the younger generation of women have learned to drive and, as Carthy *et al.* (1993) have suggested, drivers are better able to assess risks as pedestrians than non-drivers.

Most pedestrian accidents involving older people occur in daylight, in fine weather, and in familiar surroundings (Sheppard and Pattinson, 1986; Grime, 1987). Although accidents involving pedestrians most often occur when the pedestrian is on the nearside of the road, with older people accidents are more likely when the pedestrian is on the far side (Grime, 1987). This may implicate impaired judgement of speed and distance in relation to an individual's ability to take rapid evasive action.

1.2 Aims and objectives

The overall aims of the study were to gain a better understanding of the problems faced by the older pedestrian and to recommend ways of alleviating such problems. Four separate phases of the work were specified:

(a) to collect information by interview and questionnaire that would provide a broad picture of pedestrian activity in relation to the differing lifestyles adopted by older people;

(b) to devise and test experimental measures of older people's judgement of speed and distance;

(c) to observe older pedestrians crossing the road at sites identified as presenting difficulties;

(d) to link together data from the above phases leading to the recommendations.

1.3 The Newcastle upon Tyne context

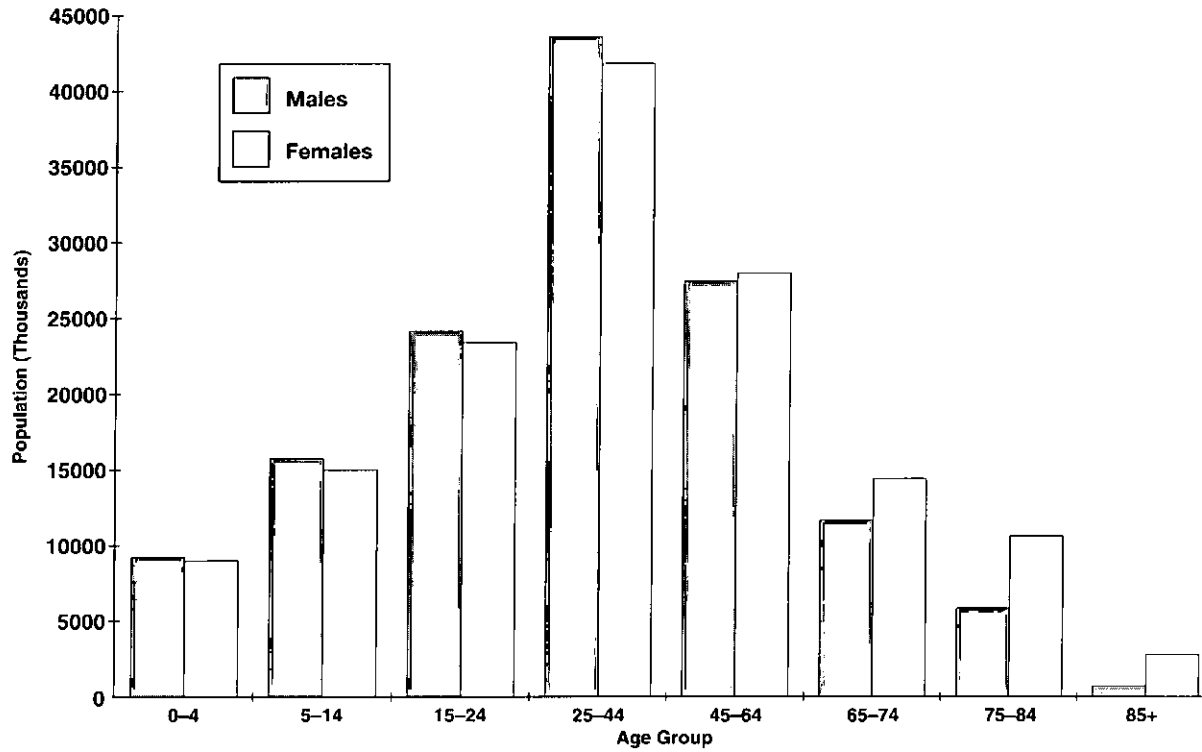
1.3.1 Population and choice of area

The elderly over 65-year-olds in Newcastle represent some 15% of the overall population. The histogram in Figure I.1 provides the distribution of the overall population of Newcastle by age and gender. Although it was not possible to identify specific names and addresses of these individuals because this information is restricted by the Data Protection Act, it was possible for the Research Services Section, City Council to provide, using the latest (OPCS, 1994) census

data, a listing of enumeration districts in which about 25% of the local population are estimated to be over 65 years of age. This information encompassed 43 districts with a population of 57,501; this included 18,843 people in the age group that we were targeting

Figure I.1

Newcastle Population Profile



Source: OPCS 1991 mid-year population estimates

Our sampling procedures were directed towards those areas where there was a higher concentration of elderly residents, such as owner occupied, private rental, housing association, or council rental. This approach yielded clusters of enumeration districts, which differed in representing distinct geographical localities and environments but were all located within short travelling distance of the City Centre. In the event the four areas that were selected as representative were Barrack Road, Benwell, Halls Estate and North Heaton, and canvassing these districts to identify potential respondents became a viable option. These areas are outlined on the accompanying map of the City (see Figure I.2). Pen pictures of the areas and typical residents are to be found in Appendix A.

Observation of crossing behaviour took place close to two of the interview areas. Participants in the judgement of speed and distance study came from a wider area of Newcastle that overlapped with the interview areas and they also provided questionnaire data that was a subset of the interview information. The choice of city itself followed from the research being directed from the University of Newcastle upon Tyne. Whilst cities differ in many respects, the choice of areas was deliberately intended to be representative of the conditions faced by older pedestrians on many urban main and residential roads.

Figure I.2

Map of Newcastle upon Tyne showing four survey areas

1.3.2 Pedestrian accidents in Newcastle

In order to set the scene for the various phases of this study, it is useful to provide local context and some comparative data as in Table 1.1. Apart from consulting national sources, the local Traffic and Accident Data Unit (TADU, Department of Engineering Services, Borough of Gateshead) supplied details of pedestrian casualties for three years to December 1993. In evaluating changes in pattern of accidents with age it is important to take into account the proportional changes in the population for the respective groups. Thus, for example, in Newcastle the population profile (Figure 1.1) shows that, although the ratio of females in the 65–74 group to those 75 and over is very similar (approximately 1:1), the equivalent ratio for males is about 5:3. These differences need to be borne in mind when considering the accident statistics.

Table 1.1

Households with elderly people and their car availability (1991 Census)

		Great Britain % with no car	Tyne and Wear % with no car
Total Households		33.4	42.2
Single lone male	65–74	58.1	68.8
	75–84	68.6	77.1
	85+	84.2	89.0
Single lone female	65–74	76.9	84.8
	75–84	90.4	94.0
	85+	96.2	97.3
Two or more pensionable < 75		29.4	43.4
Two or more pensionable with at least one < 75		51.1	62.9
Pensionable living with others below pensionable age		21.6	37.7
Elderly households as a percentage of total households		33.5	34.1
Elderly households only		53.6	63.9
Non-elderly households only		23.5	30.4

Comparisons with accident data in another northern city (the Leeds Urban Accident study by Carsten *et al.*, 1989) show similar percentages of accidents in each age group, allowing for minor differences in the boundary points between age groups (Table 1.2). Comparisons with rural roads (Hughes, 1994) show wide variations between rural counties and it is probably necessary to make distinctions between regional centres, such as Leeds and Newcastle, and less populous urban areas if pedestrian accident rates are to be meaningfully evaluated. The former county of Tyne and Wear which contributes the majority of the pedestrians in Newcastle at any one time has a similar proportion of elderly households as the rest of the country but it differs in having consistently lower car availability (see Table 1.1).

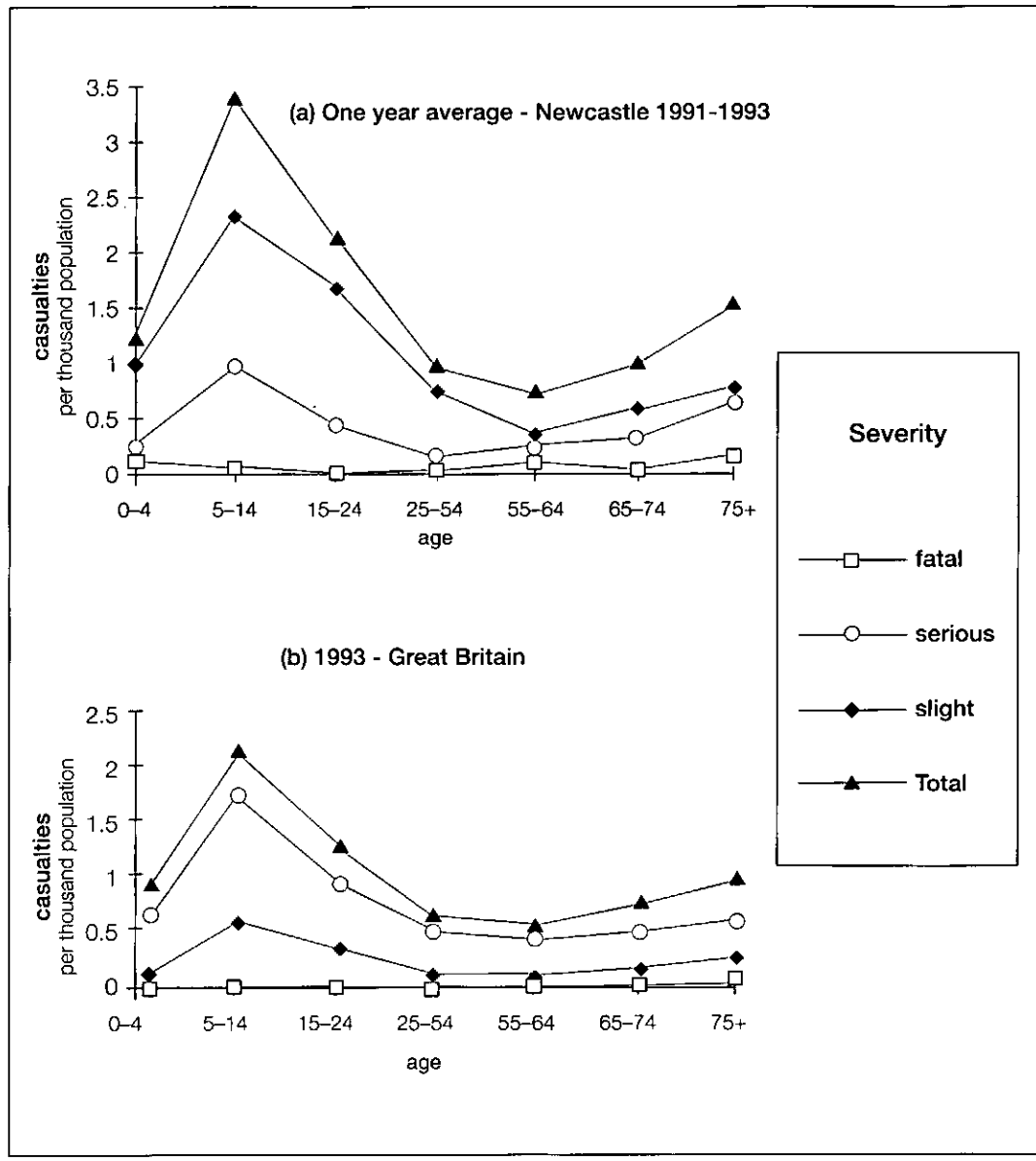
Table 1.2

Comparison of 1988 Leeds Accident Data (analysis by Sabey, 1994) with the 1991-93 Newcastle percentages per age group

Age range	0–4	5–13	14–19	20–59	60+
Leeds	6.1	30.1	16.5	28.7	18.6
Newcastle	5.6	27.2	20.3	26.8	20.1
Age range	0–4	5–14	15–24	25–54	55+

Figure I.3

Comparison of pedestrian casualties (a) in Newcastle and (b) the whole of Great Britain



As a consequence it is likely that more people of all age groups will walk and use public transport. This factor, in addition to the wholly urban character of the area, provides a plausible reason why the levels of all types of pedestrian accidents in Newcastle are at a much higher level than the national average (about 60% higher comparing Figure I.3a with Figure I.3b), although they match almost exactly the distribution across age groupings.

Looking in greater detail at the pedestrian accidents in Newcastle among older people (Tables 1.3 and 1.4), significant age and gender differences appear. While pedestrian accidents to males in both the 65–74 and the 75+ group broadly parallel their number in the population, the frequency for females 75 and over, particularly those resulting in serious injury, is about twice that expected per capita and such accidents occur largely on A and C class roads. However, because of road re-classification during this period, some caution in precise comparison between major roads is necessary.

Table 1.3

Road class of accident and its severity by age and gender for Newcastle elderly pedestrian casualties (3 years to December, 1993)

Road class	Gender	Age 65–74	Age 75+	Total
A	Male	18	12	30
	Female	12	23	35
B	Male	12	8	20
	Female	9	9	18
C	Male	7	6	13
	Female	9	21	30
Unclassified	Male	0	1	1
	Female	0	2	2
Estates	Male	3	1	4
	Female	6	8	14
Severity				
Fatal	Male	3	6	9
	Female	0	5	5
Serious	Male	13	9	22
	Female	13	27	40
Slight	Male	24	13	37
	Female	23	31	54
Totals	Male	40	28	68
	Female	36	63	99
Overall total		**76**	**91**	**167**

Table 1.4

Type of junction, type of crossing facility and type of pedestrian movement involved in Newcastle elderly pedestrian casualties (3 years to December, 1993)

Type of junction	Gender	Age 65–74	Age 75+	Total
Not a junction	Male	12	12	24
	Female	9	28	37
Automatic signals	Male	10	2	12
	Female	4	8	12
Stop sign	Male	0	1	1
	Female	0	0	0
Give way	Male	12	7	19
	Female	15	21	36
Uncontrolled	Male	6	6	12
	Female	8	6	14
Type of crossing facility within 50 metres				
Not a pedestrian crossing	Male	19	21	40
	Female	22	40	62
Zebra	Male	6	0	6
	Female	2	5	7
Pelican	Male	4	3	7
	Female	6	5	11
Other lights control	Male	8	1	9
	Female	3	6	9
Central refuge only	Male	3	3	6
	Female	3	7	10
Pedestrian movement prior to accident				
Crossing from driver's nearside	Male	18	12	30
	Female	18	25	43
As above but masked by stationary vehicles	Male	2	3	5
	Female	2	5	7
Crossing from driver's offside	Male	16	10	26
	Female	9	26	35
From offside but masked by stationary vehicles	Male	1	0	1
	Female	2	3	5
In carriageway not crossing	Male	0	1	1
	Female	1	0	1
Unknown	Male	3	2	5
	Female	4	4	8
Overall total		**76**	**91**	**167**

Turning to the location of accidents, the increased incidence for older females is neither associated with pedestrian crossings nor junctions but is linked with crossing from the driver's offside, ie in the further half of the road from starting to cross, graphically described by Jonah and Engel (1983) as "midblock dash accidents". The implication here is that choice of crossing place and changes in behaviour during the process of crossing the road should be systematically investigated.

1.4 Conduct of the study

Over a period of sixteen months we undertook the following main stages of work:

- ★ a literature review of available information and discussions with other researchers involved in similar fields;
- ★ definition of appropriate residential areas in discussion with City officials and collation of respective accident data;
- ★ a structured interview with 215 residents from the four areas which formed the main source of information on journeys, lifestyle, attitudes to and experience as a pedestrian;
- ★ supplementary evidence on attitudes and experience from 181 postal questionnaires;
- ★ 415 observations of road crossing by older and younger pedestrians at two sites close to interview areas, one with and the other without pedestrian crossing facilities;
- ★ video filming of one location, varying the speed of the vehicle and the stopping distance, and then obtaining 181 respondents' estimations of arrival time and ratings of their confidence in faster and slower judgements;
- ★ analysis and interpretation of the results of the surveys, leading to this report.

NOTE: For further information on technical usage in this and succeeding chapters the reader is referred to the notes and definitions section to be found on page iii immediately after the pages detailing contents and lists of tables, figures and plates.

Chapter 2 Factors affecting older pedestrians

2.1 Trends and features in ageing

Demographic trends indicate large increases in the population of older people over the next thirty years (Central Statistical Office, 1992). By 2025 more than a quarter of the population is likely to be over 60 years old, with corresponding increases in the numbers of people over 75. However, in considering the impact of these trends on road safety, it is necessary to bear in mind improved medical treatment and higher standards of health which mean that even now age 60 is hardly the significant boundary point that it previously represented. In terms of older pedestrians it is more important to identify an age at which substantial numbers may have to contend with some form of physical deficit. Here the analysis of Martin *et al.* (1988) suggests that half the population may be affected in some way by age 75 and three quarters by age 85, though projecting into the future these proportions may be reduced. The intention in this chapter is to consider the effects of possible deficits among active road users and to review the methods of obtaining data about the contributory causes of pedestrian accidents.

The general features of ageing that have been thought to contribute to the higher accident rate for older pedestrians include a) deterioration in hearing and vision; b) increased concern about falling and decreased ability to react quickly; c) ignorance of or inability to understand traffic rules; d) lack of adaptability at the time; e) lack of driving experience; f) increased risk of serious injury (OECD, 1979). Similar features are also mentioned by Hillerman *et al.* (1976), Grayson (1980) and Retting (1988). Thus there is a tendency for older people to be blamed for the high pedestrian accident rate in the age group, and the statistics may therefore be incorrectly perceived as being inevitable and unavoidable. For example, Singer (1963) commented:

"Many of these (elderly) pedestrians are reluctant to accept the changes in the environment resulting from the automotive revolution"

Whilst this may have been the case in 1963, older people now have lived for longer in the era of high car ownership and have thus had a longer time to adapt. However, the stereotype of the older person as unwilling to accept change still to some degree remains. Putting blame onto the victim and accepting the situation as being unavoidable acts as a justification for little being done to improve the situation. It is clearly preferable to investigate whether there is any empirical evidence to suggest that the features of ageing mentioned above contribute in some way to the increased accident rate, and also to develop explanations rather than simply describe the problem. In this way intervention programmes considered in section 7.3.2 will be more soundly based.

2.2 Sensory and physical deficits

As people grow older they suffer non-pathological changes in sensory efficiency which are both gradual and insidious. Obviously visual and hearing impairments may affect the safety of older people as pedestrians. The changes occurring in the visual system that adversely affect the ability to see clearly are greater after the age of 50 (Johnson and Choy, 1987). The lens loses its flexibility for accommodation and becomes yellow. This results in declines in static acuity (Corso, 1981) and dynamic acuity (Reading, 1972). Loss of acuity may result in difficulties in perceiving vehicles from the rest of the optic array, and can affect depth perception as the ability to discriminate details affects an individual's perception of texture gradient. This may lead to inaccurate estimations of vehicular distances. Sivak, Olson and Pastalan (1981) found that older drivers (over 61 years) exhibited legibility distances for sign reading that were only 65–77% of those of younger drivers (under 25 years) on a night-time sign reading task. They suggested that older people may have an impaired ability to detect hazards, and slower reaction times may result in a decreased ability to extricate themselves from dangerous situations. Sheppard and Pattinson (1986) interviewed elderly pedestrians who had been involved in a road accident and found that 63% of respondents did not see the

striking vehicle until it hit them. Although this may have been linked to sensory decline, the respondents were not asked why they had not seen the striking vehicle, and so other factors may have contributed to this perceptual failure such as a lapse in concentration.

Hearing impairments related to the ageing process occur in 13% of people aged 65 and over, especially for higher frequencies of sound, (Corso, 1977). Grattan and Jeffcoate (1974) found that deafness occurs 40 times as frequently in people injured in road accidents as would be expected from its incidence in the adult population. This suggests that hearing deficits may be particularly problematic to the older pedestrian. Hearing impairments may cause problems in localising sounds and consequently in ascertaining from which direction a vehicle is approaching. Furthermore, if visual and auditory information is incongruent, confusion may result and lead pedestrians to panic. Though hearing aids can be beneficial they tend to boost lower as well as higher frequencies creating a distracting 'booming' effect which can be problematic in traffic.

Declines in sensory functioning with age are well recognised as a result of laboratory studies. However, the contribution of these deficits to the problems of older people in the natural environment is not directly predictable from laboratory findings. The tasks used are often unfamiliar to the subjects and preclude compensatory strategies that might be employed in the natural environment. It may be difficult to relate sensory functioning to pedestrian performance as vision and hearing are but two factors affecting pedestrian performance and there may be a disparity between a person's sensory capacity and the extent to which this capacity is used during road-crossing. The whole behavioural sequence can be viewed as a complex interaction of sensory and cognitive processes that result in the expression of a decision and a sequence of motor responses. Thus in the next three sections cognitive deficits, judging speed and distance and taking evasive action are reviewed. A more detailed literature survey is also available separately.

2.3 Cognitive deficits

Ageing is also accompanied by changes in brain anatomy and functioning. There is neuronal loss in certain areas (such as the locus coerulus), fewer dendrites, reductions in the levels of some neurotransmitters, and some disturbed synaptic transmission (Craik and Salthouse, 1992). Such changes have been associated with age-related cognitive impairment, which the National Institute of Mental Health considers to be the primary problem of old age; mild cognitive impairment has been found in 14% of older people (Myers *et al.*, 1982).

The most marked declines have been found on tasks requiring fluid abilities such as reasoning, memory and decision-making. These abilities are particularly important in pedestrian behaviour as decisions to cross involve the simultaneous processing of elements of past experience and incoming perceptual information. Rapid performance of these processes all at once may be difficult for an older person who may not be able to collect and process enough information in order to decide on a safe course of action. Salthouse (1985) found that older people take in and process information more slowly and this is a major factor in age-related declines in general cognitive abilities (Nettlebeck and Rabbitt, 1992). Reduced information processing capacity renders older people less efficient at monitoring their own performance, less aware of their mistakes and less able to remember them (Rabbitt, 1991). In a road context, older pedestrians may not only be at risk from processing and acting upon information more slowly, but they may not learn from their mistakes and so may be less aware of hazards.

Older people are particularly impaired relative to younger adults when they have to deal with complex problem-solving situations, (Charness and Campbell, 1988). Consequently older pedestrians may be more likely to find multiple-choice traffic situations puzzling and hard to manage. Indeed when Sheppard and Pattinson (1986) asked subjects who said that the accident had occurred at a difficult place to cross why this was so, many said it was confusing because a lot of roads joined there. Wiener (1968) similarly found that older pedestrians were often confused about traffic lights and based their judgements on when to cross on the movement of the vehicles rather than the traffic signals.

Pedestrians are continually bombarded with an array of stimuli from the road while they may well be otherwise preoccupied with thoughts and feelings about other events. Attention governs which stimuli are processed and can also be viewed as a resource necessary to support information-processing (Craik and Byrd, 1982). In a traffic situation it is important to attend selectively to information pertaining to the vehicles and potential hazards. However, Kurasic *et al.* (1992) found that older adults (57–85 years) are less able to perform perceptual selection tasks than younger subjects, possibly because they are more easily distracted by irrelevant stimuli. However, a meta-analysis by Parasuraman (1985) concluded that evidence regarding age changes in sustained attention was sparse and mixed. Problems in sustained attention may mean older pedestrians have difficulties in continually assessing a situation once action has been taken; problems may occur when the situation changes and a new course of action becomes more appropriate. This could be why older pedestrians have problems with unusual situations, ie they may be slower to assimilate and act upon unpredicted situations.

2.4 Judgement of speed and distance

The underestimation of the speed of approaching vehicles is particularly perilous in a road situation. It has been postulated that road accidents among older adults may be related to difficulties in judging the speed of vehicles, (Scialfa *et al.*, 1991). Sheppard and Pattinson (1986) asked elderly interviewees how well they could judge the speed of an approaching car: 44% said they could judge it fairly well, while 30% said they could not judge speed at all well (however this may reflect a lack of confidence as a result of the accident rather than the subject's opinions before it). Similarly, Todd and Walker (1980) asked subjects what the vehicle was doing at the time of the accident. More older respondents felt that the vehicle was travelling too fast (30% compared to 22% of younger subjects), which could be an indicator of the greater difficulties experienced by older pedestrians in judging speed.

However, there is conflicting evidence as to whether these difficulties are age-related. Storie (1977) concluded that older drivers are poorer than younger drivers at judging vehicle velocity. Elderly pedestrians involved in rural vehicle accidents tended to fail to perceive motion or to judge velocity accurately, In contrast, Scialfa *et al.* (1987) found the elderly judged cars to be travelling more quickly than was judged by the young. More recently, Scialfa *et al.* (1991) found that relative to the young, older adults tended to overestimate at lower speeds and underestimate at higher speeds. More specifically, Schiff *et al.* (1992) showed that older women were especially cautious in their arrival-time estimates and even in younger adults there was a bias towards distance compared with velocity information. They conclude that if older women are at greater risk of accident, then inattention or factors other than risky judgement are more likely to contribute.

Overall, the evidence regarding age-related deficits in speed estimation appear inconclusive. One reason for this may be that the majority of these studies were carried out in the laboratory using two-dimensional videos of road traffic situations. These can be visually impoverished and minimise the need for pursuit eye-movements. To the extent that information from eye-movements is used in estimating velocity, the minimization of eye-movements may lead to systematic changes in perceived velocity. One clear implication is that such laboratory results should be cross-checked by measurements at the roadside.

A related problem is that older people may be particularly anxious in road traffic situations. Bootsma *et al.* (1992) investigated the effects of anxiety on distance perception by examining subjects' perception of the reachability of passing objects. Results suggested that the accuracy with which the relevant information and depth cues are picked up can be adversely affected if the perceiver is in a high anxiety state. Thus if the elderly are very anxious while crossing roads they may miss more visual cues to depth, which may make their distance judgement more inaccurate and place them in greater danger. A recent study by Zackay *et al.* (1992) examined whether distance perception is distorted more in an invading condition than in a departing condition, by subjects trying to halt an experimenter at a prespecified distance.

In both conditions subjects wrongly estimated the distance, but this was greater in the invading condition. This study thus suggests that distance estimation of approaching vehicles is more difficult than for departing vehicles, and that people tend to be poor at distance judgements.

Considering the evidence on detecting movement in actual accidents, the reports of the respondents in the Sheppard and Pattinson (1986) study who had seen the vehicle before it hit them are relevant. 41% said it was doing something unusual so that they were taken by surprise. This suggests an inability to anticipate or predict what is likely to happen next in the traffic situation. Vehicles reversing or moving off were frequently mentioned as causing the accident. Indeed, accidents involving reversing vehicles are more common in the elderly than in any other age group. Results of this study suggested that accidents more frequently occurred when the older pedestrian incorrectly judged the course of the vehicle rather than its speed. Another reason given was that the elderly person expected the driver to take evasive action that did not in fact occur. This may reflect unrealistic expectations of what drivers can do and may be linked to a lack of driving experience. Older adults are the least likely group to hold driving licences due to low income levels and physical problems. In the sample, 57% of respondents had never driven, 30% had once driven, and only 13% were still driving. Biehl *et al.* (1970), claimed that 90% of fatally injured pedestrians were non-drivers in a population where 50% possessed driving licences and further that on the basis of pedestrian mileage, pedestrians without a licence were 3–4 times more likely to be involved in a road accident. Licence holders are familiar with the rules of the road and, in particular, limitations of the driver and the vehicle. In contrast, non-drivers may mistakenly presume that the driver is attending to their presence, is able to predict their actions and is prepared to take evasive action. This implies that elderly non-drivers are particularly at risk of being involved in road accidents as a pedestrian, and their difficulties of anticipation may result in part from having little or no driving experience. However, the question of why pedestrians involved in accidents tend not to be licence holders, is not necessarily answered as there may be common factors preventing them from acquiring a licence and for increasing their accident risk.

2.5 Taking evasive action

There is considerable speculation that the diminution of cognitive and motor skills with advancing age decreases the older pedestrian's ability to sense danger and take measures to avoid hazards. Todd and Walker (1980) asked older subjects (60 years and over) and younger subjects (18–59 years) if they had ever been involved in a road accident as a pedestrian or if they had been in a situation where they had felt close to being knocked down. A greater number of incidents reported is to be expected from an older sample given their greater number of years as road users. However, more younger subjects mentioned incidences of 'near accidents' while a greater proportion of older subjects said they had actually been in an accident. This could imply that younger adults find themselves in dangerous traffic situations just as frequently as older persons, but seem more able to prevent 'near accidents' becoming 'real accidents'. Another interpretation concerns a pervasive problem in evaluating evidence across wide age ranges where processes of remembering and forgetting cannot be assumed to be equivalent. Older people, most at risk of a pedestrian accident, may be those who do not perceive a near miss as such and poor retrieval itself may well be associated with other forms of deficit (Martin and Jones, 1984).

However, a number of studies do suggest that older pedestrians are less able to take evasive action in order to extricate themselves from dangerous situations as they develop. Grime (1987) suggests that the time taken to react to a dangerous situation and/or take evasive action is made up of perception time (the time taken to recognise a situation), decision time (the time taken to decide upon an action), and the time taken to put that action into practice. The slower information processing speeds and motor performance impairments already discussed mean that at each of these stages the time taken is increased. In a road situation where the critical time may be measured in fractions of a second, a slower reaction time may be vital in determining the outcome.

The slowness of older pedestrians has been approached from the driver's viewpoint. Todd and Walker (1980) asked them what pedestrians did that frustrated them; replies suggested that pedestrians of 60 years and over tended to dither and hesitate while crossing more than 18–59 year olds. Mathey (1983) suggested that elderly people are often unable to react adequately because they do not plan their traffic behaviour, and because they are less able to recognise special danger points, they are less likely to approach them in a purposeful, appropriate

manner. This is partly confirmed by Sheppard and Pattinson (1986) who found that of the elderly pedestrians who had seen the striking vehicle before it hit them, 35% said they had not seen it too late to take avoiding action.

2.6 Sources of evidence

2.6.1 Individual interview data

One of the major sources of interview data is the Sheppard and Pattinson (1986) study, as already cited above and now reviewed in more detail. They interviewed 473 older people who had been personally involved in a pedestrian accident. Accidents were more common in the 70–74 years age group than the 65–69 years age group. Over 75, however, the numbers decreased as age increased and this outcome is probably attributable to decreasing levels of exposure in the over 80s; two thirds of the sample were women, reflecting population statistics. More specifically, 93% of the sample were crossing the road when the accident happened, 84% of whom said that they had looked before crossing and 79% said that they had stopped at the kerb. Thus it seems that such pedestrian accidents do not normally occur as a result of risky or dangerous behaviour. 41% of respondents said that the striking vehicle was doing something unusual, and that they did not see the vehicle before it was too late. This suggests that a potential problem may lie in an inability to anticipate what will happen in a given set of manoeuvres. Vehicles reversing or moving off were frequently mentioned as causing the accident, as were situations where the older person expected the driver to take evasive action that did not occur. Accidents involving reversing vehicles are more common for older pedestrians than any other age group. This suggests that they are often unable to 'read' the road and predict what may happen next, and may also have unrealistic expectations of what limitations affect drivers' reactions. In the Sheppard and Pattinson sample 57% had never driven, 30% had previously driven and only 13% were still driving. This suggests that non-drivers are particularly at risk of being involved in pedestrian accidents and supports the view that accidents can occur when there is an inaccurate assessment of what will happen next or how the driver will react, both of which may be linked to little or no experience in driving.

In general, the respondents tended to blame drivers' unpredictable behaviour when asked to describe the incident. This may reflect the prevalent inclination to shift responsibility for unpleasant outcomes away from oneself. While it is contentious to blame the victims, it is probable that the pedestrian behaviours contributed to many of the accidents, even though a high percentage said that they stopped and looked before crossing. It may be that those who believe that avoiding accidents is the responsibility of the driver are those who are less willing to follow pedestrian road safety guidelines, and are thus more at risk of being involved in an accident. However, blaming the driver for the accident may not only be the result of a reluctance to accept personal responsibility. Difficulties in judgement and prediction, as previously discussed, may arise from perceptual and cognitive difficulties that are unrelated to questions of personal responsibility. Thus separate intervention programmes may be necessary directed at personal responsibility or developing judgement and prediction skills. Sheppard and Pattinson (1986) did not compare their sample with data from younger adults, so it is difficult to tell how far the problems mentioned, such as inability to detect reversing vehicles, are specific to the older population. It is a common finding in all accident research data that the victim failed to see the vehicle until it was too late and so it is difficult to draw specific conclusions about the problems facing the people interviewed in this study.

Another source of information about the causes of traffic accidents involving the elderly based on interview data is to ask the road safety experts. Sheppard and Valentine (1979) asked 112 Road Safety Officers (RSOs) what they thought were the main difficulties experienced by elderly pedestrians in coping with traffic. The study found that physical limitations were thought to be particularly important, as well as an inability to make judgements and assessments. This is similar to the sorts of problems found in the Sheppard and Pattinson (1986) study. The RSOs also suggest that a reluctance to learn to cope with modern traffic, a

reluctance to admit failing powers and a stubbornness and unwillingness to wear or carry something conspicuous may also contribute to the accident rate. However, similar problems are found in all adults, not just the elderly. Sheppard and Pattinson (1986) suggest that the elderly are unaware of how their 'failing powers' may contribute to accidents, rather than being reluctant to admit them, although it may be difficult for an interviewer to distinguish between these alternatives The RSOs also mentioned fear of not having enough time to cross the road and increasing speed and volume of traffic as being typical responses. However, out of those surveyed, Sheppard and Valentine (1979) found that only 35 offered specific road safety training for this group, and so it is difficult to assess how far the RSOs were aware of the actual needs of those interviewed. The older population is very heterogeneous, and so it is difficult to assess who are the precise target group under consideration.

The general conclusions from the interview data are that older people have difficulty predicting what drivers will do, experience confusion where complex judgements are needed and are not aware of the potential effect of mobility/sensory deficiencies and medication. However, there was little to suggest that older people show overtly risky or inattentive behaviour. All the interview data have achieved is to narrow down the list of problems in ageing which may contribute to accidents, rather than provide explanations. The interviews are useful as a guide for research, but empirical data is also needed if there is to be an adequate analysis of the problems facing elderly pedestrians that lead to accidents. The technique used by Sheppard and Pattinson (1986) is open to criticism as there was a time lag of several weeks between accident and interview, and thus the reports were susceptible to interference effects and memory decay. Both the road safety officers and the elderly people interviewed may have given answers according to stereotyped beliefs rather than what had actually happened, or had been observed. It is not possible to tell how much of the reports were affected by biases in recall, forgetting, what the subjects thought the researcher wanted them to say etc. Self reports are biased by expectations and attitudes, and in an attempt to make sense of what happened the individual may construct an explanation which has little to do with what actually happened. It is difficult therefore to accept these self reports at face value. Asking older people about their road crossing behaviour is problematic, as self reports are affected by their levels of confidence and attitudes towards themselves (Rabbitt and Abson, 1991). If, for example, a group were asked how good they thought they were at crossing roads, it is difficult to predict whether they would compare themselves with younger adults or other elderly people.

2.6.2 Surveys, accident data and levels of exposure

Summarising the results of a large-scale survey, Midwinter (1991) indicates that all but 2% of older people manage to go shopping or on visits to friends and that 85% of them were very or fairly satisfied with their level of mobility. Their main forms of transportation were by car (50%) or bus (24%), involving some pedestrian activity, while 30% only walked. Analyses of journeys may therefore contribute possible explanations for higher pedestrian accidents among older people. For example, an individual making only one shopping journey per week could accrue 1000 road crossings in a year, most of them without any form of signal control. Thus the accumulated probability of unpredicted and dangerous events is substantial.

Another line of explanation is that because older people walk more slowly, they are more exposed to risk. However, Todd and Walker (1980) found that younger adults cross more roads and walk further than older pedestrians, even though the latter spend more time walking. They divided the mean number of casualties per day by the product of the mean value for exposure measure and mid year population estimate for that group, and found that in the 60+ years age group the number of casualties per million roads crossed was 0.50 but the number of casualties per million population was 3.34, and thus concluded that exposure to risk was not an adequate explanation of age differences in casualty rates. Jonah and Engel (1983), employing a different basis for their relative accident risk ratio, found that the use of distance produced higher ratios than use of duration which would relate to the variable of walking speed. Their highest overall level of risk was among children of 8-11, followed by the 65+ group and children of 3–7.

In the recent study by Ward *et al.* (1994) patterns of walking were shown to vary across the age range. For males aged 65 and over the estimate was 1030 metres per person per day, a figure nearly two and half times as far as the corresponding female group. However, accident data considered in relation to the distance walked and the number of roads crossed indicate that older females could be two and half times more at risk of injury as pedestrians than males in the same age group.

An analysis of injury accidents can also help to clarify why older women are more at risk. The Leeds Study (Carsten *et al.* 1989) on the contributory factors in urban accidents has recently been re-analysed by Sabey (1994). She found a large proportional increase in pedestrian accidents among the 70+ age group and that nearly 83 per cent of these accidents occurred between 9 o'clock in the morning and 6 o'clock in the evening. Over 60% involved failure to yield to traffic which in the original study was more prevalent among females and was explained largely by failures to look and failures to see approaching traffic.

2.6.3 Observation of behaviour

Another important source of information about the performance of older pedestrians is observation of their behaviour. Mathey (1983) suggested that they show a tendency to risky behaviour, show little attention and caution, ignore traffic rules and criticise others for things they do themselves. His view was that older pedestrians

"show behaviour tendencies which are evasive, withdrawing and indicative of passive resignation"

This implies that they need to be taught more appropriate behaviour and to follow traffic rules but Mathey (1983) did not produce any empirical data to support his assertion. More often observational studies have sought to identify behaviour that may account for the high accident rate in this group. For example, Wilson and Grayson (1986) investigated differences in road crossing behaviour in adults but failed to find distinctive crossing behaviours within the older group. Such differences as were found indicated trends, perhaps reflecting the heterogeneity of the older population. Thus they concluded that their evidence was insufficient to explain the large differences in accident rate between the two groups.

Harrell (1990) studied the perception of risk and positioning at street corners by older pedestrians. The distance stood from the kerb was taken as an index of risky behaviour in road crossing. He found that elderly pedestrians were the most cautious, standing further away from the kerb than younger adults. Older female pedestrians were the most cautious, standing furthest back; but this group have the greatest risk of injury and death from road accidents. Harrell and Beneska (1992) looked at gap acceptance (the time lag between when a pedestrian leaves the kerb to cross a street and when the next vehicle passes through) as an alternative measure of risk taking behaviour. An earlier observational study using this measure found that younger groups are more risky than older groups and that older pedestrians exercise caution when crossing streets (Harrell, 1991). However, this is not necessarily an indication of how aware they are of hazards or potential causes of accidents.

The results of the observational studies indicate that stopping at the kerb, making head movements, standing further back etc are more common among older pedestrians than their younger counterparts. Whilst indicating greater caution in road crossing behaviour, these behaviours do not necessarily result in greater safety. The balance of caution and confidence is a fine one. Cautious behaviours are not necessarily safe ones, as suggested by the higher pedestrian accident rate among older pedestrians. Adopting cautious behaviours, such as increased head movements during crossing and delay at the kerb, may instil a false sense of security and thus divert attention away from the integration of perceptual and cognitive information. Non-drivers are particularly at risk as they lack some of the knowledge about traffic flow that younger pedestrians either possess or can easily compensate for. It is possible that there is a link between not driving and adopting 'kerb drill' behaviour, as this is particularly prevalent in older non-drivers and children. Additionally, older people may have difficulty in continuously monitoring the situation once action has been started, thus creating problems when the situation changes and a new course of action becomes necessary eg stopping half way across the road where there is no refuge or crossing control. Here the use

of techniques, usually employed to specify details of near-miss accidents between vehicles, may also prove relevant to vehicle–pedestrian interactions. Muhlrad (1993) suggests that a safety diagnosis based on behavioural observation at particular sites may be used to check hypotheses derived from accident data or may even help to formulate new hypotheses. Data on critical incidents, comparable to traffic conflicts, are analysed to identify factors that are potentially associated with accidents.

2.7 Overview

The stereotype of the older person as being incompetent, risky and unaware of potential hazards suggested by, for example, Mathey (1983) has been challenged by the observational studies discussed. The results of these and the interview data suggest that the problems may be critically related to an inability to make complex judgements rapidly and to predict what drivers' intentions are and what limitations apply. Problems with hearing and vision, lack of recent experience as a driver, slower processes of anticipation, as well as limitations in speed of reaction, may all contribute. So there is likely to be a double disadvantage: less time as a result of slower decision making but more time required to get out of the way of a potential collision.

While older people show some awareness of these problems, as indicated by their cautious (compensatory) crossing behaviour, this awareness is not necessarily reflected in the self reports of their own behaviour and attitudes. Nor are their behaviours necessarily safe in the sense of decreasing risk of accident involvement. Accordingly, it is important to try and distinguish between behaviours that are safe rather than cautious, rather than simply following the kerb drill of 'Stop Look and Listen'. Rumar (1989) suggested that basic road user error is the failure to detect other road users in time to take appropriate action. Rumar noted two important factors; a) failure to look for a specific user or in a specific direction and b) failure to perceive the relevant stimuli. The first failure may be most common in older non-drivers, as they do not know what to look out for. The latter failure may also be common among older people as a result of their declining sensory abilities. Chapman *et al.* (1982) recommend returning to this sort of basic problem definition on which to base intervention programmes. It is a waste of time teaching certain skills, eg to stop at the kerb, if this already occurs and is unrelated to the high pedestrian accident rate. Rather, it may be important to recognise the problems of the older pedestrian in terms of road layout and design.

Chapter 3 The older pedestrian – 1 The area interviews

3.1 Interview sample and questionnaire summary

A lower age limit of 65 years was set for respondents but no upper age limit was proposed apart from the qualification that the participants were active pedestrians on at least a weekly basis and that they were able to respond to the interview questions in an adequate manner. The aim set for a minimum sample number for each district was set at 45 respondents (45 x four districts = 180 respondents) with data collection continuing in each district until that figure was obtained. It was not anticipated in advance that a fixed proportion of men to women should be sought within any one district housing cluster but the overall expectation was that a ratio of about 2:1 in favour of women would be interviewed as is the case for the gender distribution for the general population in this age range.

In the event, data were obtained for 215 respondents from the interviews. The breakdown for their distribution in terms of district, age and gender is set out in Table 3.1. The map in Figure I.2 shows the four interview areas in relation to the city centre and Appendix A provides statistical information and pen pictures of each area.

Table 3.1

Population sample for interviews

		Age		Age		Age		Total	
	Gender	65–74		75–84		85+			
Area									
Barrack Road	Male	14	(2)	7	(4)	0	(0)	21	(6)
	Female	17	(4)	9	(3)	7	(6)	33	(13)
Benwell	Male	4	(1)	4	(2)	1	(1)	9	(4)
	Female	9	(4)	23	(8)	4	(2)	36	(14)
Halls Estate	Male	7	(0)	8	(0)	2	(0)	17	(0)
	Female	24	(0)	17	(0)	2	(0)	43	(0)
North Heaton	Male	18	(0)	10	(0)	1	(0)	29	(0)
	Female	15	(0)	12	(0)	0	(0)	27	(0)
Total	Male	43	(3)	29	(6)	4	(1)	76	(10)
	Female	65	(8)	61	(11)	13	(8)	139	(27)
Sum		108	(11)	90	(17)	17	(9)	215	(37)

Brackets ( ) show population included from sheltered housing

It was estimated that the average interview could be completed within about an hour so that, together with canvassing, two to three interviews could be carried out within the day, but this estimate was found to vary depending on the actual number of older people living in a particular area and the acceptance rate. The questionnaire was divided into six main sections: (a) personal details; (b) details of up to four typical journeys made during a week; (c) changes in ability to cope as a road user; (d) accident history over the past three years; (e) general concerns and anxieties; and (f) attitudes to road use, including instances of risks taken. The full questionnaire is reproduced as Appendix B.

3.2 Driving experience

Driving experience was strongly related to social area and gender. Less than a quarter of the males interviewed reported that they had never driven, this proportion remaining roughly consistent across areas. None of the females interviewed in Benwell had ever held a driving licence and more than three quarters of the females interviewed in the Barrack Road area had never driven. In contrast, only 40% of the female interviewees in North Heaton had never

driven. In Halls Estate, 43% of the female respondents aged between 65 and 74 years had never driven compared with some 80% of those between 75 and 84. Those that had driven in the last year were predominantly from the privately owned or privately rented housing areas of North Heaton and Halls Estate.

Table 3.2

Driving experience of interview sample

		% of sample population having driven in the last year						% of the sample who have never driven					
	Age:	65–74	*n*	75–84	*n*	85+	*n*	65–74	n	75–84	n	85+	n
Area		%		%		%		%		%		%	
Barrack Road	Male	21.4	14	0.0	7	-	0	28.6	14	28.6	7	-	0
	Female	0.0	17	0.0	9	0.0	7	76.5	17	77.8	9	100.0	7
Benwell	Male	0.0	4	0.0	4	0.0	1	25.0	4	25.0	4	-	1
	Female	0.0	9	0.0	24	0.0	4	100.0	9	100.0	24	100.0	4
Halls Estate	Male	85.7	7	25.0	8	0.0	2	14.3	7	12.5	8	0.0	2
	Female	30.4	24	5.9	17	0.0	2	43.5	24	82.4	17	50.0	2
North Heaton	Male	44.4	18	40.0	10	100.0	1	25.8	18	20.0	10	0.0	1
	Female	46.7	15	16.7	12		0	40.0	15	41.7	12	-	0

n indicates the numbers for each area/age/gender

3.3 Travel patterns

In questioning respondents about how often they went out and how they travelled, only a very small minority reported going out only once or twice a week. The majority claimed to go out, whether locally or further, most days and this would tend to involve some walking in or near traffic. Those who reported going out less often than once a week because of extreme frailty or handicap were not interviewed.

Table 3.3

Travel patterns

Barrack Road

% Population	Most days	3–4 times a week	Once or twice a week	Less often	Rarely or never
Walking in or near traffic	68.8	14.8	13.0	0.0	3.7
Bus	37.0	29.6	22.2	3.7	7.4
Metro	1.9	0.0	13.0	18.5	66.7
Drive	0.0	0.0	1.9	1.9	96.3
Being driven	0.0	1.9	24.1	37.0	37.0
Taxi	0.0	0.0	11.1	22.2	66.7

Benwell

% Population	Most days	3–4 times a week	Once or twice a week	Less often	Rarely or never
Walking in or near traffic	55.6	20.0	24.4	0.0	0.0
Bus	24.4	28.9	26.7	4.4	15.6
Metro	0.0	2.2	8.9	22.2	66.7
Drive	0.0	0.0	0.0	0.0	100.0
Being driven	0.0	11.1	20.0	26.7	42.2
Taxi	0.0	0.0	11.1	15.6	73.3

Halls Estate

% Population	Most days	3–4 times a week	Once or twice a week	Less often	Rarely or never
Walking in or near traffic	85.0	8.3	5.0	0.0	1.7
Bus	16.7	38.3	25.0	3.3	16.7
Metro	1.7	20.0	28.3	13.3	36.7
Drive	15.0	3.3	3.3	0.0	78.3
Being driven	0.0	5.0	16.7	30.0	48.3
Taxi	0.0	0.0	5.0	21.7	73.3

North Heaton

% Population	Most days	3–4 times a week	Once or twice a week	Less often	Rarely or never
Walking in or near traffic	69.6	12.5	16.1	0.0	1.8
Bus	16.1	23.2	46.6	5.4	8.9
Metro	0.0	1.8	19.6	19.6	58.9
Drive	8.9	14.3	10.7	0.0	66.1
Being driven	5.4	5.4	33.9	25.0	30.4
Taxi	0.0	0.0	5.4	16.1	78.6

Note: The use of train or bicycle is negligible for all groups.

3.3.1 Modes of transport

Based upon the four most common journeys reported by each respondent, the principal modes of travel for males and females in the four areas is shown in table 3.4. Overall, about 75% of journeys entail using the bus or walking. 17% of men's journeys and 12% of women's journeys involved driving or being driven in a private car.

Table 3.4

Modes of transport

Area	Travel mode: (% of journeys)	Walk	Bus	Metro train	Drive	Driven	Taxi	Ambulance or minibus	Other or mixed
Barrack Road	Male	56.2	38.4	0.0	1.4	0.0	0.0	2.7	1.4
	Female	42.5	45.0	0.8	0.0	8.3	0.8	0.0	2.5
Benwell	Male	50.0	32.4	0.0	0.0	11.8	5.9	0.0	0.0
	Female	44.9	38.4	0.0	0.0	4.4	2.9	5.8	3.6
Halls Estate	Male	44.1	14.7	5.9	26.5	2.9	0.0	0.0	4.4
	Female	44.1	26.2	8.9	7.7	6.6	1.2	0.0	5.4
North Heaton	Male	38.9	28.3	0.0	22.1	2.7	0.9	0.9	5.3
	Female	35.2	35.2	0.0	11.1	12.0	2.8	0.9	2.8
Mean % Journey	Male	47.3	28.4	1.5	12.5	4.3	1.7	0.9	2.8
	Female	41.7	36.2	2.4	4.7	7.8	1.9	1.7	3.6

3.3.2 Function of journey

Although journeys may involve mixed functions, the main purpose of respondents' journeys was noted. If the main purpose was to shop, then secondary events such as going to the bank, post office or a café are not considered in this analysis. As indicated in Table 3.5, shopping comprised the majority of outings, nominally less for males than females, and representing two out of every three trips out. Journeys for the purpose of sport, cinema, classes or even to the park were too rare to warrant detailed analysis.

Table 3.5

Purpose of journeys

	Barrack Road	Benwell	Halls Estate	North Heaton
	%	%	%	%
Shopping, post office or bank	61	72	58	66
Church or community group	4	6	4	7
Pub or social club	10	8	4	4
Cafe/luncheon club	2	8	1	1
Visiting friends or family	7	5	7	10
Just walking	5	1	12	8
Other	11	2	14	4

3.3.3 Destinations

Different areas of residence yielded differences in destinations, such as shopping centres. A common destination was found to be the city centre which was the target for 40% of journeys from Barrack Road, 21% from Benwell, 15% from Halls Estate and 17% from North Heaton. Barrack Road residents undertook about 31% of their journeys within their own immediate area. Benwell residents accomplished 68% of their journeys in the Benwell, West Road or Elswick area. Halls Estate residents accomplished 63% of their journeys in the region of their estate or near Gosforth High Street. North Heaton residents completed 60% of their journeys in the Benfield Road, Chillingham Road and Heaton Road locality.

3.3.4 Distance travelled on journeys

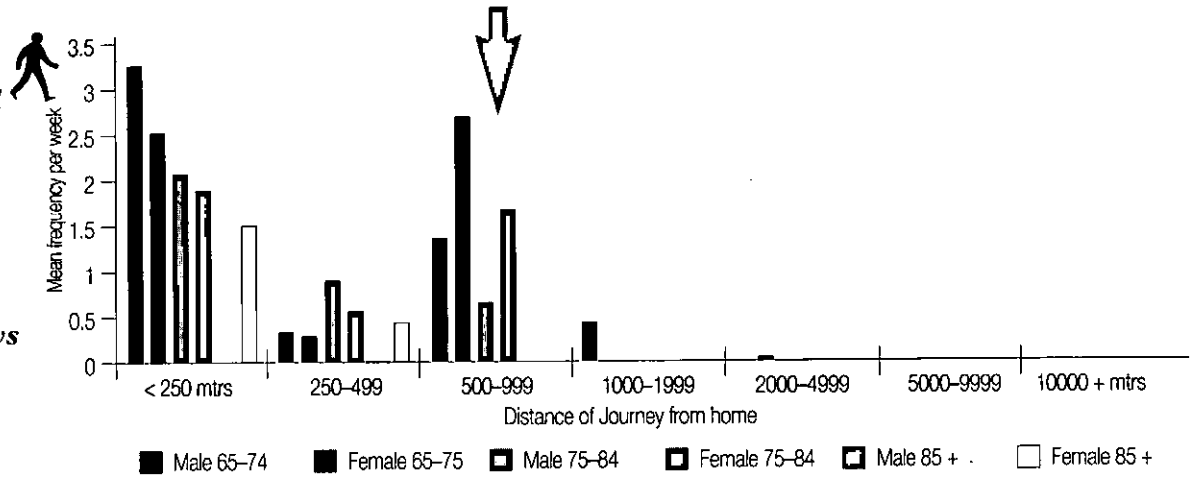
Given that the majority of journeys were by foot, bus or, to a far lesser extent, by car, and given that a respondent's location of residence with respect to shops and other facilities bears a large influence on travelling habits, average journey frequencies by mode, distance, age and gender are shown graphically for each location in Figures III.1 – III.4. It can be seen that most journeys less than 250 metres are undertaken on foot, with some exceptions, whereas journeys over one kilometre are much less commonly walked. The data give an overall indication of frequencies and distances of travel, and indicate that the 'average' older person in the survey went on three or four journeys a week on foot and about two by bus or Metro (the rapid transit system on Tyneside). These figures for walking are comparable with the ranges reported in the Northampton study by Ward *et al.* (1994), where 59% of those 65 and over walked on the survey day.

Figure III.1

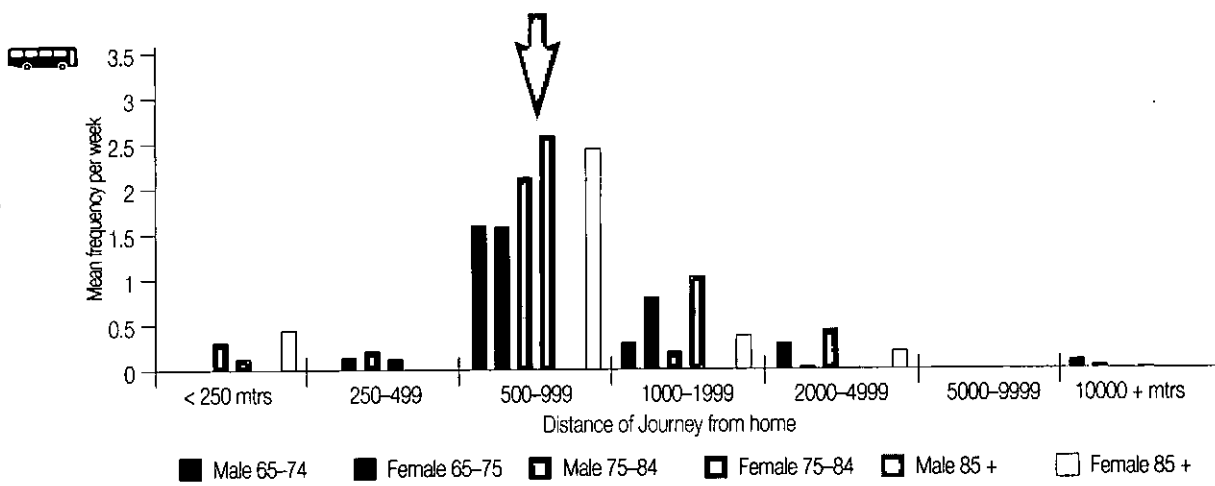
Barrack Road

Journey Distances, (in metres)

Walking Journeys



Bus Journeys



Private Car Journeys (driving or driven)

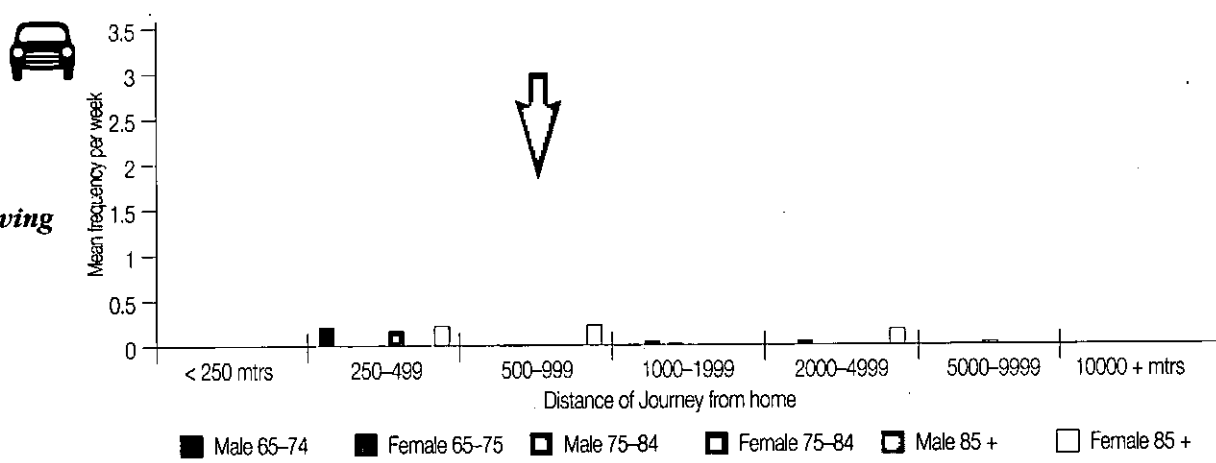
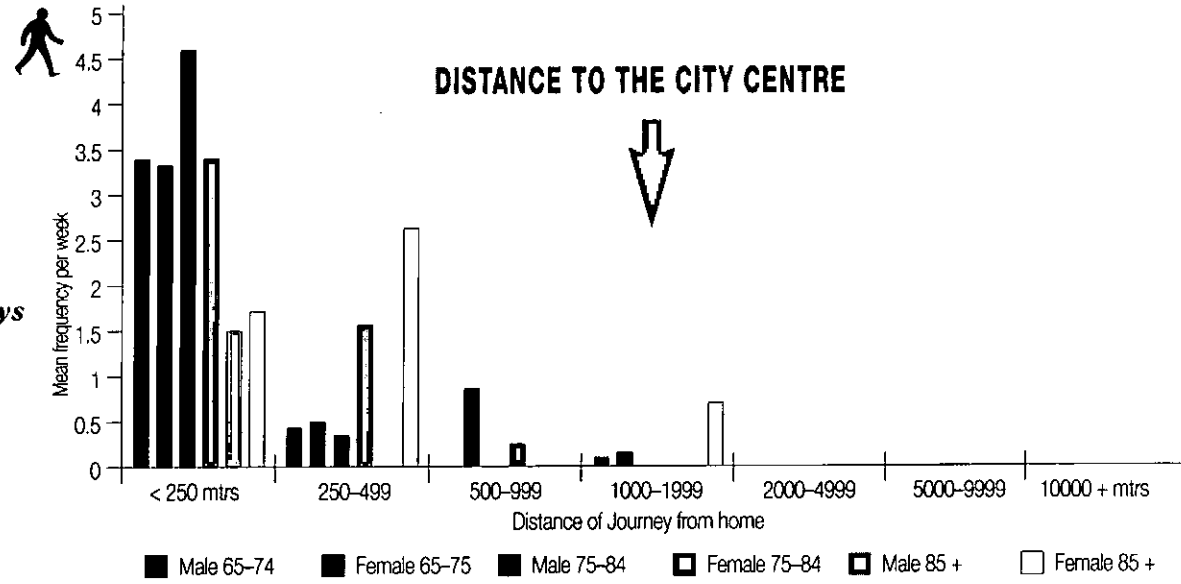


Figure III.2

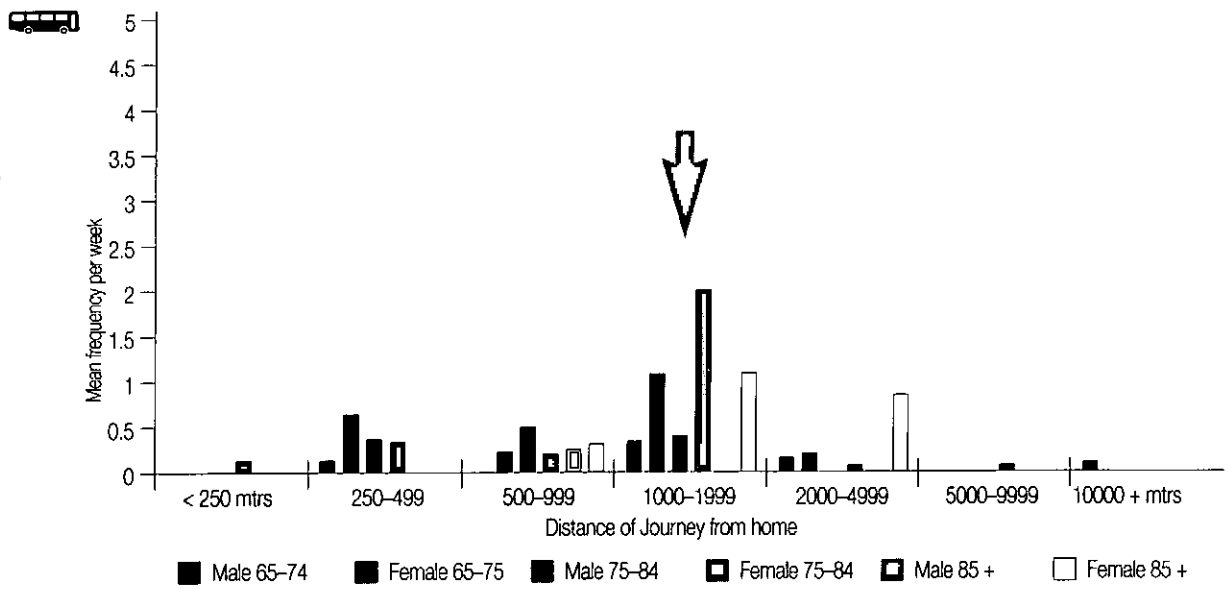
Benwell

Journey Distances, (in metres)

Walking Journeys



Bus Journeys



Private Car Journeys (driving or driven)

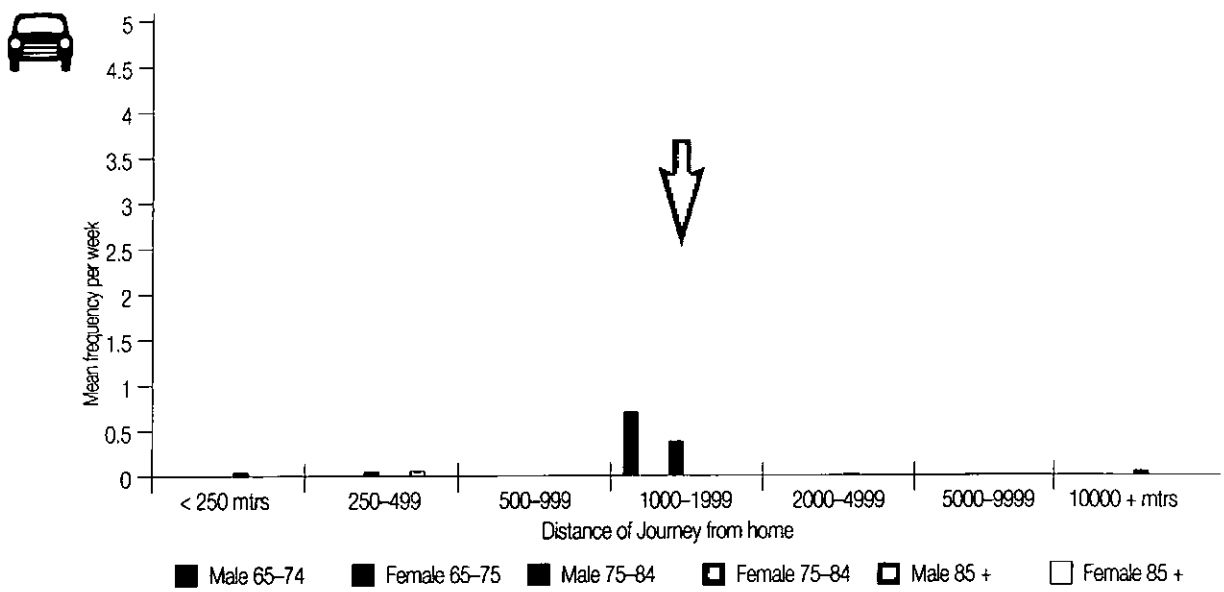
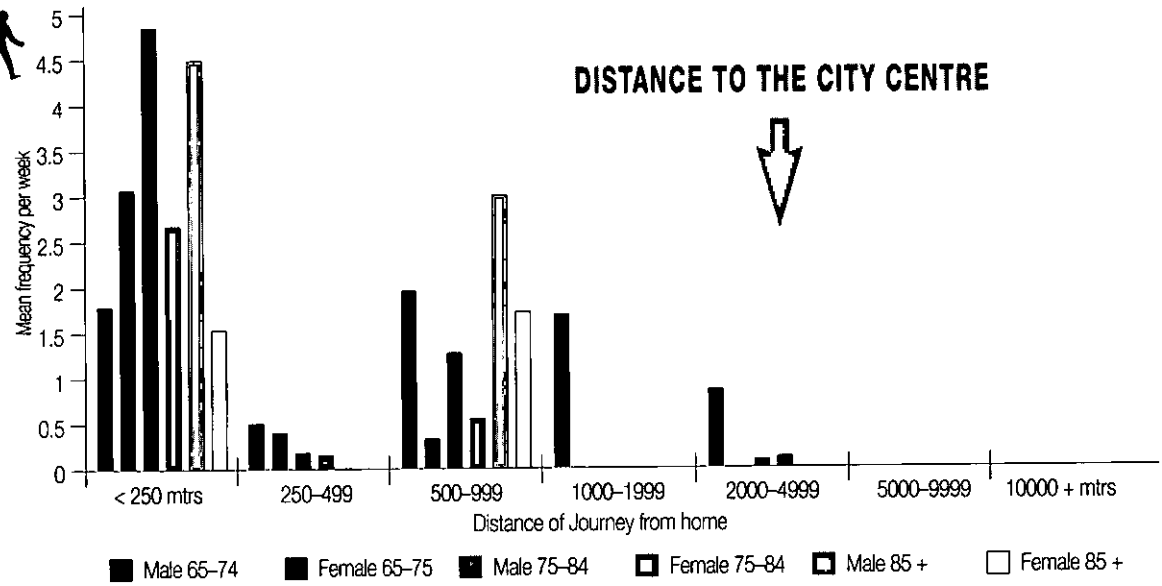


Figure III.3

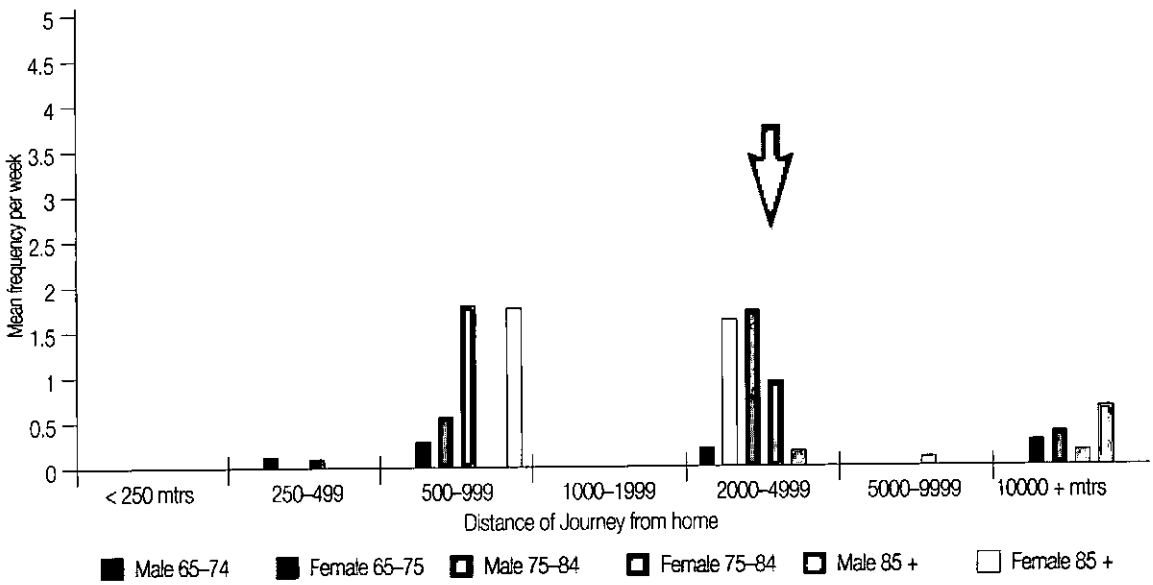
Halls Estate

Journey Distances, (in metres)

Walking Journeys



Bus and Metro Journeys



Private Car Journeys (driving or driven)

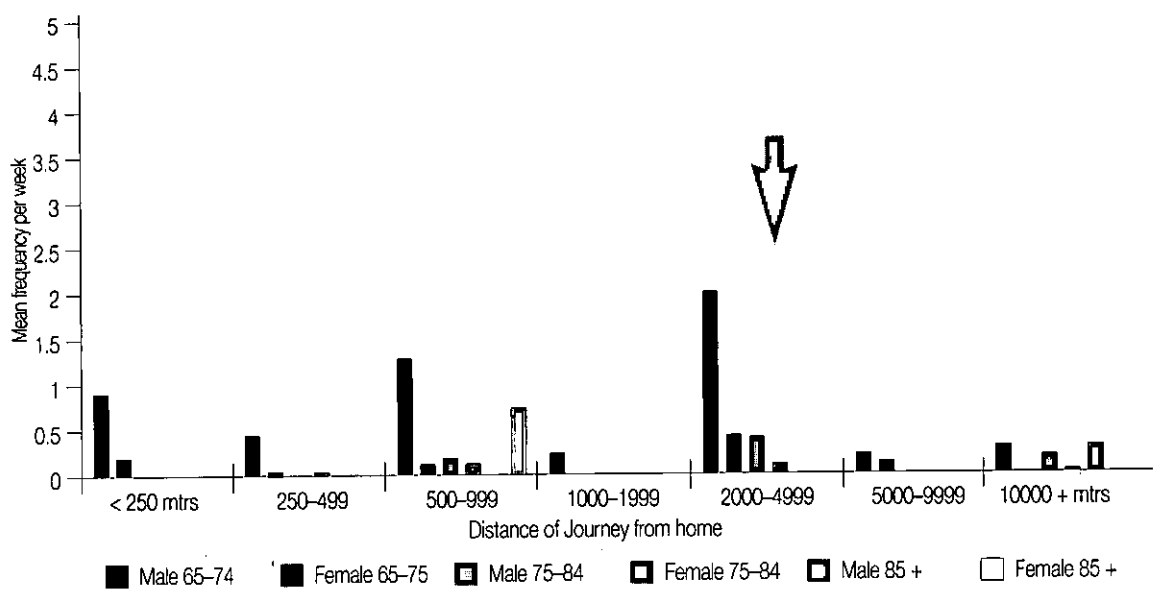
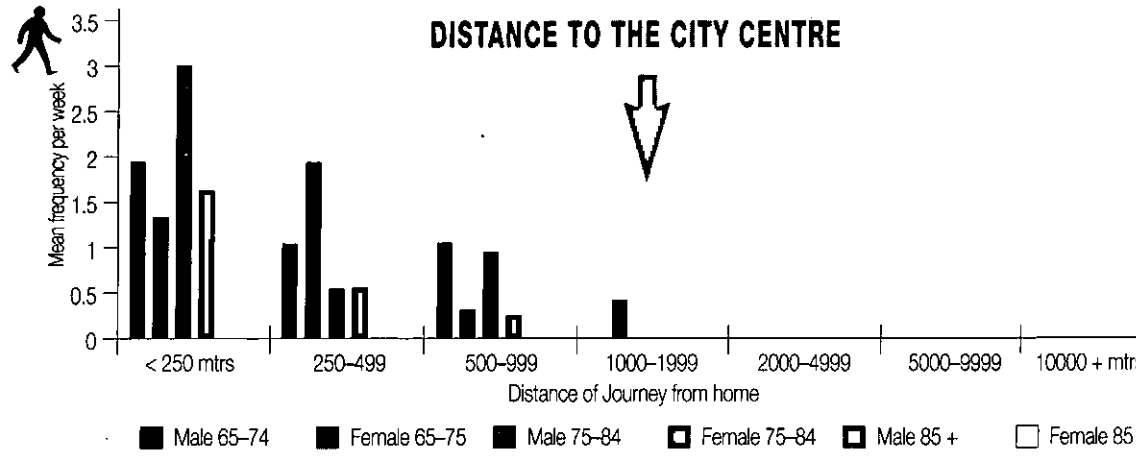


Figure III.4

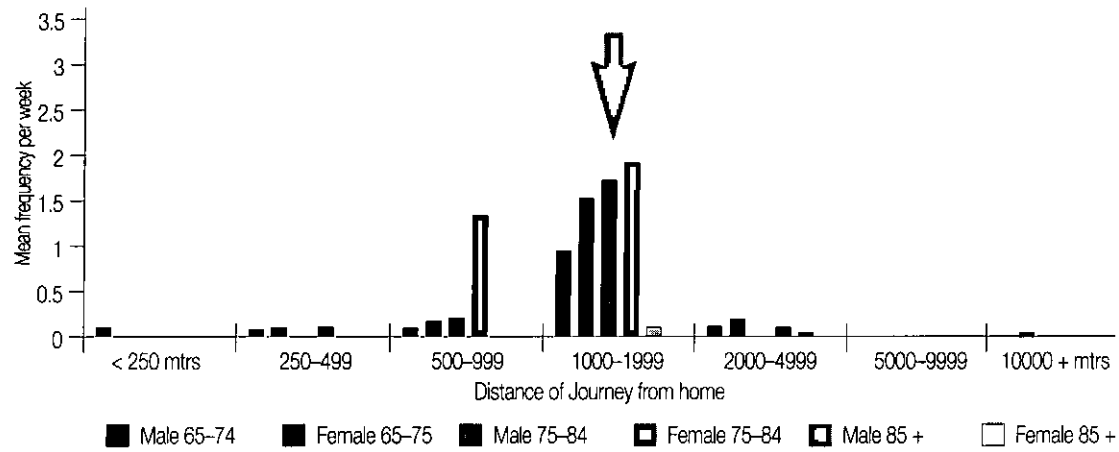
North Heaton

Journey Distances, (in metres)

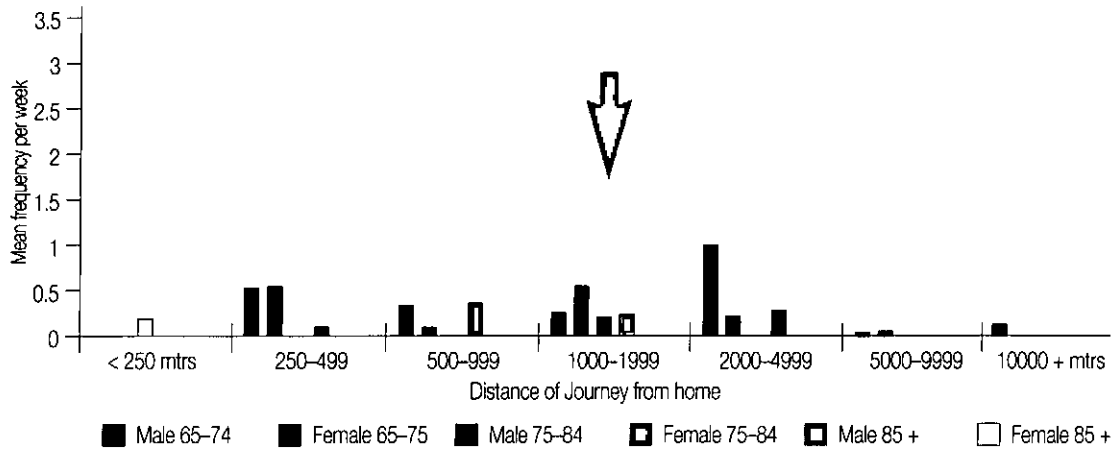
Walking Journeys



Bus Journeys



Private Car Journeys (driving or driven)



3.3.5 Types of roads crossed

Journey details were scrutinised to find the general type of roads which the interviewees would, by implication, need to cross. It is not possible to detail where and how often the respondent would cross on a particular journey, for example to the city centre. Nevertheless 50% of journeys implicated crossing at least once in a high street or city centre environment. Additionally, 62% of journeys implicated crossing other local, district or primary distributor roads.

3.4 Health issues

Set h of the interview questionnaire in Appendix B refer to health issues and are considered in that order. Difficulty or discomfort in walking was clearly an important feature. The proportion of the population always depending on support of a stick or frame to walk predictably increased with increasing age: no females in the 65–74 years age group, rising to 11% in the 75–84-year-old group and 15% in the 85+ group; of the males, 10% in the youngest group, rising to 17% of the 75–84-year-olds and 25% of the over 85s always relied on a stick or frame The proportion of individuals who suffered moderate or very much discomfort walking any distance also increased with age. Of the younger females (65–74 years), 29% suffered moderate or very much discomfort. In the middle age group (75–84 years) the proportion increased to 44% and in the older group this increased to 46% of the respondents. The data for men were comparable.

In terms of whether an individual thought they were slower than most people crossing the road, 29% of the younger (65–74 years) female respondents thought this was the case, compared with 44% of the 75–84-year-olds and 54% of the over 85s. The same pattern was not evident for males. In the younger age group (65–74 years), 40% of males thought they were slower, compared with 41% of the 75–84-year-olds.

Sense of balance was also acknowledged as an ability that could no longer be taken for granted. Of the females, 28% of the younger (65–74 years) group, 31% of the middle (75–84 years) and 38% of the older (85+) respondents thought that their balance was a fair bit or very much worse than when they were in their 40s. There was a noticeably steeper change for men with 17% of the younger (65–74 years) men and 41% of the 75–84-year-old men thinking that their sense of balance was a little or very much worse.

The ability to see distant objects clearly showed deterioration, even when corrected by spectacles if normally worn. Of the youngest women interviewed (65–74 years), 11% considered they were a fair bit or very much worse than when they were in their 40's. This figure rose to 18% for the 75–84 year olds and 38% for the oldest group (85+). In the case of men, 14% of the 65–74-year-olds thought their distance vision was a fair bit or very much worse, rising to 28% of the 75–84-year-olds. Some degree of hearing impairment was recognised by 43% of the youngest female interviewees (65–74 years), rising to 85% in the oldest group (85+). A high (71%) proportion of the youngest male respondents (ages 65–74) considered they had some noticeable hearing loss falling to 63% in the 75–84-year-old group.

Older respondents were more likely to admit falls caused by balance, vision or becoming faint. More than 80% of those in the youngest age group said that this did not occur at all. This fell to 69% of those in the 75–84 years group and 50% in the 85+ group. In terms of judging whether the speed and distance of traffic left them enough time to cross, or in terms of anticipating the progress and intentions of traffic, roughly half of the respondents thought themselves no worse than they used to be. The proportion of females thinking that they were worse by a fair bit or very much showed an increase with age, especially in judging speed and distance (14% in the youngest group rising to 24% in the 75–84-year-old group and 30% among the over 85s). Interestingly, the proportion of males reporting this fell (17% in the youngest group falling to 7% in the 75–84-year-old group).

The proportion of individuals who reported that they drank alcohol when going out showed a general decrease with age for both males and females. For females, the number who said they never or hardly ever drank when going out increased from 80% among those between the ages of 65 and 74 to 95% among the 75–84 years old group and 100% among the over 85s. A greater likelihood of alcohol consumption existed among the men. The proportion of men in the 65–74 years group who reported that they never or hardly ever drank was 36%, compared with 62% of those aged 75–84 years. There are no data to quantify an individual's alcohol intake but denial of drinking patterns would have been difficult given that journey destinations and routes were already known to the researcher on reaching this question. The findings, therefore, clearly would not support any conjecture that the increased likelihood of accidents for older females is related to drinking.

Asked about whether they took medication which might affect their alertness, respondents often seemed unsure. Among the women, those that thought not, fell from 83% in the younger age band to 68% in the 75–84-year-old band; but this increased to 92% among the 85+ group. Among the men, the proportion who considered that they did not take such medication remained roughly constant at about 83% across ages. This may suggest an increase in the likelihood of drug enhanced impairment in women in the 75–84 year age band.

A factor analysis of the main items of this health related question set was attempted. This was done using the Principal Components method with Varimax rotation which is a common method of investigating which items in a set tend to reflect common underlying dimensions of response which might reflect common components or causes between items. The result was a two factor solution. The first factor (Health f1) accounted for 28% of the variance and represented a common underlying trend grouping poor fitness, balance, poor vision, judgement and falls. The second significant factor (Health f2), accounting for a further 16% of the variance, generally represented positive physical fitness, including good perceived balance but not related one way or another to other sensory or judgement skills or deficiencies.

When routines from the SAS computing package (SAS Institute, 1985) are used to score individuals on each factor, the scores represent the essential non–overlapping components of the factors. Thus the Health f1 score represents poor balance, sensory and judgement skills which correlates with age ($r=0.22$, $p<0.002$) and being female rather than male ($r=0.24$, $p<0.0005$). The Health f2 score (physical ability or mobility) does not correlate with age ($r=0.01$, $p<0.85$) but correlates with being female ($r=0.30$, $p<0.0001$). These scores need not be considered specifically for distinguishing between ages or genders in which case the correlations are in any case statistically significant but low. Instead, they can be later considered as revealing relationships between other aspects of the questionnaire.

3.5 Concerns

In addition to asking directly about problems or difficult situations which respondents encountered on their normal journeys, the questionnaire contained three sections which investigated the issue of concerns at different levels. In Appendix B, set d questions involved a list of issues which might restrict or discourage an individual from going out and was oriented towards conditions that might affect this decision. Question set g investigated concerns and anxieties of a more general and mixed nature and set h represented an investigation of how the individual felt as a pedestrian, for example, crossing the road.

3.5.1 Issues of general concern

Responses to set g questions are ordered and presented in table 3.6 below. Responses by males and females are separated and show that the level of expressed concern for each presented issue tended to be lower for males than females, but not invariably, nor to any marked degree.

Of greatest general concern or anxiety was violent crime and house theft. Comparatively low in the ranking of concerns was, as a pedestrian, having to compete with traffic to cross the road, or the maintenance of a good local transport system. Traffic accidents appeared to rank similarly with provisions in the Health Service, of less concern than traffic speeding in residential streets, which again was of less concern than the state of the pavements.

In spite of 'competing with traffic' ranking low as a professed concern, it may be important to note that some 39% of men and 44% of women claimed some concern or anxiety. Furthermore, it may have been felt by respondents to reflect some negative connotation about themselves and could thus appear lower in ranked concern than it might otherwise have been.

In order to determine whether any pattern of responses might exist for this question set, a Principal Components factor analysis was attempted and again suggested two main factors which represented 23% and 22% of the variance respectively. Isolating items which were exclusive to or dominantly weighted on each factor, it was found that neither violent crime nor house theft was exclusive to either factor, possibly suggesting that for some individuals, violent

Table 3.6

Concerns and anxieties expressed (in descending order)

Type of concern	Gender	Doesn't bother me %	Concerned %	Anxious %	Mean rating
Violent crime	f	11.6	26.8	61.6	2.5
House theft	f	15.2	31.9	52.9	2.4
Violent crime	m	18.0	40.0	44.0	2.3
House theft	m	16.0	38.7	45.3	2.3
The state of the pavements	f	16.7	47.1	36.2	2.2
The level of unemployment	f	23.9	37.0	39.1	2.2
The level of unemployment	m	24.0	45.3	30.7	2.1
The 'cost of living'	m	24.0	45.3	30.7	2.1
Traffic speeding in residential or shopping areas	f	29.0	35.5	35.5	2.1
The 'cost of living'	f	32.6	33.3	34.1	2.0
Traffic speeding in residential or shopping areas	m	30.7	42.7	26.7	2.0
The state of the pavements	m	24.0	58.7	17.3	1.9
The amount of traffic	f	38.4	30.4	31.2	1.9
Provisions in the Health Service	m	36.0	36.0	28.0	1.9
Traffic accidents	f	40.2	27.2	32.1	1.9
The amount of traffic	m	37.3	40.0	22.7	1.9
Provisions in the Health Service	f	42.0	34.1	23.9	1.8
Traffic accidents	m	42.7	34.7	22.7	1.8
International events and conflicts	f	46.4	27.5	26.1	1.8
International events and conflicts	m	41.3	40.0	18.7	1.8
The maintenance of a good local transport system	f	47.1	31.2	21.7	1.8
Standards of education	f	48.6	29.0	22.5	1.7
Standards of education	m	48.0	36.0	16.0	1.7
Changes in the environment due to pollution	f	54.4	24.6	21.0	1.7
As a pedestrian, having to compete with traffic to cross	f	55.8	24.7	19.6	1.6
The maintenance of a good local transport system	m	53.3	30.7	16.0	1.6
Changes in the environment due to pollution	m	53.3	33.3	13.3	1.6
As a pedestrian, having to compete with traffic to cross	m	61.3	24.0	14.7	1.5

crime and house theft were thought of as relating to other items in the first factor (Concerns f1), whereas other individuals considered that violent crime and house theft related to other items in the second factor (Concerns f2).

Dominant in the first factor (Concerns f1) were, in order: the amount of traffic; as a pedestrian having to compete with traffic to cross the road; traffic speeding in residential or shopping areas; the state of the pavements; and traffic accidents. Dominant in the second factor were: provisions in the health service; international events and conflicts; standards of education; changes in the environment due to pollution; and, marginally, the maintenance of a good local transport system. Roughly, these two factors therefore appear to represent concern or anxiety about road and pavement safety (Concerns f1) and other more global concerns (Concerns f2).

After allowing the SAS package to score individuals according to these factor structures, it was noted that neither factor was significantly related to age or gender as such but there was a moderate and significant correlation ($r=0.37$, $p<0.0001$) between Concerns f1 and Health f1 scores, representing poor balance, sensory and traffic judgement skills. Thus concern or anxiety within the traffic environment is related here to those skills deteriorating with age and lower in the female versus the male sample population.

3.5.2 Issues concerning going out

Part of the questionnaire (d items) specifically concerned issues which might restrict or deter an individual from going out and are summarised in Table 3.7. Again, questionnaire items are presented in order of reported influence or effect and distinctions between gender responses are retained.

Table 3.7

Reasons attributed for not going out (in descending order)

Type of reason	Gender	Very much %	Quite a lot %	A little %	Not at all %	Mean rating
Anxiety about being out late	f	38.1	31.7	7.9	22.3	2.9
Concern about violence or crime	f	30.9	30.2	16.6	22.3	2.7
Cold or wet weather	f	13.0	26.1	23.9	37.0	2.2
Concern about violence or crime	m	12.0	18.7	17.3	56.0	2.0
Personal health or tiredness	f	8.6	17.3	25.9	48.2	1.9
Personal health or tiredness	m	13.2	13.2	19.7	54.0	1.9
Discomfort walking or walking difficulty	f	7.2	16.6	25.2	51.1	1.8
Cold or wet weather	m	4.0	20.0	26.7	49.3	1.8
Discomfort walking or walking difficulty	m	10.5	10.5	25.0	54.0	1.8
Anxiety about being out late	m	9.3	17.3	6.7	66.7	1.7
The state of the pavements	f	4.3	9.4	21.6	64.8	1.5
Feeling conspicuous or uneasy going to some places	f	5.8	7.9	18.0	68.4	1.5
Traffic to dangerous	f	6.5	5.0	13.7	74.8	1.4
The state of the pavements	m	2.7	4.0	17.3	76.0	1.3
Poor street lighting	f	1.4	5.0	10.1	83.5	1.2
Poor eyesight	f	0.7	5.0	8.6	85.6	1.2
Traffic too dangerous	m	2.7	2.7	8.0	86.7	1.2
Having to look after someone	f	2.9	2.2	1.4	95.5	1.2
Poor eyesight	m	1.3	4.0	4.0	90.7	1.2
Inconvenience of getting to or waiting for bus	f	0.0	3.6	5.8	90.7	1.1
Poor street lighting	m	2.7	1.3	2.7	93.3	1.1
Feeling conspicuous or uneasy going to some places	m	0.0	5.3	2.7	92.0	1.1
Having to look after someone	m	0.0	2.7	8.0	89.3	1.1
Lack of information about available activities	m	1.3	1.3	0.0	97.3	1.1
The cost of using public transport	f	0.0	0.7	3.6	96.6	1.1
Lack of information about available activities	f	0.0	0.7	4.3	95.0	1.1
Inconvenience of getting to or waiting for bus	m	0.0	0.0	5.3	94.7	1.1
The cost of using public transport	m	1.3	0.0	1.3	97.3	1.1

Anxiety about being out late and concern about violence and crime were clearly offered as restrictions, particularly by women. Informally, respondents (particularly female respondents) would offer that they would never be out after dark, or never unaccompanied. Apart from the weather, poor health and walking discomfort or difficulty, other issues such as the traffic, cost

of public transport or the state of the pavements did not seem common restrictions or discouragements with regard to the decision to leave the house for some journey.

Factor analysis of this question set was undertaken, in particular to discover which items could be associated. This suggested a four factor solution (Discourage f1–Discourage f4). The principal factor (Discourage f1) accounted for 19% of the variance and was dominated, in order, by the following: discomfort walking or walking difficulty; personal health or tiredness; cold or wet weather; traffic too dangerous; the inconvenience of getting to or waiting for buses, the Metro or trains; and the state of the pavements. The second factor (Discourage f2) accounted for 15% of the variance and was dominated by: the cost of public transport; lack of information about available activities; poor street lighting; and the inconvenience of buses, the Metro or trains. The third factor (Discourage f3) again accounted for 15% of the variance overall and was particularly dominated by: concern about violence or crime; and anxiety about being out late. The fourth factor (Discourage f4) accounted for 11% of the overall variance and was dominated by: having to look after someone; poor eyesight; feeling conspicuous or uneasy going some places alone and the state of the pavements.

Scores were allocated in the same way to individuals according to the loadings of individual questions on each factor. Clear but opposite relationships obtained: Discourage f1, which superficially resembles physical discomfort or difficulty was positively and strongly correlated with the factor Health f1 ($r=0.57$, $p<0.0001$) and negatively but strongly correlated with Health f2 ($r=-0.46$, $p<0.0001$). This discouragement factor was therefore associated with sensory balance and judgement skills and poor physical mobility.

The factor Discourage f2, which represented a perhaps uninformed or unmotivated approach, did not appear to relate to any other underlying measure abstracted from the questionnaire. The factor Discourage f3, again reflecting concern about violence, correlated with being female ($r=0.41$, $p<0.0001$), with Concerns f1 ($r=0.27$, $p<0.0001$), with Health f1 ($r=0.27$, $p<0.0001$) and with Health f2 ($r=0.25$, $p<0.0002$) as might be anticipated by its female attribute mentioned above.

The factor Discourage f4, dominated by having to look after someone, feeling conspicuous or uneasy going alone, poor eyesight and the state of the pavements was the weakest of the four factors and might be suggested to reflect some social withdrawal which bears a low ($r=0.26$, $p<0.0002$) correlation with Health f1 representing poor balance, sensory and traffic judgement skills, and a low correlation with Concerns f1 ($r=0.22$, $p<0.002$) which represents general concern or anxiety about road and pavement safety. If the Discourage f4 factor does indeed measure some underlying degree of social withdrawal its weak association with Concerns f1 is likely to be spuriously generated by the correlation between Health f1 and Concerns f1, ie a potential outcome of sensory and/or intellectual impairment.

3.5.3 Feelings as a pedestrian

Question set h was specifically intended to probe how individuals felt as a pedestrian crossing the road. Questions were deliberately mixed in nature to allow respondents to represent themselves as nervous, cautious or risk-taking and to measure to some degree how confident individuals may feel about particular aspects of the road environment. Respondents were encouraged to provide an answer of 'true' or 'false' to each of twenty three statements. Nevertheless, 'don't know' responses were recorded and treated as mid-points at the factor analysis stage.

Overall the data suggest a significant degree of anxiety and uncertainty, particularly among the female respondents. Females were more likely to claim often feeling nervous about crossing, to be less likely to try to cross without holding up the traffic at the lights, to be more likely to go out of their way to find a proper crossing place and to be less likely to take a quick opportunity to cross rather than wait. There were ominous indications in the data: (i) *a significant majority of respondents seemed to feel that crossing with and even relying on*

moving with a group of others while crossing was a safety feature; (ii) *a majority would rather cross traffic if at all possible than use a pedestrian subway;* (iii) *a majority considered that at some signal-controlled crossings they were unsure what traffic would go next;* (iv) *a majority said there were junctions they would deliberately avoid because they could not anticipate which traffic would go next;* (v) *a majority said that they would cross some way from a junction if there was no crossing: a question testing whether they knew what was meant by the beeping sound at a pelican crossing was answered, it appeared, no differently to a random guess.*

Further elaboration can be provided by comparison with another data sample in which volunteers were chosen from the North East Age Research panel according to age, gender and verbal and numerical reasoning skills. This will be discussed in the next chapter. Meanwhile, factor analysis of the items in the current set suggested four main factors. The first factor (Feelings f1) can be described as representing a level of combined nervousness, slowness and following behaviour. This represented 14% of the variance and was dominated (in order) by nervousness crossing, being slower than most people crossing, being anxious if the road was busy and there was no crossing near, waiting for others rather than depending on the lights, thinking that the green man did not give enough time, worrying about falling in the road, at some lights-controlled crossings being unable to tell which traffic would go next, avoiding crossing at some junctions because of not being able to tell which traffic would go next, and occasionally needing someone to help across.

Factor Feelings f1 was positively correlated with age ($r=0.23$, $p<0.0015$), strongly correlated with Health f1 ($r=0.60$, $p<0.0001$) which has already been described as representing poor balance, sensory and traffic judgement skills, and has a moderate correlation with Health f2 ($r=-0.35$, $p<0.0001$) implicating poor physical mobility. Feelings f1 also correlated moderately well ($r=0.48$, $p<0.0001$) with Discourage f1 which can described as physical discomfort or difficulty discouraging going out and in turn correlated moderately with Concerns f1 ($r=0.51$, $p<0.0001$) which relates to general traffic concern. Thus, Feelings f1 is a factor which ostensibly gauges difficulty involving actually coping in the road environment and, by reference to other components of the questionnaire, squarely implicates sensory, judgement and physical abilities as contributory.

A further three factors (Feelings f2, Feelings f3 and Feeling f4) were proposed by the factor analysis procedure. These accounted for a further 13%, 7% and 6% of the data variance respectively. Feelings f2 appeared to measure opportunistic behaviour which may or may not be competently applied. The main loadings on this factor were: *being quick to take what seemed a reasonable opportunity rather than wait; going to a proper crossing point only when it wasn't out of the way or the traffic was particularly bad; sometimes taking a risk and feeling a little pleasure in succeeding; if the lights took too long, ending up taking a decision for myself; crossing between traffic when I can rather than pressing the button and holding the traffic up; sometimes enjoying the challenge of crossing; and rather crossing traffic than using a pedestrian subway.*

Although Feelings f2 has some correlation with Health f1 scores which relate to sensory and traffic judgement, this correlation is only low ($r=-0.22$, $p<0.0023$). Therefore, individuals who appear opportunistic cannot reliably be considered better at sensory and traffic judgements. It may indeed be important that this opportunistic dimension lies orthogonal to Feelings f1 which ostensibly gauges difficulty involving actually coping in the road environment. Scores on these two dimensions theoretically might well move independently, and indeed the factor analysis results (othogonality of factors) implies that they do. Increasing problems coping with the environment do not imply safer or more cautious behaviour. Furthermore, scores on either of these factors do not substantively predict knowledge of the beeping sound on some pelican crossings or whether it is safer to cross among parked cars or to avoid them.

Feelings f3 and Feelings f4 do not individually account for a substantive amount of the variance in the data and produce no substantive correlations with other components of the questionnaire. Further consideration of them in this chapter would not appear justified.

3.5.4 Places found difficult

The aspects or locations which respondents raised as difficult or dangerous while giving details of their journey patterns are summarised in the technical annex to this report (separately available). Since these comments occurred in an open response format section within the interviews, they provide qualitative rather than quantitative information concerning problems encountered.

The characteristic circumstances tended to be where crossing was desired but traffic was busy and they as pedestrians felt uncertain or felt that traffic was not controlled in their favour. This may amount to there being several lanes to cross with no feature to stop traffic, where there were traffic lights but the pedestrian felt that there was risk caused by drivers trying to beat the lights, where there were lights but the pedestrian was (apparently) nevertheless trying to cross instinctively and felt unable to tell which traffic would go next, where there were lights and the pedestrian felt unsure when an opportunity to cross would arise (even though the lights may have an 'all pedestrians clear' phase – this was exacerbated by all traffic being apparently stopped while the green man still did not follow), where the green man reportedly did not give sufficient time, traffic was too fast on a stretch and perhaps overtaking near where the pedestrian might cross, a zebra crossing on a blind bend, junctions which had lights which did not allow the pedestrian to see which traffic was signalled to go or stop, or the uncertainty of which traffic might turn off a roundabout where the pedestrian wished to cross and there were no pedestrian facilities.

In extreme cases, the pedestrian may report that the green man on pedestrian crossings is too small for them to see or their difficulty arises from being slow or even on crutches which is a circumstance where the quick uptake or execution of a crossing opportunity, perhaps in a traffic island crossing, is limited.

In many cases, respondents considered that particular crossing places offered them complexity and unpredictability rather than advantage and chose to cross away from the designated crossing place. There were other cases where the respondents considered that they only used local crossing facilities such as pelican lights when the traffic was particularly bad, preferring to use judgement to their own convenience. In summary, the avoidance of a formal crossing site might, in one case, be a result of confidence in one's judgement to cross elsewhere or, in another, it might be a lack of confidence in being able to cope with the designed location.

Other problems affecting journeys were mentioned by respondents. Some elderly complained about being thrown about on buses by not having enough time to be seated or having to stand before the bus stopped. There were difficulties with the bus steps. A small number were unable to easily handle small change, because of stiffness or paralysis of a hand or limb, or to hold on to a bar while carrying shopping. Waiting for buses was complained of, especially if they should eventually arrive in a cluster of if the weather was cold, windy or wet and shelters offered no protection because of missing glass or roof.

Carrying heavy bags of shopping was complained of, as was having to walk uphill, even the slightest incline in some cases. Because of their poor state of health, some found walking any distance stressful. Some needed to carry medication because of asthma and heart conditions even on the shortest shopping journeys.

The state of the pavements was sometimes criticised. One individual claimed to often walk in the middle of the side-street because the path was bad. The state of the pavements and roads was a common criticism with respondents who stated that they had fallen several times because of uneven pavements or cracks in them.

3.6 Self-report accident data

Question set f of the interview questionnaire asked about accidents of various types, as a driver, passenger, pedestrian, etc, in which the respondents might have been involved in the previous three years. A summary of the percentages of respondents involved in the different

types of accident is given in table 3.8 below. It was not felt that data on number or severity of accidents to an individual were sufficiently reliable to analyse in detail, nor did the interview situation allow sufficient opportunity to request a detailed account of accident circumstances.

Table 3.8

Accidents reported in last three years

Accident type	Gender	65–74 %	75–84 %	85+ %
Accident as a driver	f	4.6	0.0	0.0
	m	4.7	3.5	0.0
As a car passenger	f	4.6	3.3	0.0
	m	0.0	0.0	0.0
While cycling	f	0.0	0.0	0.0
	m	0.0	0.0	0.0
As a pedestrian hit by a motor vehicle	f	0.0	1.7	0.0
	m	2.3	3.5	0.0
As a pedestrian hit by a cyclist	f	0.0	0.0	7.7
	m	0.0	3.5	0.0
Fall on public transport	f	3.0	11.5	7.7
	m	7.0	10.4	0.0
Fall in the street due to tripping or bumping into something	f	14.6	36.1	30.8
	m	18.6	20.7	50.0

3.6.1 Types of accident

The relative proportion of individuals involved in conventional traffic-related accidents was small, as would be expected from a knowledge of recorded accidents per thousand population. By far the most significant number of self-reported accidents involved falls in the street, mainly due to tripping or slipping. These appeared to be roughly twice as common for those over 75 than for those between 65 and 74 years, with roughly a third of those over 75 years reporting such an accident in that approximate interval. The next most commonly self-reported accident involved a fall on public transport which was reported by approximately 10% of respondents in the 75–84 year group and roughly 5% of the 65–74-year-old group.

Comparing the number of falls or no such incidents reported by all the women interviewed, there was a significant difference between those on medication and those not on medication ($\chi^2 = 4.29$, $p<0.05$). The same comparison for men was not statistically significant. Conclusions, however, can only be tentative as the various deficits and conditions involved may both require medication and also increase the likelihood of falls. In any case warnings about side-effects of certain forms of medication could usefully be emphasised in relation to pedestrian safety.

3.6.2 Near misses

The final section m of the interview questionnaire was involved in verbally presenting the respondents with number of potential traffic situations in which they might have been involved, roughly in the past three years and asking if that had happened to them, as pedestrians, as far as they could easily remember. All of the situations related to circumstances and causes in which someone (themselves) could have easily been run over. A summary of the most common near-miss situations is presented in Table 3.9. It should be emphasised that not all respondents were considered sufficiently attentive by this stage of the interview. However, a significant proportion (87%) of interviewees contributed data.

Table 3.9

Reasons associated with more frequent occurrence of near misses

Reason	Frequency in last three years Often	Sometimes	Once or twice
Cyclist on pavement	2	22	66
Driver failed or almost failed to stop	1	10	41
Driver failed to signal before turning	1	7	30
Looked but did not see vehicle coming	1	2	22
A safer crossing place was too far away	1	2	6
Driver accelerated away from signals	–	8	33
Had to look into too many directions	–	6	22
Traffic was too fast	–	6	11
Did not check carefully before crossing	–	4	33
Road clear initially then suddenly changed	–	4	30
Driver turning did not give way	–	4	24
Vehicle began to overtake or change lane	–	4	19
Did not have enough time	–	4	18
Road layout or traffic flow was confusing	–	4	12
Accident avoided by another's intervention	–	3	19
Vehicle accelerated more quickly than expected	–	3	18
Vehicle driven dangerously or carelessly	–	2	29
Was tired or preoccupied	–	2	16
Vehicle mounted kerb	–	2	16

It may be that causes of near miss events are recalled most easily in terms of the other person's violation of expectations and that many near miss events related to one's own actions are less often realised or are quickly shrugged off. Nevertheless, the data provide knowledge of what individuals acknowledge recalling. The most common complaint among the elderly was recall of cyclists who would approach along the pavement unexpectedly and pass at close distance. This is followed by the failure of drivers at traffic or pedestrian lights, and then by the pedestrian's failure to check, anticipate, or to be able to take in the traffic situation all at once. No-one reported being in a near miss because of drink.

A factor analysis of response suggested four factors of response. It is emphasised that factors represent items which tend to be grouped together either because of recognised similarity or because of similar underlying causation. In either case, factor analysis might reveal some knowledge of underlying explanation or conceptualisation within respondents.

Near-miss f1 accounted for the largest proportion of variance (12.7%) and mostly seemed to identify the driver or cyclist's failure or fault. The significant items loading on this factor were: *the driver failing to stop at the signals or lights, a driver in a hurry to get away after the lights, a vehicle overtaking or changing lanes, a driver failing to signal before turning, a driver failing to give way at a junction, dangerous or careless driving, a vehicle mounting the kerb on a corner, a cyclist on the pavement, or unexpected reversing.* Near-miss f2 accounted for 10.3% of the variance and appeared to group together situations where the pedestrian found difficulty coping with the complexity or uncertainty of the situation. The significant items loading on this factor were: *where the layout or traffic flow was too complex or confusing, the pedestrian had to look too many ways at once, starting to cross after the flashing green man, and where the lights or a driver did not allow enough time.*

Near-miss f3 accounted for 9.6% of the variance and appeared to acknowledge some extent of judgement error on the part of the pedestrian. The significant items loading on this factor were: *the traffic being too fast, vehicles accelerating more quickly than expected, where a safer crossing place was considered too far out of the way, and being pulled back at the last moment.* Near-miss f4 accounted for 9.5% of the variance and might be interpreted as attention failure rather than purely judgement error. The significant items loading on this factor were: *looked but failed to see the vehicle coming, being tired or pre-occupied, a cyclist on the road which was not expected, and not checking before crossing.*

Further statistical interpretation of factor scores from this near-miss data is considered again in section 6.2.1. In the case of Near-miss f1, it looks on preliminary analysis that attributing near-miss events to the driver or rider is associated with the pedestrian being younger (although in the 65+ group), male and most likely with some driving experience. Near-miss f2 appears associated with Feelings f1 (nervous, slow and following), as does Near-miss f3. These tentative associations are promising indications that accident associated incidents are genuinely related to the feelings and perceptions of individuals in the actual environment.

Chapter 4 The older pedestrian – 2 NEAR survey data

4.1 Interview sample and questionnaire summary

The sample group recruited through the North East Age Research Group (NEAR) was a group of elderly people who were familiar with experimental testing as part of an ongoing study into the intellectual effects of ageing. Individuals were selected from the pool of volunteers and represented a balance according to criteria of age (65–74 and 75+), gender (male and female) and a reasoning test score (AH4) within each age and gender group. The total number of volunteers was 181 (see Chapter 5.3 for further details).

The main purpose of the NEAR sample was to advance the enquiry by controlling for age and ability and by conducting a series of laboratory experiments. However, the opportunity was taken to obtain extra questionnaire data by asking them to complete a shortened form of the interview questionnaire before attending laboratory trials and the purpose of this section is to describe the information provided by this sample of 181 NEAR volunteers.

It should be noted that the NEAR volunteers completed only a sub-set of the main interview questions. Travel modes, journey functions and destinations are not available for the NEAR sample.

4.2 Driving experience

Questionnaire responses concerning driving experience show the NEAR group to be more likely to be drivers or have driving experience. Of either age group (65–74 or 75+), 50% of females had some driving experience which did not seem related to their test score.

Table 4.1

Driving experience of the NEAR sample

Age (years)	Gender	AH4 high test scores % of NEAR sample driving in the last wk	AH4 high test scores % of NEAR sample driving in the last year	AH4 high test scores % of NEAR sample driving never driven	AH4 low test scores % of NEAR sample driving in the last wk	AH4 low test scores % of NEAR sample driving in the last year	AH4 low test scores % of NEAR sample driving never driven
65–74	m	68.2	68.2	13.6	33.1	42.9	33.3
	f	26.1	30.4	43.5	18.2	18.2	59.1
75–84	m	59.1	68.2	4.6	31.8	31.8	45.5
	f	16.7	20.8	54.2	18.2	22.7	59.1

For males in either age group, only 25% had no driving experience with less than 10% of the higher ability group having no driving experience. 68% of the younger, higher ability males had driven in the week before the laboratory trials, and 59% of the older high ability males. This compares with 33% of the younger and 31% of the older, lower ability males. This may well hint at the main interview sample as being largely equivalent to the lower ability NEAR group, at least in respect of driving experience. The likelihood that they would compare more closely with the lower ability NEAR group in AH4 performance is evident in relation to the comments in section 5.3 regarding the lowering of test performance in later years.

4.3 Health

There seem to be differences in response according to gender and AH4 score. In Appendix B question e2 shows that females scoring low are more likely to emphasise difficulty or discomfort when they walk any distance. Older low scoring females are less likely to acknowledge a hearing problem. Low scoring males and females are more likely to

acknowledge some worsening in terms of judging whether they have time to cross the road; and to acknowledge being worse at anticipating the progress and intentions of traffic.

Compared with the main interview sample, factor analysis of the health questions for the NEAR respondents produced a similar but more clear-cut set of two factors similar to those found from the street sample. The factors represented (i) Health f1: physical fitness and (ii) Health f2: poor judgement and sensory ability. How these factors correlate with other factors and with results from the laboratory trials is discussed in Chapter 6. Here Health f1 accounts for 27% of the variance and Health f2 accounts for 26% of the variance for these questions in the NEAR questionnaire. It will be seen later that age and gender as such are less strongly related to Health f1 and Health f2 than Health f1 and Health f2 are related to feelings as a pedestrian crossing the road (being nervous, slower and following, for example).

4.4 Concerns

The concerns questions put to the NEAR respondents excluded open format items which, in the case of the house-to-house survey were related to particular journeys undertaken and they excluded reference to issues which might deter or prevent them from going out more often than they otherwise did. Questions asked were in a closed format and related to general issues which included traffic and other items.

4.4.1 Issues of general concern

Responses to general issue questions (g items in the NEAR questionnaire) have been tabulated for both individuals scoring high and low on the AH4 test. Table 4.2 shows the low AH4 group to be more anxious in terms of violent crime, pollution, competing with traffic to cross and the amount of traffic.

Factor analysis of the concerns questionnaire produced two main factors which were clearly separated as personal concerns (Concerns f1) vs global or social concerns (Concerns f2).

Concerns f1 accounted for 26% of the variance in the set of (g) questions; Concerns f2 accounted for 22% of the variance.

Violent crime, House theft, the state of the pavements, competing with traffic to cross the road, traffic speeding in residential areas and provisions in the Health Service were typical of the personal concerns factor. Unemployment, standards of education, pollution and international events and conflicts were typical of the global concerns factor.

4.4.2 Feelings as a pedestrian

Tabulation of scores for this part of the questionnaire (see Appendix B) reveals AH4 scores as informative about how an individual was likely to feel or respond. For example, question h1 – *When crossing the road, I often feel nervous* – shows that the response TRUE is roughly three times more likely for the low AH4 group than the high. For ages 65–74, those with low scores are twice as likely as high scorers to feel slower than most people crossing the road. Low AH4 scorers are clearly more likely to feel that it is safer to wait for other people to start crossing than depend on the lights, to feel more confident if there are other people waiting to cross at the same time, to feel anxious if there is no crossing near enough, to be unable to tell which traffic will go next (yet to feel a little pleasure in taking a risk), to forget to look sometimes when crossing a side street, to completely misunderstand (or be easily confused when asked about) the beeping sounds on some pelican crossings and to be less sure than others that it is risky to cross from between parked cars.

Table 4.2

Concerns and anxieties expressed by the NEAR sample

Type of concern	Gender	AH4 high test scores: Doesn't bother me	Concerned	Anxious	Mean rating	AH4 low test scores: Doesn't bother me	Concerned	Anxious	Mean rating
Violent crime	f	0.0	0.3	0.6	2.6	0.0	0.3	0.7	2.7
	m	0.1	0.6	0.3	2.3	0.1	0.3	0.6	2.5
Changes in the environment due to pollution	f	0.2	0.5	0.4	2.2	0.2	0.2	0.6	2.4
	m	0.3	0.5	0.2	1.8	0.2	0.4	0.4	2.2
The state of the pavements	f	0.1	0.5	0.4	2.3	0.1	0.6	0.4	2.3
	m	0.4	0.5	0.1	1.8	0.1	0.6	0.3	2.2
As a pedestrian, having to compete with traffic to cross the road	f	0.5	0.3	0.2	1.7	0.2	0.3	0.5	2.2
	m	0.5	0.4	0.1	1.6	0.5	0.4	0.2	1.7
The level of unemployment	f	0.1	0.3	0.6	2.5	0.2	0.2	0.6	2.5
	m	0.2	0.4	0.4	2.2	0.2	0.3	0.5	2.3
Traffic accidents	f	0.0	0.4	0.6	2.6	0.2	0.3	0.6	2.4
	m	0.2	0.6	0.3	2.1	0.1	0.4	0.5	2.4
The 'cost of living'	f	0.2	0.5	0.3	2.1	0.1	0.6	0.3	2.2
	m	0.4	0.4	0.2	1.8	0.2	0.5	0.4	2.2
The amount of traffic	f	0.3	0.4	0.4	2.1	0.1	0.3	0.5	2.4
	m	0.4	0.3	0.3	1.9	0.1	0.4	0.4	2.3
House theft	f	0.0	0.5	0.5	2.5	0.1	0.4	0.5	2.5
	m	0.1	0.5	0.5	2.4	0.1	0.4	0.5	2.5
Standards of education	f	0.1	0.3	0.6	2.5	0.3	0.3	0.5	2.2
	m	0.3	0.4	0.3	2.1	0.2	0.4	0.5	2.3
Provisions in the Health Service	f	0.1	0.4	0.5	2.4	0.1	0.5	0.4	2.3
	m	0.3	0.4	0.3	2.1	0.2	0.4	0.5	2.3
International events and conflicts	f	0.2	0.4	0.4	2.3	0.2	0.3	0.5	2.3
	m	0.2	0.6	0.3	2.1	0.4	0.2	0.4	2.1
Maintenance of good local transport system	f	0.1	0.5	0.4	2.3	0.2	0.5	0.3	2.1
	m	0.1	0.6	0.3	2.2	0.1	0.5	0.4	2.1
Traffic speeding in residential or shopping areas	f	0.1	0.4	0.6	2.5	0.1	0.4	0.5	2.3
	m	0.1	0.5	0.4	2.3	0.0	0.5	0.5	2.6

Note: rounding up and down produces totals between .9 and 1.1 for the proportions.

The question set relating to how people feel as pedestrians crossing the road appeared to produce a choice of a five or a six factor solution. Adopting the simpler five factors gives:

Factor	**Description**	**% Variance**
Feelings f1	Nervous, slower, worried	11
Feelings f2	Opportunity taking	10
Feelings f3	Not traffic minded	10
Feelings f4	Convenience minded	10
Feelings f5	Follows others/doesn't understand beeping sound	8

The appearance of the first two factors again appears supportive of the analysis of responses from the house to house survey data but less so in the following others component. Not traffic

minded (Feelings f3) appeared to be related to the respondent thinking that there were lights controlled junctions where they could not tell which traffic would go next, and also avoiding some junctions because of not being able to tell which traffic would go next. Feelings f4 appeared to carry some aspects of opportunity taking but less the risk connotations. Feelings f5 appeared to capture the reliance on following others which was captured in the first factor in the analysis of the main interview survey.

Allowing the SAS system to score individuals on these factors and correlating the results with other variables indicated that Feelings f1 was correlated ($r=-0.39$, $p<0.0001$) with AH4 score as was Feelings f5 ($r=-0.24$, $p<0.002$). In essence, both of these factor scores are reflected in a lower verbal and numerical reasoning ability which, to a large extent, is characteristic of the ageing process. Both are negatively correlated with Health f1 scores ($r=-0.32$, $p<0.0001$; and $r=-0.20$, $p<0.02$) suggesting they are also related to poorer physical fitness. Furthermore, they are correlated ($r=0.38$, $p<0.0001$; and $r=0.20$, $p<0.02$) with Health f2 which relates to poorer judgement and sensory ability.

While Feelings f3 (not traffic minded) correlates ($r=0.42$, $p<0.0001$) with Health f2 relating to poorer judgement and sensory ability, Feelings f2, Feelings f3 and Feelings f4 do not significantly correlate with age, gender or AH4 scores. Since the factors relating to being opportunity minded or convenience minded are orthogonal (cannot correlate) by definition with Feelings f1 and Feelings f5 we are led to the same interpretation as in section 3.5.3, that is that increasing problems in coping with the environment do not imply that older people will adopt safer or more cautious behaviour.

4.5 Self-report accident data

4.5.1 Types of accident

Question set h from the NEAR postal questionnaire asked for information about accidents relating to being hit by a vehicle or falls in the street or on public transport in the previous three years. A summary of the percentages of respondents involved in such accidents is given below in Table 4.3.

These data represent reasonable correspondence to those for the interview sample (see Table 3.8 for comparison), with falls in the street due to tripping, slipping or bumping into something by far outweighing (by a factor of ten) the likelihood of other types of accident and the older (75+) group generally being more than twice as likely to suffer such accidents as the younger (65–74 years) group.

The data on falls for males scoring low on the AH4 test may represent an anomaly since their

Table 4.3

Accidents in last three years reported by NEAR sample

		AH4 high test scores		AH4 low test scores	
		65–74	75–84	65–74	75–84
Accident type	gender	%	%	%	%
As a pedestrian hit by a motor vehicle	f	0	0	0	4.6
	m	0	4.6	0	4.6
As a pedestrian hit by a cyclist	f	0	0	0	0
	m	0	0	0	0
Fall on public transport	f	0	8.3	0	4.4
	m	0	9.1	0	4.6
Fall in the street due to tripping or bumping into something	f	17.4	41.7	13.3	45.5
	m	13.6	40.9	33.3	22.7

reported falls indicate a reverse trend with age in comparison with other groups. No obvious explanation can be offered for this result.

4.6 Comparison of interview and NEAR survey data

The data collected by questionnaire from the NEAR volunteers supplement that from the main interview respondents and points to verbal and numerical reasoning ability or concentration skills (as measured by the AH4 test) being an additional feature which weighs in the problems of older people coping with the road environment. A decline in such ability in the senior years is commonplace although not universal and will possibly represent itself in terms of difficulty in dividing attentional resources between formal signs and signals and interacting objects within the traffic environment so that there is confusion or simply one or other may be ignored. It must be emphasised that this is not the equivalent of dementia which may represent a further accident hazard; and further that the abilities of some of the elderly in respect of verbal and numerical skills are still superior to large numbers of people under the age of 60.

Chapter 5 Judging speed and distance

5.1 The road and the laboratory

One of the problems inherent in the use of questionnaires that formed the basis of evidence discussed in the last two chapters was that it was not possible to assess the skills or limitations referred to by respondents. We therefore regarded it as essential to collect data that could be used to evaluate the various interpretations that could be made from the subjective reports of older people. However, there is a perennial problem in choosing an appropriate method, namely that there is a conflict between the demands of control over relevant variables and the need to relate findings to the real world. In the event, we decided that both approaches were legitimate and it would be preferable to conduct two further studies of limited scope rather than opting for a single approach. Thus the following sections employed two different methods: (i) subjective observation at the kerbside and (ii) automated testing of simplified speed and distance tasks presented on videotape.

5.2 At the kerbside

5.2.1 Choice of locations

From the four main districts which were canvassed in the main interview stage of the questionnaire, two locations to observe pedestrians' crossing behaviour were selected. These two locations were chosen because they were specifically mentioned as a local problem by the respondents in Chapter 3. The two sites also provided contrasts in their general design and layout, such as type of road, traffic control, or pedestrian facilities. As it happened, other locations may well have proven equally appropriate for this observational study, but those finally selected were suitable in that they were neither too frequented to prevent adequate monitoring of most significant pedestrian behaviour within limited times for observation nor too quiet in terms of pedestrian activity to enable a reasonable sample of crossings to be recorded within a limited resource allocation. These pilot observations at the kerbside were envisaged as a preliminary investigation to provide a basis to collect data in a more extensive study at some later date.

The **first location** at Barrack Road (Site A) was chosen because it was mentioned by interview respondents from the locality. Some aspects of its nature can be obtained from the two photographs of views to the west and east from the south side of the road (Plates I and II) together with the schematic maps of the locations in Figure V.1. These show four separate sectors which were straightforward to define as a result of initial observation and discussion.

Site A: Barrack Road (A6082)

Figure V.1

Schematic Map of Observation Site A: Barrack Road

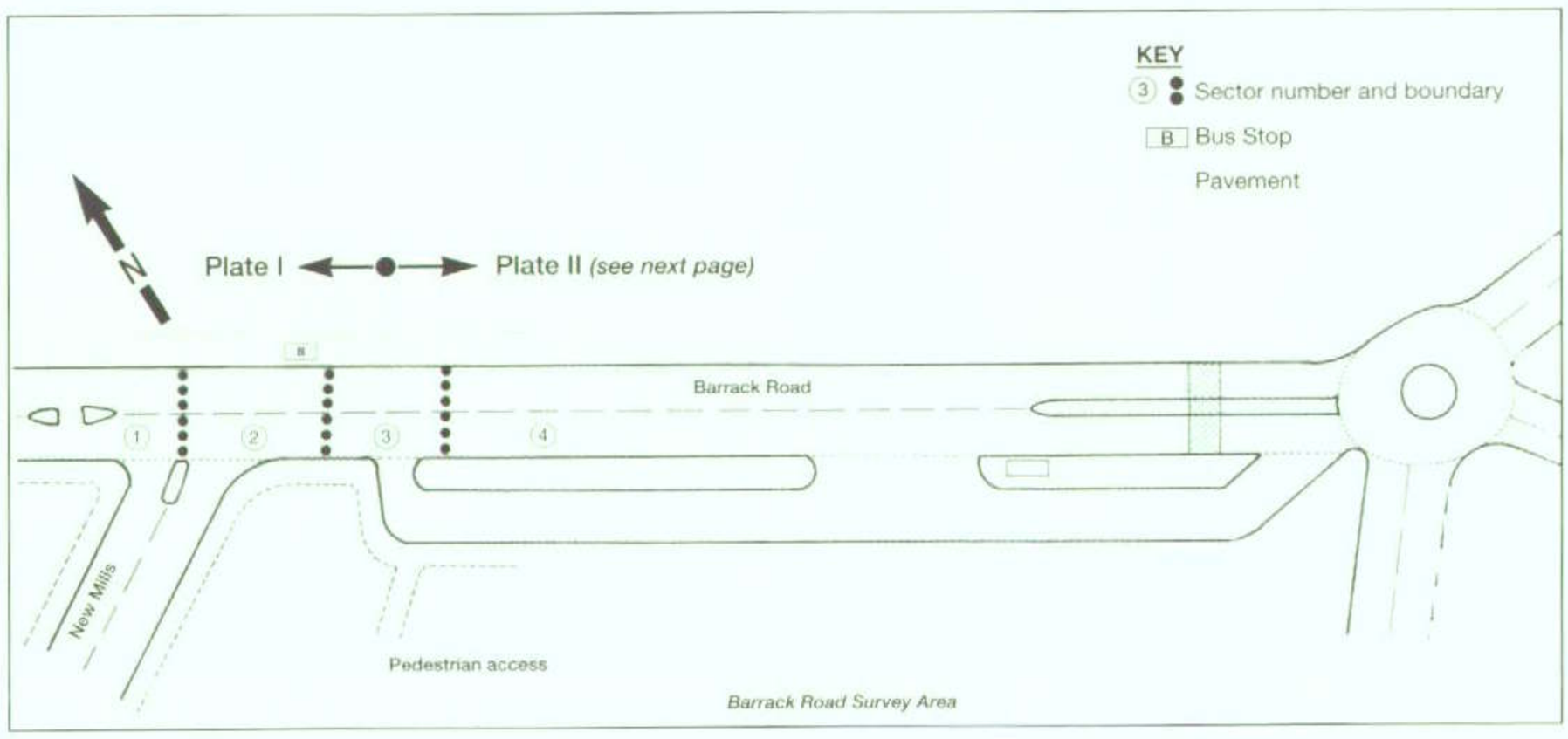


Plate I: View west

Plate II: View east

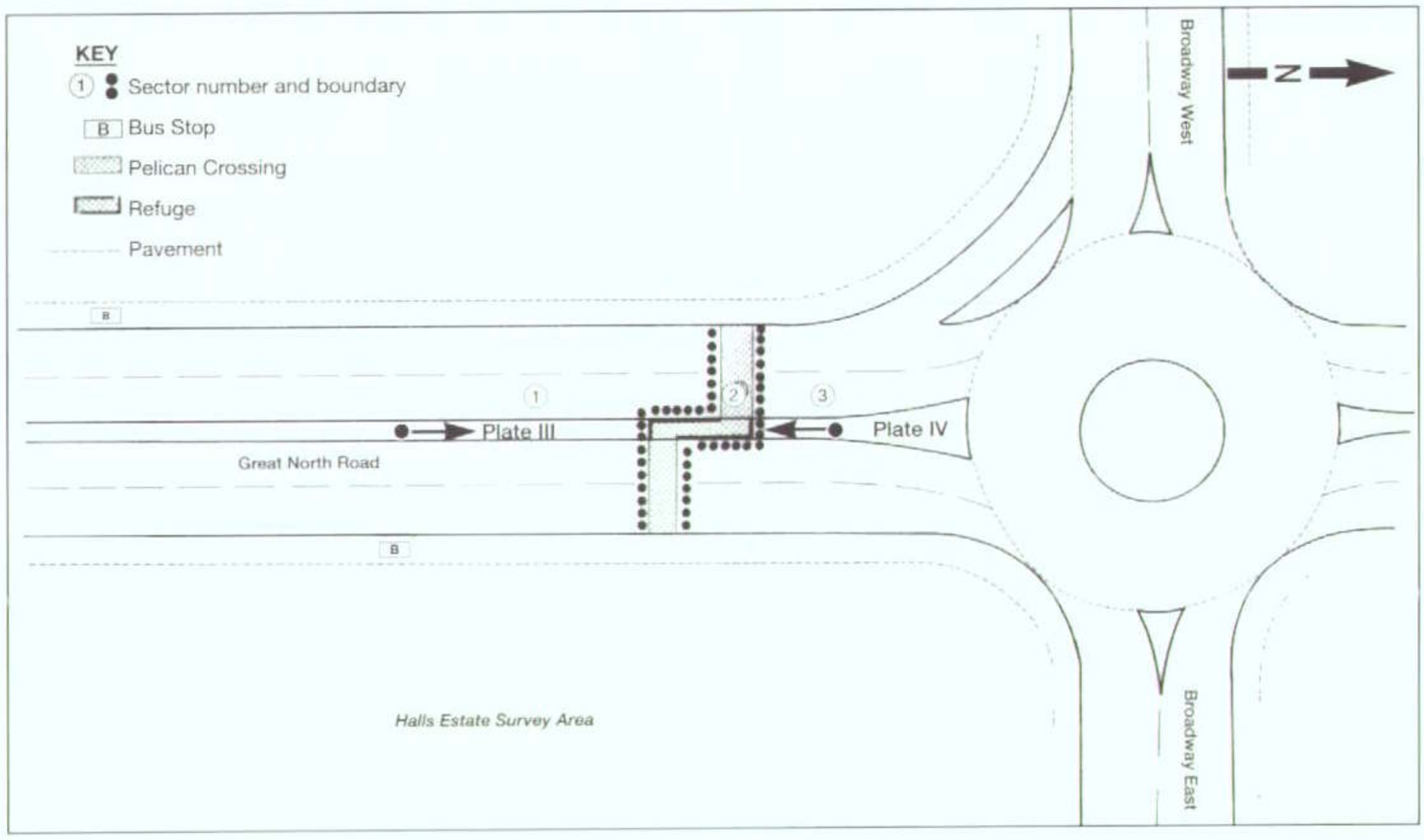
The location was specifically mentioned as causing difficulty for those living close by when they wished to cross from the south side to catch a bus to the city centre, their major shopping destination. A pedestrian zebra crossing was over 100 metres away to the east. A useful traffic island situated at the west end of the area also meant that pedestrians had to make an initial detour when they came out of their homes on the estate's south side and this also required that they had to cross a junction with New Mills before they could take advantage of the traffic island. The residents' statements against using this detour included reasons such as its being out of the way and their having to cross the junction with an inadequate view of any traffic coming from behind them (west from the city) which might turn. New Mills is an additional complication to pedestrians crossing east of the island on Barrack Road because buses and other vehicles commonly exit in an easterly direction towards the city. From a safety aspect this is very relevant because the vehicle may complete this manoeuvre abruptly to compensate for their limited view along the road to the west without regard for the fact there may also be pedestrians crossing the Barrack Road in the path of the vehicle at the same time.

Crossing Barrack Road, particularly from south to north, there is a visibility restriction up the slope caused by a bend in the road some 50 metres to the west. From our subjective observations, 30mph appeared to be the lower limit of actual traffic speeds on this stretch of the road. In the immediate area of the bus stop opposite this junction with New Mills in the middle of the road, there is no safe area of refuge for the pedestrians crossing Barrack Road, no barriers to prevent their attempted crossings, and no central hatching in the carriageway where the traffic in both directions is closely opposed.

Site B: Halls Estate (B 1318) Pedestrian Crossing

Figure V.2

Schematic Map of Observation Site B: Halls Estate



The **second location** (Site B) was a Pelican crossing with pedestrian controlled lights, situated to the north western corner of Halls Estate, a private rental housing area where we had previously interviewed. This crossing is one of two in the immediate area which straddle the Great North Road (B 1318). The road forms the west boundary of the estate and is also a four-lane traffic route but with a separated dual carriageway. Immediately adjacent to the crossing are bus stops and a doctor's surgery. There is also another second crossing point within 50 metres to where Broadway East and Broadway West access the Great North Road.

The crossing with its roundabout immediately adjacent to the north is visually restricted for pedestrians in that they are unable to have an unrestricted view of the oncoming traffic, particularly if it is heading south to approach and pass the roundabout and to travel on past the pedestrian crossing itself. Complaints from the interviewees about this crossing location pinpointed particular features about drivers' behaviour such as: jumping the lights, travelling too fast, or failing to stop at the lights. Photographic illustrations providing views to the north and south are shown in Plates III and IV along with a schematic map of the crossing location itself in Figure V.2. This time the crossing area was partitioned into three sectors, ie within the crossing or outside it to one side or the other.

Plate III: View north

Plate IV: View south

5.2.2 Method of observation

To record pedestrian behaviours at the two crossing locations, an outline diagram of the road layout (see above) was drawn for each site so that a record could be made of each pedestrian's behaviour and direction, the positions and movement of vehicles, and the phase of control lights if present. A separate form (see Appendix D) allowed the record of such details as: the estimated age of the pedestrian (ie child less than 14 years, adult, or elderly); number if more than one pedestrian in the group; gender; any special features as for example: carrying a bag, using a stick, pushing a pram, or leading a dog; mobility (or rate of movement on a 1–5 scale); phase of the crossing lights; whether an opportunity to cross the road was missed (with the criterion that an 80 metre gap was a missed opportunity). There was also space on the record form to comment on crossing behaviour in the first half versus the second half of the road crossing.

Observations were conducted during seven one hour intervals at the Barrack Road crossing. Five of these were between 10.00 and 11.00 am and two between 2.30 and 4.00 pm during week days in April 1994. Five observation periods were made at the Halls Estate crossing. These records varied in duration from between one to three hours at various times between 10.00 am and 4.00 pm, again on weekdays during April 1994. The total number of seven hours was spent at Barrack Road and nine and a half hours at the Halls Estate location.

In all sessions, two observers participated to record each crossing, dividing their observational activities to either mapping the movement in the road layout diagram or entering other details about the pedestrian's road crossing behaviour. They conferred and agreed about the particular aspects of each event. The individual crossings were recorded on separate, consecutively numbered mapped sheets. Any pedestrian events which occurred outside the area of direct observation were ignored. If in the event that one observer was still recording a previous event when a further crossing occurred so that vital details were missed, the observational data for the subsequent crossing were ignored.

5.2.3 Classifying types of crossing

The initial means of classifying the data is to aggregate the number of crossings per person per sector in each direction. These are shown separately for each site in Table 5.1. At Site A, Barrack Road, about half of the total crossings observed were in sector 1 by way of the traffic islands. However, there were only two individuals whose path could be interpreted as deliberately walking out of their way to make use of this facility. The main reasons for these crossings were twofold: (a) to go to and from the bus stop or (b) to walk to and from the park. From sectors 2 and 3 the apparent purpose was to go to and from the flats (part of the area canvassed for interviews). From sector 4 most crossings were made by younger adults walking in the direction of the City Centre.

Table 5.1

Observational data

(i) Site A – Barrack Road

Sector	1	2	3	4	Total
From S to N	97	19	35	15	166
From N to S	31	20	9	3	63
	128	39	44	18	229

	Child	Younger Adult	Older Adult	Total
Male	1	92	61	154
Female	1	43	31	75
	2	135	92	229

(ii) Site B – Halls Estate

Sector	1	2	3	Total
From W to E	12	118	5	135
From E to W	7	42	2	51
	19	160	7	186

	Child	Younger Adult	Older Adult	Total
Male	2	29	37	68
Female	1	80	37	118
	3	109	74	186

At Site B, Halls Estate, the vast majority of people (86%) used the pedestrian crossing provided and older people did not differ from younger adults in their likelihood of using these facilities. The numbers crossing elsewhere are small and do not form a clear pattern, except that there was a slight tendency for people alighting from the bus from Newcastle to walk away from the pedestrian crossing and cross the road (W to E) to Halls Estate in the middle of sector 1.

5.2.4 Potentially unsafe behaviour

It is increasingly being recognised (eg Muhlrad, 1993) that a comprehensive diagnosis of features of road use that can lead to accidents cannot solely be achieved from analysis of accident data. It also requires a study of the psychological context that can apply equally to near accidents. As a first step towards a better understanding, the designation of potentially unsafe behaviour has to be based on systematic observation at relevant sites and, in line with section 3.5.3, the criterion adopted was that local respondents had identified problems.

Of course the bases for judging behaviour as potentially unsafe also pose difficulty. The critical feature for this classification was that an incident labelled potentially unsafe necessitated some form of evasive action, for example, a driver had to slow down or a pedestrian had to hurry their crossing or return to the kerb. Within this definition the subjective impression was that there was scope to discriminate a range of severity of incidents. However, given the limited number of observations, this index is not included in the analysis.

Table 5.2

Potentially unsafe (PU) crossings

(i) Site A – Barrack Road

	PU crossings per sector as percentage of total crossings				
Sector	1	2	3	4	Overall
From S to N	6.2	15.8	25.7	20.0	12.7
From N to S	6.5	25.0	*	*	17.5

	PU crossings as percentage of total by types of pedestrian		
	Younger Adult	Older Adult	Overall
Male	6.5	16.4	10.4
Female	14.0	29.0	20.0

(ii) Site B – Halls Estate

	PU crossings per sector as percentage of total crossings			
Sector	1	2	3	Overall
From W to E	16.7	7.6	*	10.4
From E to W	14.3	9.5	*	13.7

	PU crossings as percentage of total by type of pedestrian		
	Younger Adult	Older Adult	Overall
Male	13.8	18.9	16.2
Female	6.3	13.5	8.5

* Very small numbers of observations

Table 5.2 shows the proportion of potentially unsafe (PU) crossings as percentages of totals at each site and for younger and older adults. Overall PUs were 13.97% at Barrack Road and 11.29% at Halls Estate. These data provide interesting comparisons across sites and with accident figures detailed in section 1.3.2. Not surprisingly, the safest places to cross (lowest PUs) are either via the traffic islands at Barrack Road or the pedestrian crossing to Halls Estate. Older people are disproportionately represented in the PU data but the cause for most concern are the older females crossing Barrack Road between the flats and the bus stop (sectors 2/3).

They are at more than twice the risk of their counterparts using the pedestrian crossing. While the method of observation did not allow the same precision on age as the Newcastle accident figures, which show twice the expected risk per capita to older females, the parallel is striking. This is the more so because the older males do not exhibit differences between uncontrolled and controlled crossings, just as their accident proneness as pedestrians does not seem to increase with age.

Insofar as it is possible to characterise potentially unsafe behaviour, two elements emerge. The first is essentially similar to the 'failure to yield' in the Leeds Urban Accident study (Carsten *et al.*, 1989) that was identified as the most frequent cause of accidents. Furthermore, re-analysis by Sabey (1994) shows that 48.7% of pedestrian accidents among the 60–69 age group are linked to this aspect and 60.3% among the 70+ group. The second set of behaviours were more complex but could be typified by care, even clear caution, in crossing the first half of the road but without considering the outcome for the second half. Extreme instances resulted in older people mid-way across the road in a state of virtual panic to reach the other side.

Table 5.3

Use of crossing push buttons at Site B – Halls Estate

PU crossing by type of adult pedestrian expressed as percentages of total pedestrians (i) use of crossing push button

Distance of traffic	Younger/Older Yes		Younger/Older No		Younger/Older Didn't use crossing	
Very far	0	0	0	9	0	8
Far	3	3	0	0	0	40
Close	5	3	5	14	18	0
At crossing	1	1	9	19	27	27

PU crossing by type of adult pedestrian expressed as percentages of total pedestrians (ii) crossing with or against lights

Distance of traffic	Younger/Older Lights green		Younger/Older flashing		Younger/Older Red		Younger/Older Didn't use crossing	
Very far	11	0	0	0	3	10	5	14
Far	0	0	0	0	0	0	0	40
Close	33	0	0	0	3	3	20	0
At crossing	2	2	0	50	27	45	60	40

Table 5.3 summarises the use of push buttons to operate the crossing facilities at Site B only. Here older people were less likely than younger adults to press the button to stop the traffic. There was no evidence that they were more likely to cross against the red man but their PU crossings were more likely to involve crossing against flashing lights, probably because of their slower pace of walking. Their PU crossings were also associated with not pressing the button or occurred outside the perimeter in sector 1 or 3.

5.2.5 Assessing the observational data

At Site A, Barrack Road, pedestrian crossings occurred on average every two minutes and about every three minutes at the Halls Estate crossing, Site B. The nature of the observations drew attention to some methodological problems, such as the determination of the exact time periods to be monitored and how to check on the judgement reliability between the different teams of raters. The ratings necessarily were subjective and the individual contribution of the observations cannot be excluded when observations of such complex, interactive human situations are being observed. More extensive time and funding would be necessary for automated recording and associated rating procedures to be developed.

Essentially these observations were conducted as a pilot study to provide information so that consideration could be given to the actual behaviour of how pedestrians actually adapt to the

conditions of their road environment and how they make use of any facilities provided. As has been shown at Site A, this could include the generation and checking of hypotheses linked to accident data. A different kind of instance involves the operation of the pedestrian phase of the controlled lights (such as the use of an all pedestrian phase at a crossroads at the Grainger Street and Newgate Street intersection in the City Centre). Some pedestrians seemed confused about exactly when they should cross or found the actual crossing of the road itself a difficult manoeuvre. It may be inferred from observations about their behaviour that they worked on the simple principle that they would follow the lead of others across the road or, more dangerously acting on their own decision, tried to anticipate a break in the traffic stream quite independently of the appropriate phase to cross. The implication that might be drawn is that they perceived the green man signal as having some purpose but as an additional parameter which was quite independent from their own crossing strategy. They may even have regarded this control feature as an additional dimension, something extra to take into account, thus adding to the cognitive complexity of the situation or they may have viewed it as just something which did not apply to them. This does not mean that the conclusion can be drawn, for example, that the pedestrian lights are of no benefit but it does suggest that there is scope for the crossing functions to be made even more explicit and simpler to grasp for older people. Otherwise, as is confirmed by the interview data, there will be significant numbers of older people who prefer to avoid pedestrian crossings.

5.3 The video experiments

The test videos which were filmed prior to testing required the use of a test vehicle (a white two-door hatchback Vauxhall Astra), one red and white traffic cone, three luminous yellow distance markers and the filming was carried using a VHS camcorder with tripod and the appropriate editing equipment.

The location for the video recording of the test vehicle as it approached was Rothbury Terrace. This venue was selected as it was a long, straight road with an unobstructed view. It also had the advantage of being relatively quiet in terms of other passing vehicles and pedestrians. The filming was done in one session between the hours of 10.00am and 12.00 noon in fair weather conditions.

Camcorder and tripod were situated at the roadside with its height and angle positioned in a position similar to that of a pedestrian waiting to cross the road. The traffic cone was positioned three metres from the camera. Beyond it three yellow markers were placed 20, 40, and 60 metres respectively from the cone. Filming was carried when the road was free of other road users with recordings of the test vehicle approaching and passing the test cone at six different speeds: 20, 25, 30, 35, 40 and 45mph. The speedometer of the test vehicle was calibrated with another car before filming commenced.

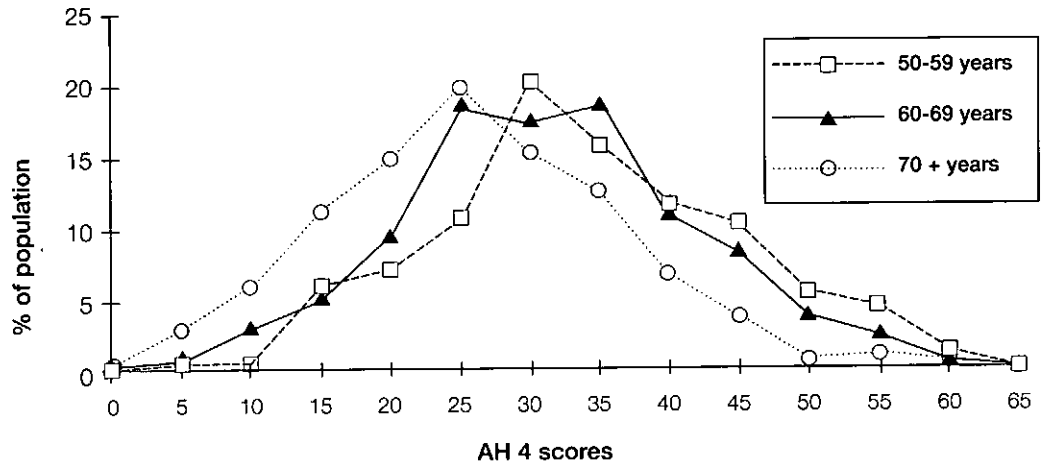
These basic video recordings were edited using blank pulsed VHS cassette tapes with Vidchron time-coding equipment. During the editing, care was taken to ensure that prevailing conditions, such as lighting and other road environment characteristics, were held constant. Six video sequences were subsequently produced with one sequence for each approach speed, which were identical except for the particular speed at which the test vehicle was approaching. These six clips were then edited to constitute the four film sequences and exact times were obtained in the editing for each video frame by etching with Vidchron times codes. The specification for VIDEOS A, B, C, and D to be used for the three judgement tasks are set out in Appendix C.

In order to obtain experimental measures of the older persons' ability to make judgements of speed and distance, various video tests were set up in the laboratory. The subjects were 181 volunteers provided through the North East Age Research (NEAR) group, working at the Department of Psychology in the University of Newcastle upon Tyne. These participants were grouped into categories of approximately equal numbers by gender, by age, and by their scores for reasoning and logical thinking. This score was obtained by NEAR using the AH4 Part I test, (Heim, Watts and Simmonds, 1970). The low scoring category were individuals scoring less than 33 and high scoring individuals more than 35 on the AH4 (Part 1) test. This criterion excluded approximately the middle ten percent of the score range. Data from Rabbitt

(1991) on 2100 residents of Newcastle upon Tyne aged from 50 to 86 years found that distributions of scores for people in their 50s were normal and quite similar to those obtained for younger adults. In contrast, as Figure V.3 illustrates, distributions of scores become increasingly skewed as mean group ages increase from 65 to 75 years. The most able 70 year olds still have scores comparable to the best 50 year olds but the number of low scoring individuals increase with age. Although there may be difficulty in extrapolating in specific terms from a volunteer sample, it is clear that ageing shifts the scores of increasing numbers of people towards the lower end of the range. Thus the men and women over 75 in this sample who scored over 35 on the AH4 are exceptional for their age group.

Figure V.3

Distributions of test scores for 1115 persons



Divisions by age, gender and test score thus produced a 2 x 2 x 2 factorial design with eight subject groups for gender: 88 men and 93 women, for age: 89 younger subjects (60–74 years) and 92 older subjects (>75years), and for their score on the AH4 test: 90 low scoring subjects and 91 high scoring subjects. All subjects were English speaking and were able to see the video screen and the test films without difficulty. The videos were presented in a specially equipped laboratory within the Department of Psychology at the University of Newcastle upon Tyne using a remote control video projector with its accompanying 6'x6' projector screen. The recording of responses required the operation of the Newcastle Multiple Test Facility.

5.3.1 The multiple test facility

The subject responses were recorded automatically by using the Newcastle Multiple Test Facility. This system allows the collection of information from up to 64 subjects simultaneously. In front of each subject is a small keypad, which provides a choice of six buttons, labelled 1 through 6. Each keypad has a position number and is linked online to a computer which records each individual key press and the time at which it occurred. Responses were monitored on the computer screen during testing by a computer operator sitting behind the subject panel. For a technical specification, see Technical Annex 3 for *Risk and Safety on the Roads: perceptions and attitudes* (Carthy *et al.*, 1993) Before each testing session, a prepared script was read out to the subjects to explain the testing procedure. Preliminary test trials were run to ensure that everyone was able to press the keypad buttons correctly and also to ensure that all buttons were working on the computer operator's monitor.

5.3.2. The three tasks

Task I: Registering arrival times

VIDEO A consisted of 12 trial clips with appropriate titles with two clips for each of the six stimulus speeds. Each clip depicted the test vehicle approaching from a standard distance until it passed the cone. The duration of the clips ranged from 14.7 to 8.1 seconds with a clip onset interval of 22 seconds. The total duration of this video lasted 294 seconds.

VIDEO A was used for Task I of the three test sequences. For each trial, the subjects were instructed to press a specified button on the keypad using their index finger at the exact moment when the front of the test vehicle reached the front of the cone. Before proper testing began, a preliminary calibration check was carried out for the button press of all participants via the multiple test facility. In order to familiarise the subjects with this procedure and to reduce variance from any learning effect, five trial runs with a demonstration were given before the task proper was begun. All the auditory instructions were duplicated by a visual presentation from an overhead projector onto a second screen to one side of the main projection screen. The computer recorded the subjects' individual response times to the nearest millisecond.

Task II: Anticipation of arrival times

VIDEO C was required for Task II of the test trials. It consisted of 12 trial clips with appropriate titles with two clips for each of the six stimulus speeds used in the previous tests. Each clip depicted the test vehicle approaching from a distance for a duration of 7 seconds at which point the screen went blank. The point at which the video clip was interrupted was when the test vehicle was either 20 metres or 60 metres from the cone. The total duration of this video lasted 294 seconds with a clip onset interval of 22 seconds.

For Task II the subject again estimated the exact time of the vehicle's arrival at the cone placed 3 metres in front of the camera. Unlike Task I, they now had only a brief presentation of direct visual data on which to project the movement of the test vehicle to approach the cone. In each trial they were instructed to imagine that, when the screen went blank, the vehicle continued with its approach towards and past the traffic cone. They were then to press a specified button with their index finger at the exact moment they judged the front of the car would have reached the front of the cone if the clip had not been interrupted. After the verbal and visually duplicated instructions were presented, twelve practice trial runs were given. The experimental trials then commenced and their individual response times were recorded automatically by computer.

Task III: Comparing relative speeds

VIDEOS B and D were used for Task III in which the participants compared the relative speeds of the vehicles in adjacent video clips.

VIDEO B consisted of 16 trial clips with titles. Each clip depicted the test vehicle approaching from a distance for a duration of either three or five seconds with the durations alternating for successive clips. The clip was terminated when the test vehicle was 20 metres or 60 metres from the cone when the screen was blanked. In each clip the test vehicle was travelling at a different speed to the vehicle in the previous clip.

Scaling subjective speeds by means of visual stimuli presents a problem in that for distance and duration, either one or both of the variables must be subject to change. This means that if the clip duration remains constant, then the distance travelled will be greater for higher speeds, and a shorter distance for the lower speeds. Participants would then be able to estimate judgements of speed by comparing the distances covered rather than basing their judgements on speed alone. Similarly, if the distance travelled by the vehicle in each clip remains the same, the video replay is of a shorter duration for the higher speeds and longer for the lower speeds. To overcome this difficulty, the clip duration was varied and alternated between three and five seconds. In order that each of the six approach speeds (20–45mph) could be compared with each other, thirty comparisons across adjacent clips were necessary. Prior pilot studies had suggested that to complete all 31 trials in one continuous session could not be well sustained in terms of concentration and attention; the sequence was therefore split into two halves with VIDEO B consisting of trials 1–16 and VIDEO D containing the remaining trials 17–31. In these videos the clip onset interval was 15 seconds with the total clip duration of 270 seconds. VIDEO D was similar in almost every respect to VIDEO B except that the trial speed sequencing was different.

VIDEOS B and D were designed to collect data for Task III which required the participants to make comparisons of faster versus slower speeds across adjacent video clips. For this task, the

subjects were instructed to decide whether the vehicle in the current clip was travelling faster or slower than the vehicle in the previous clip. That is, whether the car in the second clip was travelling faster/slower than the car in the first clip, whether the car in the third clip was travelling faster/slower than the car in the second clip, and so on. Subjects rated their decision on the press pads in front of them on a scale from one to six as follows:

BUTTON 1: Definitely slower	BUTTON 4: Possibly faster
BUTTON 2: Probably slower	BUTTON 5: Probably faster
BUTTON 3: Possibly slower	BUTTON 6: Definitely faster

After presenting simultaneously auditory and visual instructions, some preliminary tests were made and five trial runs were given for practice. Immediately after the presentation of each video clip, the prompt "SLOWER/FASTER?" appeared on the projector screen. As VIDEOS B and D could be presented in either order, the procedure for whichever video was presented second was identical to the first session, except that no trial practice runs were given for the second sequence.

Overall design

The stimulus videos in the Test trials I, II, and III were presented across participants in a between subjects group design with the two longer sequences, VIDEOS B and D, counterbalanced across the testing sessions to distribute the effects of practice and fatigue across test trials. Formal testing was distributed across five testing sessions. The position number of their keypad provided the link between the individual participants and their stored data responses for the subsequent computer analysis.

Three overhead projector sheets with scripts for the task instructions were prepared to be projected on the overhead projector to one side to reinforce the simultaneous verbal instructions. The video sequences were made on four 30 minute blank pulsed VHS cassette edited tapes. Each testing session lasted for approximately 70 minutes.

5.3.3 Anticipation and estimating arrival times

Volunteers were initially compared on Task I, ie pressing a button the moment they saw cars travelling at different speeds reach a traffic cone. In reality, precision at this task requires anticipating the moment before it occurs. Using the average absolute error across trials as the dependent variable (name meanaa), this measure was found to be related to AH4 ability ($p<.005$) and driving experience ($p<0.025$). The higher ability group were more accurate than the lower ability group and those with driving experience were better than those without such experience, but there was no independent effect for age or gender.

The more complex version of Task I was Task II, ie estimating arrival time of the oncoming car at various speeds which was blanked either 20 or 60 metres before the cone. It is in principle possible to estimate the time to arrival of the vehicle at the cone from the rate of increase of the image prior to the moment of blanking. Moreover, it is a common assumption that individuals are capable of projecting perceptual information of this sort to anticipate a predicted arrival time. From this assumption, it follows that

$$\text{log of proportional change in arrival time} = \frac{\text{log of proportional change in distance} - \text{log of proportional change in speed for successive cars}}{}$$

From the results, two variables were computed by least squares regression. FN1 represented the indices of distance such that a value of unity would represent a perfect compensation for distance, regardless of whether overall time estimates were long or short. An FN1 value of zero would represent a failure to accommodate the distance variable. An FN2 value of minus one (-1) would represent a perfect compensation for relative speed; and a value near zero would represent an inadequate compensation.

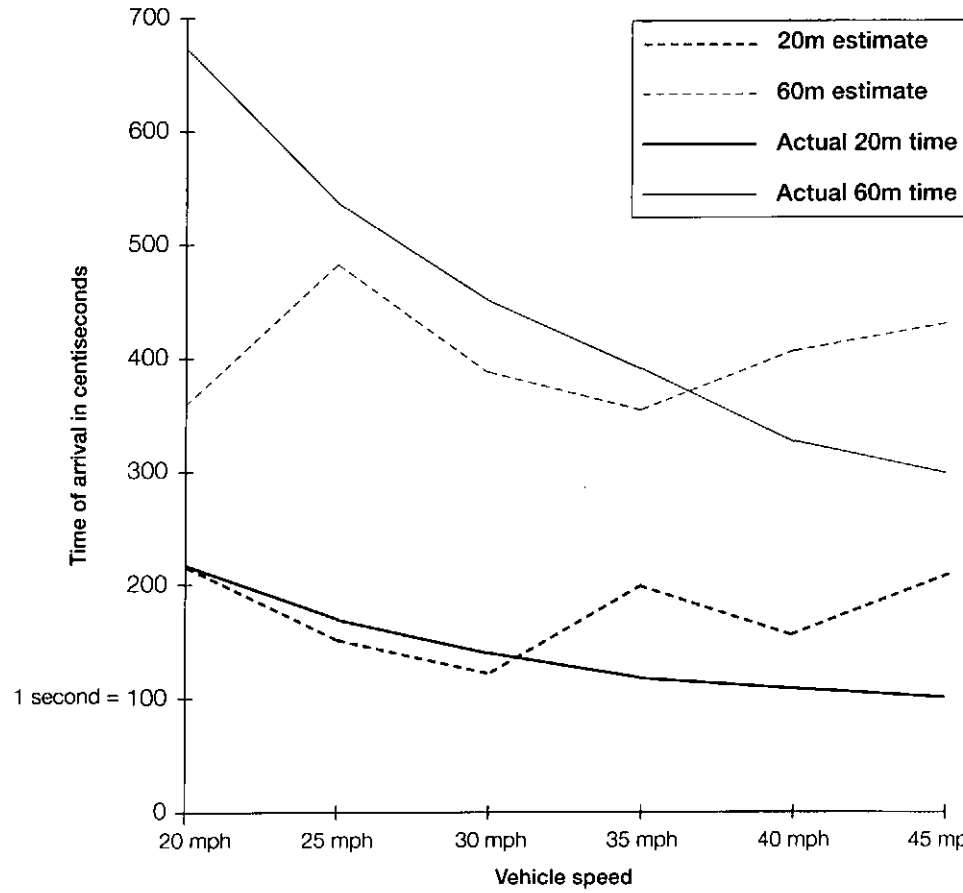
The mean FN1 value was 0.78, indicating a reasonable compensation for distance. The AH4 test discriminated between better and worse performers on this measure ($p<0.0001$). High AH4 scorers averaged FN1=0.87; low AH4 scorers averaged FN1=0.67. Gender x AH4 seemed

a significant interaction ($p<0.002$) such that male high AH4 scorers had an average FN1=0.95. The estimation of time difference from spatial difference appeared enhanced for higher AH4 males compared with others.

The mean FN2 value was -0.1. This was a surprisingly negligible value considering that d-prime results were consistent with individuals being able to discriminate between faster and slower approaching vehicles (see next section). No evidence suggested that individuals were able to make a reliable compound judgement from speed and distance information. Speed differences were consistently under-weighted. This shortcoming is also obvious from a plot of arrival times at various speeds for the 20 and 60 metre trials (Figure V.4).

Figure V.4

Time of arrival judgements for different vehicle speeds and distances



It appears that the method of determining arrival time was based on a combination of simple responses which produces ill conditioning (in the mathematical sense), when combined. A faster car may arrive earlier and a further car may arrive later but, when the arrival time is compounded from variations in the two dimensions, volunteers could only cope with a simple 'more or less' judgement which seems weighted on the distance aspect of the information available. This result comes from testing the response to speed and distance variables given the expectation of an adequate system of incorporation. Since none of the respondents could be labelled as effective at this combined task, it appears that much work on assessment of arrival time may be flawed. Problems may have been obscured, for example, by randomising variable changes and then averaging results across dimensions (Schiff *et al.*, 1992), or simply by not varying speed and distance variables simultaneously.

The general insensitivity of arrival time estimates will be compounded by the older person's attention and mobility difficulties. As a compensatory feature, it is noted that arrival times are anticipated too early for all but the higher speeds. Nevertheless, it is apparent that any estimate of the arrival of an oncoming vehicle may be considered suspect, regardless of physical age or aptitude. Distance itself is the only criterion which we can be certain gives a reasonably sound base for estimating the time remaining to cross and it is probable that in real circumstances an

individual will provide her/himself with feedback by monitoring changes against expectation and their own progress. The combined failure of initial judgement (made more likely by sensory and intellectual loss with age) and failure to accommodate or modify behaviour to avoid a developing incident (made more likely by physical and intellectual impairment) suggests that many urban roads (particularly where speed is excessive, the flow system is complex, or where it is assumed that the pedestrian can grasp novel signals or rules) can pose a threat to the older pedestrian.

5.3.4 Faster/slower judgements

In Signal Detection Theory, d-prime is a measure of ability to discriminate between two states, such as low vs high or present vs absent. The measure is obtained over a general sample set in which the signal is present or absent together with 'noise' which generally prohibits perfect performance. Noise represents a variable since its momentary effects upon the to be detected signal vary. The higher the value of d-prime, the better the discrimination performance. A zero value represents a no better than chance performance and a negative value represents worse than chance. In order to simplify the calculations and programming required to apply these principles, Luce's Choice Theorem was found to provide an equivalent basis but assumed a logit rather than normal underlying distribution. For practical purposes, the logit distribution can be considered an approximation to the normal in any case, so that measures were produced from this methodology.

The task required that volunteers could remember the last vehicles' progress and judge whether the progress of the next vehicle was faster or slower. To express his or her response, the volunteer would press a button 1 for definitely slower through to 6 for definitely faster. Several frames were previewed so that volunteers could practice without being recorded. In the real trials each speed (20, 25, 30, 35, 40, 45mph) was followed by each of the other speeds in a fixed design to allow for all possible comparisons other than equal speeds (30 comparisons).

Results of d-prime analysed against age, gender, ability, driving experience and possible interactions of these revealed a relatively simple pair of relationships. The value of d-prime tended to be lower for the older respondents ($p<0.005$); but higher for respondents with a current driving licence ($p<0.01$). There was no independent AH4 test effect. A variable measuring how likely a person was to say faster when the car was indeed slower produced no relationship with age, gender, ability, experience or any interactions.

5.3.5 Assessing the experimental data

Other sources of data, included recorded accidents (see Tables 1.3 and 1.4), help in focusing on potentially important elements from the mass of reaction time data generated by this approach. Thus attention was directed to the performance of the older female group whose AH4 test scores were in the lower range. This group showed the greatest mean estimation error of 1725msecs in Task II which may seem an insubstantial level of error. However, translating this error into the distance travelled by a vehicle at 45mph produces approximately 35 metres, a figure that makes the high incidence of accidents on major roads quite plausible. Taken together with the tendency to overestimate arrival times at the shorter distance of 20 metres, this would mean that people would wrongly believe they had more time to cross in circumstances when the close proximity of the vehicle would reduce the possibility of taking evasive action.

Of course the pedestrian's decision-making in real life is affected by many stimuli that cannot be adequately represented by video sequences. These include as examples of potentially negative effects background noise and distraction, and as offering potentially useful information the visual cues to depth that are not available in two-dimensional videotapes. Such counteracting influences are difficult to evaluate but, in the light of the interview evidence, may be less significant than other aspects of managing attentional resources. One great advantage in the laboratory, provided the demands are not excessive, is that the older person

can focus attention wholly to the task in hand, with little difficulty in making the response. In contrast, when actually crossing the road, the requirements of walking sufficiently quickly can compete for the available cognitive capacity. This competition will be even more pronounced if the pedestrian has physical disabilities or a generally reduced level of functioning. Accordingly, it can be instructive to make cross-comparisons between data gathered using the methods described in the last three chapters. The fact that the same NEAR sample provided both questionnaire and reaction time data allows a level of precision in those areas greater than in the other cases. However, similarities between sets of the NEAR replies and the interview data are apparent and the observations were made at sites adjacent to two of the interview areas.

Chapter 6 Relating data from different sources

6.1 Linking the evidence

The review in Chapter 2 has demonstrated that there is a lack of research into the problems of older pedestrians and that unsupported assertions and speculation still remain. The two main approaches to the empirical study of older pedestrians have involved interviews and behavioural observations, though both can create difficulties of interpretation. Self reports are often unreliable but can provide much information about the actual reasons for accidents. Similarly, it is difficult to tell to what degree the behaviour of older pedestrians just prior to an accident reflects their normal behaviour. More corroboration from different sources, such as eyewitness accounts, drivers' and police reports, is needed. At the moment findings in common, ie when the two sources agree, carry most weight and, for example, both suggest that older pedestrians do initially stop and look before crossing. So problems apparently arise from an inability to make an accurate assessment of the situation or to judge what will happen next. Here further analyses linking interview and experimental data can contribute to the discussion.

6.2 Further analysis of the interviews

None of the interview respondents participated in the laboratory study nor was their level of reasoning ability assessed. The focus in this section is on the additional questionnaire data that was provided, particularly about factors which discourage going out and self-reports of near-miss events. Responses to these question sets were factor analysed. These analyses build from self-reported data to provide some insight into problems for older pedestrians, providing a balance to already known accident data.

The inter-correlations resulting between variables from the interview sample are shown in Table 6.1. Correlations are shown only when significant and only to two places of decimals. The significance criterion adopted is the 0.05 level. Using this criterion, a relationship is acknowledged as unlikely to be by chance if the correlation found would occur on average only once or less in every twenty sets of data. Correlation coefficients are shown only where it is conservative to consider that some effect over and above random 'noise' may be represented as present. Significance levels are shown in small case below each correlation coefficient, for example the level shown as 0.0001 indicates that the related correlation could be expected to occur by chance alone only once, on average, in every ten thousand sets.

6.2.1 Interpreting self-reports of near-misses

Near-miss pedestrian events that consider the fault was primarily with the driver or rider are collected within the factor Near-miss f1. Older respondents (75+) were less likely than the younger group (65–74 years) to report near-miss events as pedestrians stemming from the driver or cyclist's fault or failure ($r=-0.22$, $p<0.003$). Near-miss f1 also correlated negatively ($r=-0.17$, $p<0.02$) with being discouraged by concerns for violence or crime or about being out late which are reflected in Discourage f3. Therefore, those attributing blame to the driver are less likely to feel threatened in a social sense. They are more likely to be male than female ($r=-0.16$, $p<0.03$). They are more likely to express concern for global issues or events (Concerns f2) which might affect other, perhaps unknown people ($r=0.32$, $p<0.0001$).

The factor Near-miss f2 was a measure of incidents occurring where the pedestrian found difficulty coping with the complexity or uncertainty of a road traffic situation. This factor was positively correlated with Concerns f1 ($r=0.27$, $p<0.0002$), a measure of concern or anxiety for personal safety. Near-miss f2 correlated with the self-report measure (Feelings f1) of combined nervousness, slowness and following behaviour in the crossing environment ($r=0.23$, $p<0.002$). As a clue that 'opportunistic' behaviour may appear as a desperate effort in circumstances beyond the individual's capacity, it is found that Near-miss f2 correlates to a small but

Table 6.1

Correlation matrix of main sample data showing only correlations significant beyond the 0.05 level

Variables are specified in more detail in the Notes and Definitions section preceding Chapter 1

	age	female	discourage f1	discourage f2	discourage f3	discourage f4	concerns f1	concerns f2	feelings f1	feelings f2	feelings f3	feelings f4	near-miss f1	near-miss f2	near-miss f3	near-miss f4	health f1
age																	
female																	
discourage f1	0.19																
	0.0043																
discourage f2																	
discourage f3		0.41															
		0.0001															
discourage f4																	
concerns f1			0.23		0.27	0.22											
			0.0007		0.0001	0.0011											
concerns f2	–0.16																
	0.0236																
feelings f1	0.23		0.48		0.23	0.25	0.51										
	0.0015		0.0001		0.0010	0.0004	0.0001										
feelings f2			–0.22					0.17									
			0.0021					0.0150									
feelings f3						0.14		0.16									
						0.00455		0.0272									
feelings f4							0.15	–0.19									
							0.04	0.0098									
near-miss f1	–0.22	–0.16			–0.17			0.32									
	0.0026	0.0238			0.0191			0.0001									
near-miss f2					0.22		0.27		0.23	0.16							
					0.0024		0.0002		0.0018	0.0362							
near-miss f3	0.17		0.17						0.22		–0.16						
	0.0200		0.0200						0.0032		0.0265						
near-miss f4					–0.17												
					0.0233												
health f1	0.22	0.24	0.57		0.27	0.26	0.37		0.60	–0.22				0.16			
	0.0016	0.0006	0.0001		0.0001	0.0002	0.0001		0.0001	0.0023				0.0331			
health f2		0.30	–0.46		0.25				–0.35				–0.16				
		0.0001	0.0001		0.0002				0.0001				0.0452				

significant extent with self-reported opportunistic crossing behaviour as measured by Feelings f2 discussed in section 3.5.3 ($r=0.15$, $p<0.04$). Near-miss f2 also correlates with Health f1 ($r=0.16$, $p<0.04$) suggesting poorer balance and judgement skills. Finally, Near-miss f2 correlates with Discourage f2 ($r=0.22$, $p<0.0025$) which has been interpreted as either an uninformed or unmotivated attitude to going out. In essence, Near-miss f2 represents a class of reported incident experienced by the elderly because of their difficulty with regard to representing and coping with some parts of the road traffic environment.

A subtle distinction exists between the previously described factor (Near-miss f2) and Near-miss f3. This represents near-miss events which may have arisen from a typical judgement error or difficulty, such as the speed of the traffic, rate of acceleration, considering a safer crossing too inconvenient, or just being pulled back at the last moment. It was correlated with increasing age ($r=0.17$, $p<0.02$), with feeling discouraged from going out because of physical discomfort or difficulty (Discourage f1, $r=0.17$, $p<0.02$) and with nervous, slow and following behaviour as a pedestrian (Feelings f1, $r=0.22$, $p<0.004$).

Near-miss f4 was a measure most resembling purely attention failure such as not checking or checking but not seeing. Its measure correlates only with Discourage f3 ($r=-0.17$, $p<0.03$) and that factor relates to discouragement about going out because of violence and crime and concern about being out late. Acknowledging attention failure as contributing to personal pedestrian near-miss events appears slightly related, therefore, to less fear for personal security. The fact that this is an isolated and low correlation suggests some caution in interpreting Near-miss f4. Principally, this is because some respondents might not see attention deficits as such and attribute incidents to other factors; and in fact it might sometimes be the case that the more aware and more confident will more readily admit or recall such a slip.

It is always necessary to consider self-reported data with some caution. However an interview approach is one obvious way of achieving a sketch of how individuals, particularly the elderly, perceive threat in the road environment. From the near-miss data the elderly, particularly older women who are unlikely to have had driving experience, are in turn less likely to blame the driver or rider for an incident. It may be the case that they have less expectation about the driver or rider's action in the first place. Feeling anxious as a pedestrian relates to identifying complexity or uncertainty in the road environment as contributing to their own close accidents. Errors in personal judgement relate to nervousness and slowness which can nevertheless lead to opportunistic acts in over-demanding or bewildering circumstances.

6.3 Further analysis of the NEAR data

The NEAR participants in this research programme were accustomed to completing questionnaires and attending laboratory sessions or interview as part of the ongoing NEAR research into aspects of ageing and related aptitudes and abilities. This degree of voluntary flexibility would be considered unusual from house to house questionnaire respondents to whom a request to attend the University for nominal payment might easily be considered as a source of inconvenience and apprehension. The existence of the NEAR panel, the NEAR researchers and their administration staff was therefore a significant benefit for the current project, making the video test phase far easier to organise than would otherwise have been possible and allowing an overall analysis of questionnaire and laboratory data.

The correlations between laboratory measures described in section 5.3 and the NEAR questionnaire data described in section 4.3 – 4.5 are shown in Table 6.2. Included in this table are correlations with age in years, gender, level of AH4 test scores and time since last driven (lastd). Time since last driven was a seven point scale derived from questionnaire responses (1 : driven in the last week – 7 : never driven). Correlations are presented in the same format as in Table 6.1.

Table 6.2

Correlation matrix of NEAR data showing only correlations significant beyond the 0.05 level

Variables are specified in more detail in the Notes and Definitions section preceding Chapter 1

	age	female	ah4 pt 1	lastd	concf 1	concf 2	health f1	health f2	feelings f1	feelings f2	feelings f3	feelings f4	feelings f5	meanaa	FN1	FN2	dprime
age																	
female																	
AH4 pt 1	-0.15																
	0.0409																
lastd		0.36	-0.20														
		0.0001	0.0082														
concerns f1			-0.19	0.24													
			0.0114	0.0014													
concerns f2																	
health f1																	
health f2			-0.15	0.25	0.28												
			0.0500	0.0008	0.0002												
feelings f1	0.19		-0.39		0.22		-0.32	0.38									
	0.0145		0.0001		0.0050		0.0001	0.0001									
feelings f2																	
feelings f3				0.25	0.30			0.42									
				0.0013	0.0001			0.0001									
feelings f4																	
feelings f5			-0.24			0.16	-0.20	0.20									
			0.0019			0.0495	0.0146	0.0156									
meanaa	0.20		-0.25	0.24									0.19				
	0.0064		0.0006	0.0013									0.0196				
FN1			0.31						-0.19								
			0.0001						0.0164								
FN2	0.15																
	0.0480																
dprime	-0.28			-0.26				-0.25			-0.24			-0.15		-0.18	
	0.0002			0.0005				0.0010			0.0021			0.0432		0.0174	
Xcriterion																	

6.3.1 Simple arrival time judgement

Task 1 in section 5.3.1 required volunteers to watch a videotape of a car approaching and passing a traffic cone, as it travelled at varying speeds from 20 to 45mph and to press a button when the front of the car reached the cone. The main purpose of this task was as a lead-in to a succeeding task in which the approaching vehicle would be blanked from view before arriving at the cone and respondents would then be required to estimate the moment that they thought the vehicle would arrive.

It was possible to determine the nearest video frame which represented the moment the car reached the cone by reading the Vidchron Time Code electronically impressed on the video but invisible to respondents. The computerised recording of press-button responses allowed for each person's button press time to be compared with this instant. The mean absolute error (variable name Meanaa) for a volunteer represents the average error of the volunteer, disregarding the sign so that, for example, one second early was treated as equivalent to one second late. The reason for disregarding the sign was to prevent an individual's potentially large error responses from cancelling each other on summation, thereby falsely indicating accurate performance.

The correlation of the resulting measure (Meanaa) from Task 1 with other items from both the NEAR questionnaires and results from the other related laboratory tasks shows that there is little relationship between Meanaa and questionnaire items. The only questionnaire factor from the NEAR participants to correlate significantly with Meanaa was Feelings f5 ($r=0.19$, $p<0.02$). Feelings f5 was described (Section 4.3.2) as predominantly a measure of reliance on following others and not understanding the beeping at pedestrian crossings. The variable Meanaa did not show any significant relationships with concerns or with obvious health related questions, although it was related to more direct measures. Age, for example, correlated with Meanaa ($r=0.20$, $p<0.01$). Thus older respondents tended to be worse at anticipating the exact moment of arrival. Larger values of Meanaa related to lower AH4 Part 1 scores ($r=-0.25$, $p<0.001$). Larger Meanaa scores related to lack of recent, or any, driving experience (variable Lastd, $r=0.24$, $p<0.002$). Thus even performing a simple task such as pressing a button at a visually predictable moment bears relationships with verbal and numeric reasoning ability (AH4 Part 1) or a process that underlies such ability, as well as age and lack of recent driving experience.

What may be important for pedestrian safety is that the older pedestrian is more likely to be somewhat less accurate in estimating the moment of an event even when they are continuously monitoring its lead-up. This seems marginally related to a worse performance at judging relative speeds of approach ($r=-0.15$, $p<0.05$) and corresponds to some increase in the likelihood of following others across the road rather than making an independent decision. There is no evidence in our analysis, however, that worse scores on the Meanaa variable compounds directly to a concern or anxiety about crossing in the road environment.

6.3.2 Faster/slower judgements

One method of measuring the ability to discriminate a difference is to use d-prime derived from signal detection theory (refer for a more detailed description to section 5.3.4). In this case it was used to measure an individual's ability to determine whether an approaching vehicle is faster or slower than in the previous episode. The history of research using this measure has rarely been in connection with driver or pedestrian safety but it is a potentially useful tool. For example, those better able to discriminate whether or not a vehicle was approaching more or less quickly in the laboratory task should also be those more equipped to decide whether a pedestrian crossing opportunity can be accepted.

The measure, d-prime, was found to be the strongest of all measures to correspond directly with age ($r=-0.28$, $p<0.002$) – see Table 6.2. Of very similar order of correlation with d-prime was Health f2 ($r=-0.25$, $p<0.001$) which was derived from the NEAR postal questionnaire and is considered a measure of self-reported judgement and sensory ability. By simply observing the sign of this correlation and definition of the variables it appears that those claiming to be less

good in terms of judgement of traffic and sensory ability performed less well in estimating relative speed. It also happens that more recent driving experience related to a better d-prime score ($r=-0.26$, $p<0.0005$) but gender was not significantly correlated.

One measure which is relevant to d-prime is the variable X-criterion in Table 6.2. This is a measure over and above d-prime and indicates whether judgements are being made in any systematically cautious or incautious pattern by an individual. This measure produced no systematic relationships with age, with other laboratory measures nor with questionnaire measures.

Since AH4 Part 1 scores were balanced within the NEAR component of this study, an age effect on AH4 scores is prevented, although a general deterioration of this score with age is recognised. The AH4 Part 1 test of verbal and numeric reasoning ability showed no correlation with d-prime scores. The latter measure correlated negatively with Feelings f3 from the NEAR questionnaire ($r=-0.24$, $p<0.003$) so that higher values were associated with respondents feeling that, at junctions, they could better anticipate which traffic would go next. They also reported being less likely to avoid such junctions. However, low AH4 Part 1 scorers were more likely to report feeling nervous or anxious crossing the road (Feelings f1, $r=-0.39$, $p<0.0001$).

Thus AH4 Part 1 and measures of d-prime may contribute separate insights into problems experienced by older pedestrians, with the latter representing the more direct sensory discrimination of traffic speeds which also deteriorates with age. This would imply that fast vehicles pose a particular threat to older pedestrians in urban areas.

6.3.3 Combining speed and distance cues in estimating arrival time

Task II of the laboratory trials involved the estimation of the delay between the blanking of an approaching vehicle and its arrival at a further point. The main question under investigation was how much effect each of the combined variables of approach speed and distance had upon the estimated time of arrival. Two indices or measures were devised: FN1 measured the relative effect that the distance of blanking had upon the estimated delay before arrival; FN2 measured the relative effect of the speed of the approaching vehicle upon volunteers' judgements. These measures were designed to track whether judgements were being systematically and geometrically affected by variation in both speed and distance, by mainly just one or the other, or by neither.

The results, as presented in section 5.3.3, indicate that variability in arrival time is most clearly and directly estimated from the distance of blanking of the approaching vehicle with negligible effect resulting from approach speed variability. The variable FN1 shown in Table 6.2 represents the index associating arrival time with distance before blanking. This is shown to have a positive correlation with AH4 Part 1 scores ($r=0.31$, $p<0.0001$). Lower AH4 Part 1 scorers tend to underestimate increasing distance so that their errors become more cautious. FN1 is correlated with Feelings f1 from the NEAR questionnaire analysis ($r=-0.19$, $p<0.02$), suggesting that those worse at utilising distance cues to amend their estimates of arrival time appropriately, were slower and more nervous in the road environment (which is in itself a correlate of low AH4 Part 1 scores).

The variable FN2 in Table 6.2 is the index relating arrival time to the speed of the blanked vehicle. A value of –1 would represent a proportionate adjustment for changing speed between trials. A value of zero would represent a volunteer's failure to make any systematically based adjustments. The mean FN2 value was only -0.1. Hence, there was no evidence that any group could make judgements effectively combining the two proportional variables of distance ***and*** speed. Judgements tended to be dominated by the distance variable.

It must be stressed that FN2 was not a measure of perceived relative speed so much as the respondent's ability to compensate for speed in terms of estimating the delay in arrival which should result from speed change combined with distance change. The ability to discriminate between different speeds is directly measured by d-prime.

Despite the systematically low and negligible value of FN2, it nevertheless had a significant but low correlation with d-prime ($r=-0.18$, $p<0.02$) which was the independent measure of a volunteer's ability to discriminate the relative speeds of approaching vehicles. FN2 also correlated marginally with age ($r=0.15$, $p<0.05$), so that the older volunteers tended to show even less facility to utilise speed cues in the arrival time estimates.

In essence, regardless of an individual's ability to discriminate effectively between speeds of successive vehicles, the NEAR participants, whether scoring relatively high or low on the AH4 test, were poor at integrating speed information with distance cues. Their arrival time estimates were dominated by simple distance information and there seems a strong likelihood that a similar result might be found even with a younger group. This remains to be tested. The challenging aspect to the pedestrian (especially the more elderly) is that they do not know necessarily what time is available to cross and might well make the same crossing decision with a faster approaching vehicle – or at least fail to compensate for the speed of the vehicle compared with its distance.

6.4 The use of multiple methods

The foregoing discussion conveys something of the difficulty in relating the results of studies where many variables interact and their combined effects can even appear contradictory. However, we see no simple solution. In studies involving any form of self-report the initial approach to the road user will be important if attitudes and the bases for choice are to be accurately reflected, eg any perceived threat or need to avoid attribution of blame could significantly affect responses. Equally, the range of methods used and the opportunity for a proportion of people to participate in more than one phase of a study will improve the quality of data that will be collected and confidence in making broader inferences from the results.

Moreover, the interpretations that have been drawn here about the problems of older pedestrians have been strengthened by the cross referencing made possible because of the different phases of the project. Had we relied solely on questionnaire data, it would not have been possible to assess skills relating to judging speed and distance directly and, without the independently collected accident data, the particular difficulties of many women over the age of 75 would have lacked adequate corroboration. More generally, linking objective and subjective measures with direct and indirect assessments should enable us to interpret more accurately the intricate and sometimes paradoxical behaviour of road users.

Chapter 7 Implications

7.1 Levels of extrapolation

Just as there are methodological issues of a general nature that were discussed towards the end of the last chapter, it is useful to clarify the various levels at which the findings of this three-part study can be applied to the real world problems of the older pedestrian. Initially, they can be considered in the light of the existing work in the field and conclusions drawn of a general kind for different groups of road users. Thus in the next two sections we review the overall implications in terms of drivers' responsibilities and the provision of publicity materials for older pedestrians themselves.

The processes of planning and conducting the different phases of the work have also drawn to our attention practical ways in which older pedestrians may be helped and to techniques that can further advance the study of the complex interaction between people and their surroundings when crossing the road. Both of these aspects are examined in relation to formulating specific recommendations and finally we set the results in the wider context of the quality of older people's lives.

7.2 Drivers' responsibilities

7.2.1 Paying more attention to pedestrians

High rates of pedestrian accidents may be explained in part by drivers paying little attention to pedestrians in their assessment of risk on the road. This problem emerged strongly from several aspects of an earlier AA Foundation report by Carthy *et al.* (1993). Summarising their results, the drivers' perception of risk ratings did not correlate with pedestrian accidents, and the regression model explaining variation in risk ratings did not even include level of pedestrian activity as a variable. Video ratings of perceived risk from the driver's perspective did not reveal pedestrian activity as a motivating attribute and this was reinforced by the pedestrian walks where driver's ratings differed from non-drivers. Given that about a quarter of all road casualties in this country are pedestrians, these sources of misperception are important to correct.

However, the analysis of attitudes in the Carthy *et al.* study suggests that there are some groups of drivers who are likely to respond favourably to better or more comprehensive information (the community oriented) and to rules (the order oriented), but that the self oriented and youth oriented groups offer less likelihood of success from information alone and can react obstructively to explicit constraints. So, even if it is agreed that drivers need to take on more responsibility, the balance between changing attitudes, enforcement and unobtrusive guidance will be difficult to strike.

Before considering specific solutions it is worth summarising the kind of justifications currently advanced. If accidents are viewed as the fault of the victim, the general public may be less concerned about the need for the design and implementation of safer road systems, especially if they are more costly; they may accept injuries and even fatalities. Attitudes regarding the failure of others depend critically upon whether the cause of the failure is perceived to be under the control of the victim. One's own behaviour can be explained in terms of comparison to norms, the effects of external factors and the exercise of control, whereas intentionality or lack of foresight is often attributed to the other person's actions. If the victim is deemed to be at fault, then people are less likely to feel empathy or concern: they may prefer at least to distance themselves from the victim if not actually condemning them. Programmes that convey the fallibility of human functioning without provoking anxiety may help to focus on the possibility of adverse consequences and encourage the taking of responsibility to counteract the uncontrolled and unintended actions of others.

A direct application would be to extend the recent campaign directed at younger drivers who are over-represented in the accident statistics, as are older pedestrians. One of the central features of the BBC DRIVE series of six programmes in early 1994 was to try and inculcate a greater sense of responsibility and to spell out graphically the tragic costs of momentary bad driving. Medina (1994) recounts similar attempts in Spain that have portrayed the ways in which the various long-term consequences of an accident can wreck people's lives. There seems little doubt that powerful immediate effects can be achieved, although the nature of back-up, repetition and the appropriate intervals still needs to be defined. One specific possibility would be to simulate the problems of older people when crossing the road, eg restricted hearing and vision, physical limitations in walking, difficulties in judging speed and distance aimed not only at providing advice for the older person but also at making drivers more aware of their problems as pedestrians, especially crossing to and from bus stops.

The specification of limits can also play a part in changing attitudes. The recent use of 20mph limits in certain areas, apart from other benefits, has introduced the notion of a more finely graded set of speed restrictions that may gradually become accepted. Widening the specific category of knowledge relating to pedestrians, required as part of a revised driving test, could similarly focus attention on the pedestrian perspective.

More appealing, if sufficient ingenuity can be applied to the problem, is to influence driver behaviour and driving habits without obtruding directly on their attention. A variety of engineering techniques are already in use, collectively termed traffic calming, but most are restrictive rather than persuasive. However, the growing need to make use of measures which are environmentally acceptable (as well as effective in reducing vehicle speeds) has lead to more subtlety. For example, using different surfaces to create a perception of a narrower carriageway; landscape treatments to create an illusion of a calmer environment; and conscious decisions to improve conditions for pedestrians by using regularly spaced refuges, both to narrow the running carriageway and to break road crossing into two parts, can all be effective. Care must be taken to ensure that problems are not simply relocated, although this possibility can often be avoided by adopting a comprehensive, urban safety management approach.

7.2.2 Speed and distance cues for drivers

The common requirement to judge both speed and distance for both pedestrians and drivers implies a wider message in the finding from the laboratory study that distance remains the predominant cue in these judgements. The widespread assumption is that road users are capable of integrating the two measures in making estimates of a vehicle's time of arrival. However, as section 6.3.3 concludes, people cannot make reliable compound judgements from speed and distance information and distance appears to predominate. The implications here are wider than for pedestrian accidents.

Evans (1991) discusses two likely reasons that increase the incidence of rear-end collisions. Firstly, in normal following, he notes that the difference in speed is close to zero (although this could equally be stated in terms of the distance between the vehicles remaining constant). Secondly, there is the role of experience that conditions on the roads are generally forgiving and that the vehicle in front seldom does brake suddenly. The point is that drivers can continue to assume falsely that they can accurately handle speed and distance interrelationships whereas close following is much more an act of misplaced faith than of sound judgement. Whilst demonstrations are expensive to stage, the railway authorities have recently filmed a locomotive/car crash at a road crossing in order to bring to drivers' attention the risks of trying to beat the warning lights. Given the financial and human costs of road accidents arising from tailgating, especially on major roads and motorways where multiple collisions can result, the extension of techniques to focus on commonplace misperceptions about safety margins could be justified and might also be informed by data from video cameras regarding the incidence and nature of tailgating at high speeds.

Successive warnings on such dangers would need to be followed up, though an initial approach could simply be informative. Drivers generally do not receive objective feedback on

their unsafe behaviour in the same way that they observe it in others. Even when it is available, it may be often offered in a hostile way that guarantees rejection.

7.3 Educational materials and publicity

7.3.1 Selection of content

The review of evidence in Chapter 2 suggests that the reasons for pedestrian accidents involving older people are interrelated. Broadly speaking, the interaction is between factors such as sensory deficiencies, slow information processing, lack of driving experience, failure to anticipate outcomes and inability to take evasive action. Although they are more cautious than younger adults in their behaviour, their compensatory behaviours are not necessarily safe. Indeed, it is very difficult to predict how an older person who does not understand the principles underlying traffic movement will behave in a road setting that involves complex choice. The examples in the observational study of initial caution followed by subsequent indecision or panic reaction provide a case in point.

Evans (1990) has argued that behavioural factors, especially social norms, are playing an increasingly larger role in traffic safety and that intervention programmes should be aimed at altering human behaviour and attitudes. Whilst there has been some research into driving courses for older drivers, little has been available for pedestrians. A WHO report (1989) suggested that road safety intervention programmes should look at local data for each area and address those specific problems. This may apply particularly when complex new road junctions are built, which make greatest information processing demands and thus pose greatest problems to older people. Specific interventions should also concentrate on the areas where older people often go, eg local shopping areas, as confirmed by the data in section 3.3.2.

Rothengatter (1984) stated that, before designing a road safety intervention programme, it is necessary not only to identify the crucial behaviours to be targeted, but also to assess whether the target group is capable of performing these behaviours. The latter may be important for older people as the behavioural repertoire declines with age, mostly as a result of physical changes. However, as already noted, they are a heterogeneous population and therefore it will be difficult to design a programme appropriate for the capabilities of a large group. But given that there are some common difficulties, say in performing a rapid assessment of a situation, it is important that programmes address issues of how to maximise the available information, for example, avoiding obstacles which screen the traffic and thus improving the chances of making a safe judgement (OECD, 1986). Finding a means of conveying that unexpected events can occur, such as vehicles overtaking, reversing, going faster than expected etc, may improve anticipation and lessen the unrealistic expectations that some non-drivers seem to hold.

Another important aspect concerns the style and emotional tone of the message. Anxiety producing information may be viewed as irrelevant or be ignored if older people are fatalistic or less bothered by injury or death in their contemporaries. At the other extreme the outcome may be avoidance or excessive caution. Either way fear-arousing publicity is unlikely to work (OECD, 1986). Well selected material would thus include information which is personally relevant and encourages acceptance of personal responsibility without arousing fear. It is also important that the tone is not patronising, is suited to the population and takes a positive line, emphasising what can be done to reduce risk. Similarly, older people are more likely to respond to a road safety professional who is middle aged, rather than younger.

Road safety programmes for older people may encounter specific problems that are not found in other programmes. It is difficult with habits developed over many years to try to change behaviour. Some older people may insist that, as they have been crossing roads for many years without having had an accident, there is no need to learn new strategies. Thus Evans (1991) writes:

"The longer one drives, the greater is the accumulation of evidence that all the really bad things happen to others."

The same conclusion applies to pedestrians and is especially pernicious for older pedestrians whose sensory and cognitive abilities have gradually diminished. They may retain levels of confidence that are now inappropriately based, if not dangerously unrealistic. A negative reaction may also mask concern over mastering new information so any techniques to assist assimilation of the material can be crucial. Thus important pieces of information may have to be repeated several times, and cue cards with the essential pieces of information on them which the audience can keep, may accompany a video or talk. This will act as a memory aid, and thus is likely to improve compliance. According to Varma (1988) the discussion format can be more influential than the directive approach with a passive audience, and understanding why specific behaviours are important can promote active involvement in the programme. Understanding rather than simple learning will encourage flexibility and adaptive behaviour, and thus the older people will be better able to respond to changing behavioural demands as the situation changes.

7.3.2 Types of intervention

Very few intervention programmes for older pedestrians have been attempted, a product perhaps of scarce publicity about the problem, lack of resources and ignorance about empirical evidence on the high pedestrian accident rate. Existing provision, however, may not reach many of those for whom it is intended. Sheppard and Valentine's (1979) study involved 112 Road Safety Officers (RSOs). Only 35 of those interviewed gave training specifically to older pedestrians only, and 55 to both pedestrians and drivers. Percentage effort in training did relate to percentage road casualty rate for older people in that area. Talks and discussions were most commonly given, particularly about new facilities, followed by distribution of publicity material. Only 10 RSOs gave a course of talks, and in general only visited a group about once a year. Thus there is little prospect of feedback occurring. Old people's clubs were most commonly targeted for talks, although only 13% of old people in the UK attend such clubs (HMSO, 1990). There are practical difficulties in getting access to groups of elderly people since they often have no regular meeting points (HMSO, 1987), as confirmed by our interview data. However, studies have found that knowledge gains from leaflets are smaller than those who attend talks (OECD, 1986), and thus it is worth looking at ways of reaching a larger section of the elderly population through talks if facilities are available in the community.

'Defensive Walking' (HMSO, 1990) is a road safety programme aimed at older pedestrians. It informs RSOs how to reach older people and to utilise the resources available to them. The programme itself includes a video and cards which demonstrate the seven 'Defensive Walking' principles. The cards are used to encourage an interactive approach to learning, as well as serving as useful memory aids. The seven principles give specific pieces of advice, but also include more general statements, such as "Check the driver is doing what you expect." However, people who have never driven before often have unrealistic expectations of drivers (Sheppard and Pattinson, 1986) and in our study there was a higher proportion of non-drivers in the sample (cf. sections 2.6.1 and 3.2). Thus such statements need to be accompanied by more specific instruction and advice such as what sort of mistakes drivers usually make, what to do if the vehicle is not doing what is expected, etc. Moreover, 'Defensive Walking' principles do not tackle the problems that older people have in predicting and judging the traffic situation, and seem to be encouraging cautious rather than safe behaviour. The title itself, 'Defensive Walking', suggests that people have something to fear, and, while advice such as planning a trip in advance to cut down the number of roads crossed may seem to be sensible advice, it could also lower confidence in the road user's ability to cross a road safely. This will not be an effective way of altering behaviour if it encourages disengagement or developing defensive reactions against traffic. The emphasis in 'Defensive Walking' is on increasing knowledge rather than teaching specific behaviours. It is suggested that the programme should be evaluated by looking at the extent to which "the road safety message(s)

have been received and understood". However, these variables are poor predictors of actual behaviour.

Direct information about safe crossing procedure is not the only way in which attempts have been made to improve road safety among older people. Holland and Rabbitt (1992) found that older people in their sample did not report any decline in their vision and hearing, despite objective measurements suggesting the contrary. However, once they had been informed of their deterioration, they made appropriate compensatory behaviours, such as wearing glasses more often and taking more care at unfamiliar or complex junctions. This suggests that, if given appropriate feedback that is specific to a certain difficulty, older people can make self-initiated compensatory adjustments. However, there were people in that study who said that they felt more at risk after having taken part. Thus, when giving information about potential dangers, it is important to be tactful and emphasise what can be done to minimise risk. Further research is needed to assess whether these self-initiated adjustments are associated with decreased accident rate and whether they are maintained in the long term.

7.3.3 Limitations of this approach

Apart from the specific doubts discussed above, there is a more fundamental reason to look for other than educational solutions directed at older people. While, for the older population as a whole, there are potential benefits associated with some form of road safety education, especially in the area of risk perception, this approach seems very unlikely to attract or be effective with the group that all aspects of our analysis show to be the most vulnerable, namely women over 75, who are in the average or lower ranges of cognitive ability. Indeed, it could be argued that they are likely to profit least from this type of intervention and that we need to formulate solutions with this sub-group of older pedestrians particularly in mind. In the longer term, the increase in the proportion of women with driving experience may help to offset their potential risks as pedestrians later in life but any such effects are not likely to become evident until some twenty years from now.

7.4 Specific recommendations

7.4.1 Reappraising pedestrian crossings

The observations at Site B, Halls Estate, involved a simple crossing facility that allowed pedestrians to stop the flow of traffic and there were no contingent relationships elsewhere. While there were instances of potentially unsafe behaviour observed, there was no implication that these resulted from failure to understand the sequence of events. Ward *et al.* (1994) have shown that pelican crossings on district distributors are associated with half the pedestrian casualty rates (per 100 million crossings) compared with no facility. However the local *v* the district distributor may not be the critical distinction Bearing in mind that much road crossing relates directly or indirectly (by catching buses) to shopping, questions about possible differences in layout and complexity of pedestrian crossings also arise.

As part of planning for the observation phase and in order to elucidate references made by interviewees, a number of more complex pedestrian crossings in the City Centre were visited and observed. Two broad conclusions can be drawn: (a) that many older people do not understand the sequence of traffic movements, such as an all green phase for pedestrians to cross and (b) that in a state of uncertainty, reactions are very variable and may result, eg in (i) following others; (ii) going elsewhere to cross; and (iii) trying to anticipate a break in the traffic independently of the appropriate phase to cross.

The overall problem seems yet another example of those who determine the rules and understand the relevant principles (of traffic flow in this case) assuming that users will base their behaviour on those same rules. Our evidence suggests rather that older people with difficulties in dividing their attentional resources will either ignore complex information or

choose to avoid places where they feel uncertain. Taking the example of when a traffic signal will change, it may be possible to display a 'countdown to cross' that would encourage people to wait and increase confidence about when to cross among the anxious and unsure. Alternatively, where it is physically practicable, older people are likely to be more at ease and willing to accept a narrowed crossing place or a place where traffic is consistently slower (near a road hump or similar traffic calming measure).

7.4.2 Crossing the road in two stages

Most local roads carry traffic travelling in two directions. With any appreciable volume of traffic this further compounds the difficulty of judging when it is safe to cross. It is accepted engineering practice, when seeking to provide assistance to pedestrians wishing to cross a busy road, that a refuge or traffic island is of considerable benefit. The rationale is straightforward: by providing a (relatively) safe place between the two directions of traffic, crossing the road can be undertaken in two stages, with attention focused in only one direction at a time. The need for such refuges applies with more force in places where the main group of people crossing are likely to have attentional difficulties.

A related problem is that nearly all pedestrians choose to take the shortest route from A to B (for very clear reasons if they have difficulty in walking) and it is often not practicable to locate the refuges on that part of the route. Barriers can be used to divert, or to force, the pedestrians to cross where the refuge is provided but, in their absence, many people can be observed crossing within sight of, but not at, the refuge. The Barrack Road Site (see Figure V.1) is a case in point. In order to have used that refuge, many of those crossing to the bus stop would have had to divert from their minimum distance path. None did, even when they were obviously unsure about the crossing judgement, especially in relation to the second half of the road. More care needs to be given to understanding pedestrian routes when locating refuges or traffic islands which can fulfil this function. This is particularly important at junctions, where traffic movements are complex and where many pedestrians are likely to cross.

7.4.3 Barriers in communication

The pervasive difficulty in seeing the world from a different viewpoint than one's own, in this case road use solely as a pedestrian over many years, has generated well intentioned but unhelpful interventions. Despite lack of evidence, it is safe to assume that those involved in road safety initiatives possess driving experience, ie they have had to meet levels of performance and knowledge in order to pass their test and have continued to accumulate substantial experience about the dynamics of interaction on the road from that standpoint.

Further, Carthy *et al.* (1993) have shown that drivers assess risk as pedestrians differently from non-drivers. In other words such processes become so ingrained that it becomes extremely difficult to view the road from a different perspective. The vocabulary of the two groups to describe commonplace events differs both in range and complexity. With some interviewees in the study it was obvious that the level of analysis required to respond to the questionnaire (even after repetition and rephrasing) went well beyond their normal consideration of pedestrian behaviour. Typical phrases were "I just step out" or words to that effect. Thus effective communication with the target group cannot be assumed and, as a first step, consulting on a local basis about problematic locations with panels of older pedestrians who have never driven would be worthwhile. Similarly, there is a need to clarify the bases on which decisions to cross are taken. The evidence from the video experiments suggests that distance is likely to be the most effective criterion and it may be possible to develop simple forms of advice on that dimension (having taken account of walking pace, traffic speed and road width).

7.4.4 Traffic conflict techniques

It remains controversial whether traffic conflicts are satisfactory surrogates for accidents but from a subjective impression we have little doubt that some of the potentially unsafe crossings observed at the two sites in section 5.2 could have lead to accidents given one or two more concurrent events, such as increased speed of vehicles or limiting of sight distance by buses. Most of the accumulated evidence relates to vehicle-only accidents but recently studies in Sweden have included applications relevant to pedestrian accidents. Garder (1989) examined risk at 120 intersections and showed the potential benefit of the technique in analysing requirements for traffic signals.

Current development of Swedish techniques at the Lund Institute of Technology (Odelid and Svensson, 1993) can reduce costs by making the observation and conflict scoring processes automatic. The aim is to produce a PC-card for processing co-ordinate data from a video recorded sequence. Their example concerns a cyclist crossing a major road in front of a car but in principle this is little different from a pedestrian emerging suddenly from behind an obstruction into the path of a vehicle. The system should allow for the selection of different types of conflict and detailed analysis of the various components.

7.5 Quality of life

From the foregoing it seems beyond question that the needs of older people as pedestrians are not being adequately met and that, as their numbers in the population increase, better solutions will have to be found unless their quality of life is to be further eroded. Hillman (1990) has argued that it cannot be valid to claim that the roads are necessarily safer just because there is a reduction in accidents. It may simply be that changes in behaviour are curtailing the use of the roads by the most vulnerable groups. Thus young children are ferried from place to place by their parents and the elderly venture out less frequently. Whilst there is little comparative data for past years, the very low numbers in absolute terms of old people who go out after dark speaks for itself and there were numerous examples in the interview data of deliberate self-restriction. Moreover, this applies in relatively safe areas amongst those surveyed, such as Halls Estate and North Heaton.

One solution, which has support in the USA, is to create housing precincts solely for the elderly where it is possible to pay particular attention to their needs and to remove them from the problems encountered in typical urban environments. However, there currently seems to be resistance by many in this country who feel that the price of isolation from other age groups would be too high to pay. Less radical solutions centre on improved information, traffic calming or similar engineering measures and placing more responsibility on drivers. However, there is also a need to offset the distortion of information about the incidence of crime and theft that is currently prevalent in the media which may be leading older people to restrict their lifestyles unnecessarily. The role of local councils and the police could be usefully increased in this context, both in disseminating information and facilitating group activities.

However, the outlook is not all unrelieved gloom. Individual examples serve to make the point that old age is not necessarily associated with decline and restriction. In the interview sample and in the NEAR survey there were instances of men and women leading active lives and pursuing their interests (athletics, bowling, church activities, exercise, social clubs). These activities served to offset any natural tendency to stay indoors and, indeed, it was these people who showed least concern about being out in the evening. Nor was it that they were entirely free from disabilities (visual difficulties, raised blood pressure, arthritis were all mentioned) but these were given little prominence compared with getting on with their lives. Driving, or having driven until well after retirement, was frequently cited as a reason for confidence on the roads but the more significant factor was the presence of strong interests.

In the laboratory study also there were striking examples. In the task involving judgements of faster/slower, perfect performance required 16 responses of faster when actually faster (and the rest slower) with differences in some trials of only 5mph. One participant made only one error (a level that most of the students who assisted in pilot studies did not achieve) and several others were only a little worse in the accuracy of their judgements.

Thus, in conclusion, there is cause for optimism in that there are people in our studies well into their 80s who do not experience substantial limitations on their lives and whose level of functioning has remained undiminished for practical purposes over several decades. They do not find crossing the road any more problematic than most of us and they serve as an example of energy and enthusiasm for life that more of their peers might in future emulate.

8 References

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Appendix A: The four areas: statistical description and pen pictures

The following information is provided to convey an impression of the areas from which the interview samples were drawn. The statistical information relates to the enumeration districts concerned but cannot be regarded as precise because some interviews took place outside the boundaries. The pen pictures are entirely subjective and are intended to portray the main differences between the areas in terms of the lives of their older residents.

(i) **Barrack Road**

Total population: 502
Total female: 278
Total male: 224
Pensionable age and over: 216
Living alone: 82
Ethnicity: 98% white
Economically inactive: 175
Percentage households with cars: 20
Limiting long-term illness: 99 persons, 65 years and over
Predominant housing type: Rented from local authority, 82%

These residents live in a heavily populated area (mainly maisonettes and multi-storey flats) near Newcastle City Centre and the open green space surrounding the North and West of the City. House theft is a particular problem and there were visible signs of attempts to force entry, such as removing beading retaining glass in doors. Locally the interviewees' trips were much the same as for other groups: they made frequent journeys to shops, newsagents etc and slightly further afield to a supermarket. However, they made full use of their proximity to City Centre shops. With very few exceptions they went there to enjoy the wide range of facilities. A common pattern was to walk in and take the bus back home. A substantial number reported mobility problems, usually associated with getting on and off buses. Even so, some of this group were comparatively adventurous and made more wide ranging journeys using public transport than people from the other areas. For instance, they went across the river to the Gateshead Metro Centre, to the coast and across the City to visit friends and relatives. Very few elderly people had access to cars and those who travelled by car mainly had lifts from their children.

In some cases good use was made of the local park and green space by walking for pleasure and a few people were still vigorous enough to maintain allotments close by but equally a proportion of respondents would not venture into the park alone for fear of mugging. Few regular journeys were made to hospitals or GPs. Far more trips out were of a social nature, eg going to a social club or pub was common for the men, whereas the range was greater for women and included church groups, dances and whist drives. Far fewer men than women expressed anxiety about being out late. Overall, despite a modest level of income, there seemed to be a high level of social activity.

(ii) **Benwell**

Total population: 399
Total female: 222
Total male: 177
Pensionable age and over: 93
Living alone: 80
Ethnicity: 90% white
Economically inactive: 123
Percentage households with cars: 30
Limiting long-term illness: 14 persons, 65 years and over
Predominant housing type: None but older group rent from local authority

Life for the elderly residents of Benwell is characterised by low income, ill-health and the well founded fear of crime, including personal violence that severely limits any journeys after dark. Early widowhood is common. Car ownership is minimal nor is the experience of travelling by car usual. Despite these disadvantages the community is resilient. There is a warmth of personal manner which offsets the bad image acquired by the area following the 1991 riots and the well-publicised lawlessness in some streets.

The poor health experienced by many residents who often suffer from multiple complaints, such as diabetes, hypertension, heart disease and arthritis, severely restricts their mobility. Trips for such people are limited to the local shops and a supermarket a few hundred yards away. Even these limited journeys present problems through obvious practical difficulties of carrying shopping any distance. Their journeys are restricted to necessary visits to GPs, hospitals and post office. Those with very poor health rarely go further afield and when they go the City Centre, they are invariably accompanied. Usually a daughter will take them because of some physical fear, such as having 'blackouts' in the shops, or a generalised loss of confidence. The healthier, more mobile, more confident people frequently take advantage of the frequent and cheap bus service to the City Centre. Going round the shops is primarily a source of enjoyment for the bustle and the varied displays and they clearly feel they continue to exercise choice in their daily lives. Likewise, some make use of the social clubs, luncheon clubs and exercise groups in this area. In order to reach these activities people either walk in both directions, taking rest as necessary when going uphill, or they go by the minibus provided.

People appear to take pride in coping with their limited financial resources. Many adhered to the pattern of life they had always known and for a few this included walking the relatively long distances in their local area rather than taking advantage of cheap fares to travel further afield. The pattern of family and community relationships also remains strong and often provides the support for people to cope with the restrictions imposed by age.

(iii) **Halls Estate**

Total population: 290
Total female: 193
Total male: 97
Pensionable age and over: 197
Living alone: 115
Ethnicity: 99% white
Economically inactive: 205
Percentage households with cars: 29
Limiting long-term illness: 73, 65 years and over
Predominant housing type: Privately rented unfurnished, 92%

Halls Estate residents greatly value the privacy and quiet of their area which is an unusual estate of privately rented maisonettes owned by one landlord and built in the inter-war years.

Many of the residents are the original tenants and have lived on the estate for many years. Consequently it is made up principally of middle aged and elderly people. Most residents are relatively well off with both an occupational and state pension – two holidays a year (summer and winter) are not unusual. Although many people travel considerable distances on package holidays, their daily lives are far more circumscribed. The vast majority visit the local superstore adjacent to the estate three to four times a week and most visit local shops and post office, involving the crossing of a district distributor at least once a week. A substantial number of women enjoy going by bus to the City Centre where looking at the changing displays in the Department stores is a time consuming hobby.

Otherwise the lack of social clubs and exercise facilities nearby means that for many the range, if not the frequency, of their activities is restricted. There is a Residents' Association on the estate but, lacking its own premises, it is not a major focus of community life and it survives because of the efforts of a few individuals. If people have interests in sport or other forms of exercise, they go out of the area. Very often the nature and location of these interests is determined by particular friendships. Unless they have the support of friends or contacts, people are unwilling to join new groups.

Some residents have serious health problems that restrict their mobility. For instance, some can only manage the short walk to catch the bus that makes a detour into the estate so that a service is provided to the City Centre. Comparatively few take advantage of the nearby Metro system to travel well out of the area, eg a day trip to the Coast (about 10 miles away).

The onset of dusk brings the cessation of social life for most older women who do not venture out after dark for fear of crime. However, this fear is not rooted in reality as in certain other parts of the city. While many people suffer the restrictions of a self imposed curfew, they could if they wished cross the Great North Road and walk safely a few hundred yards to the local High School which has a thriving Adult Association. For many people their social life is family based and accounts for many of the trips taken by car. Such people have few other contacts or activities other than visits to relatives. It was noticeable that the retired people with the greatest range of outside interests and contacts were single people without family support and included examples of unusual initiative, such as taking up a demanding hobby late in life Similarly, those attending local churches most frequently consisted of single or widowed women who went in groups to these activities.

(iv) **North Heaton**

Total population: 385
Total female: 209
Total male: 176
Pensionable age and over: 118
Living alone: 76
Ethnicity: 99% white
Economically inactive: 158
Percentage households with cars: 51
Limiting long-term illness: 31 persons, 65 years and over
Predominant housing type: Owner occupied, 70%

The residents of this post-war bungalow development in owner occupation and situated immediately south of the primary route from Newcastle to the Coast enjoy a relatively prosperous lifestyle with the best levels of health in the four areas. The group also had the highest level of car ownership or at least access to a relative's or friend's car. This opened up a wider range of recreational opportunities as people used their cars to visit country parks and the coast to walk. In addition, car ownership resulted in their travelling to a wider range of shopping facilities both within Newcastle and well outside its boundaries. Trips of this sort were frequent, typically once a week, although they also showed the common pattern of walking to local shops and catching the bus to the City Centre. The range of activities was also quite wide with a substantial number going out to social clubs, pubs, local churches and some participating in voluntary work.

Not surprisingly, the combination of satisfactory health, mobility and financial resources is associated with more confidence in using the road, less fear of the dark and consequently less restriction on their activities in the evening. However some residents, usually women, expressed anxiety about being out in the dark but this did not in fact deter them because they made arrangements to be escorted.

Appendix B: Interview Questionnaire

Personal details

Name: .....

Address: .....

.....

.....

Post code: ..... Tel: .....

65–74 ☐ 75–84 ☐ 85+ yrs ☐ *(tick as appropriate)*

Gender: Male ☐ Female ☐ *(tick as appropriate)*

Single ☐ Married ☐ Widowed ☐ Divorced ☐ *(tick as appropriate)*

Housing:	**House**	**Terrace**	**Flat**	**Sheltered**
Owned				
Private rent				
Council				
Housing Assoc				

Q1 Do you go out sometimes whether locally or further?

Most days	**Once or twice a week**	**Less often***	**Never***
☐	☐	☐	☐
		disqualifies ◄——►	

*Is there a special reason? .....

.....

Interviewer: .....

Time started: .....

Date: .....

Duration: .....

Journeys

Q2 When going or returning, does some of your journey involve

	Most days	**3-4 times a week**	**Once or twice a week**	**Less often**	**Rarely or never**	
Walking in or near traffic (beyond your own door)						a1
Bus						a2
Metro						a3
Drive car						a4
Being driven						a5
Taxi						a6
Train						a7
Cycle						a8
Ambulance						a9
Other*						a10
*State _____						a11

Q3 In order to get an idea of the places people go, especially since it is easy to overlook some of them, could you look at this list and say whether you go out for any of these reasons and how often.

	Most days	3-4 times a week	Once or twice a week	2-3 times a month	Once a month	Less often or never	
Post Office							b1
Local shops (eg newsagent)							b2
City Centre shops							b3
Bank or cash machine							b4
Supermarket (if not same location as local shops or city centre) Where? _____							b5 b5a
Cafe restaurant							b6
Luncheon club							b7
Church service							b8
Community group meeting (eg bridge club, church group, guild meeting)							b9
Pub or social club							b10
Exercise class/ Yoga/Swimming							b11
Outdoor sport (eg bowls/golf)							b12
Launderette							b13
Work/Voluntary work							b14
Hairdresser							b15
Day or evening classes							b16
Seaside or country							b17
Visit friends/family							b18
Doctors/hospital							b19
Collecting children							b20
Cinema/theatre							b21
Football match/ hockey/cricket							b22
A park							b23
Just walking							b24
Other							b25
What (eg a drive) _____							

Q4 If some activities tend to be covered within the same trip rather than by a special journey, which are they? Items can be placed in a list if they mainly tend to be covered within the same general journey.

Note: list 1 should represent the most common general journey, list 2 the next, etc.

	List 1	List 2	List 3	List 4	
Post Office					c1
Local shops					c2
City centre shops					c3
Bank or cash machine					c4
Supermarket if different from local shops or city					c5
Cafe/restaurant					c6
Luncheon club					c7
Church service					c8
Communal group meeting					c9
Pub or social club					c10
Exercise class					c11
Outdoor sport					c12
Launderette					c13
Work/Voluntary work					c14
Hairdresser					c15
Classes					c16
Seaside or country					c17
Visit friends/family					c18
Doctors/hospital					c19
Collecting children					c20
Cinema/theatre					c21
Football/hockey/cricket match					c22
A park					c23
Just walking					c24
Other?					c25

Q5 Do you feel that any of these are problems that actually restrict or discourage you from going out if it involves walking even to use public transport.

	Very much	**Quite a lot**	**A little**	**Not at all**	
Personal health or tiredness					**d1**
Discomfort walking or walking difficulty					**d2**
Poor eyesight					**d3**
Anxiety about being out late					**d4**
Traffic too dangerous					**d5**
Having to look after someone					**d6**
Poor street lighting					**d7**
The state of the pavements					**d8**
Inconvenience of getting to, or waiting for, buses/Metro or trains					**d9**
Feeling conspicuous or uneasy going to some places alone					**d10**
Concern about violence or crime					**d11**
The cost of using public transport					**d12**
Lack of information about available activities					**d13**
Cold or wet weather					**d14**

Q6 (i) How do you go and return? Describe your usual journey to List 1 (or what respondent feels is his/her most important frequent journey)

Outward

.....

.....

.....

.....

Main activity at destination: .....

Return

.....

.....

.....

.....

Is the journey (or returning) any problem for you? Yes/No _____

In what way? .....

.....

.....

Do you have to cross at any difficult or dangerous places? Yes/No _____

Which places do you think are bad and in what way?

.....

.....

.....

.....

What might be done to improve the situation? And where?

eg Better crossing/reduce traffic speeds/stop through traffic/improve parking.

.....

.....

.....

.....

Q6 (ii) How do you go and return? Describe your usual journey to List 2 (or next most important frequent journey)

Outward

.....

.....

.....

.....

Main activity at destination: .....

Return

.....

.....

.....

.....

Is the journey (or returning) any problem for you? Yes/No _____

In what way? .....

.....

.....

Do you have to cross at any difficult or dangerous places? Yes/No _____

Which places do you think are bad and in what way?

.....

.....

.....

.....

What might be done to improve the situation? And where?

eg Better crossing/reduce traffic speeds/stop through traffic/improve parking.

.....

.....

.....

.....

Q6 (iii) How do you go and return? Describe your usual journey to List 3 (or third most important frequent journey)

Outward

.....

.....

.....

.....

Main activity at destination: .....

Return

.....

.....

.....

.....

Is the journey (or returning) any problem for you? Yes/No _____

In what way? .....

.....

.....

Do you have to cross at any difficult or dangerous places? Yes/No _____

Which places do you think are bad and in what way?

.....

.....

.....

.....

What might be done to improve the situation? And where?

eg Better crossing/reduce traffic speeds/stop through traffic/improve parking.

.....

.....

.....

.....

Q6 (iv) How do you go and return? Describe your usual journey to List 4 (or fourth most important frequent journey)

Outward

.....

.....

.....

.....

Main activity at destination: .....

Return

.....

.....

.....

.....

Is the journey (or returning) any problem for you? Yes/No _____

In what way? .....

.....

.....

Do you have to cross at any difficult or dangerous places? Yes/No _____

Which places do you think are bad and in what way?

.....

.....

.....

.....

What might be done to improve the situation? And where?

eg Better crossing/reduce traffic speeds/stop through traffic/improve parking.

.....

.....

.....

.....

Abilities

Changes occur as people get older but it is perfectly normal for them to be affected in different ways.

When you go out do you use a wheelchair?

Exclusively ☐ **Sometimes** ☐ **Occasionally** ☐ **Never** ☐ **e1**

If not always
Do you need support such as a stick or frame to walk?

Always ☐ **Sometimes** ☐ **Never** ☐ **e2**

If you can walk
Do you suffer noticeable physical difficulty or discomfort when you walk any distance?

Very Much ☐ **Moderate** ☐ **Slight** ☐ **None** ☐ **e3**

When crossing the road, how fast are you compared to other people?

Faster ☐ **Slightly Faster** ☐ **About the same** ☐ **Slightly slower** ☐ **Much slower** ☐ **e4**

If you can walk
Do you suffer stiffness which makes it difficult to turn your head or your body to check the traffic while crossing the road?

Very much ☐ **Moderate** ☐ **Slight** ☐ **None** ☐ **e5**

Do you feel that your sense of balance is noticeably worse than when you were in your 40s?

Not at all ☐ **A little** ☐ **A fair bit** ☐ **Very much** ☐ **e6**

Do you feel that your ability to see things at a distance (with glasses if you normally use them) is noticeably worse?

Not at all ☐ **A little** ☐ **A fair bit** ☐ **Very much** ☐ **e7**

Do you feel that your hearing is noticeably worse than it was?

Not at all ☐ **A little** ☐ **A fair bit** ☐ **Very much** ☐ **e8**

Some older people suffer more falls, because of balance, not seeing so clearly or becoming dizzy or faint. Does this happen to you?

Not at all ☐ **A little** ☐ **A fair bit** ☐ **Very much** ☐ **e9**

Do you feel you are worse at judging whether the speed and distances of vehicles leaves you enough time to cross?

Not at all ☐ **A little** ☐ **A fair bit** ☐ **Very much** ☐ **e10**

Do you feel that you are worse at anticipating the progress and intentions of traffic than you were?

Not at all ☐ **A little** ☐ **A fair bit** ☐ **Very much** ☐ e11

Do you sometimes drink when you are out or when you are going out near traffic?

Never ☐ **Hardly ever** ☐ **Occasionally** ☐ **Sometimes** ☐ **Quite often** ☐ e12

Do you take regular medication that might affect your alertness (such as tranquillisers or sleeping pills)?

Yes ☐ **No** ☐ **Not sure** ☐ e13

Do you have any long-standing health or physical problem that makes it difficult for you to...

Use buses and coaches? Yes No e14
If yes, in what way? _____ e15

Use trains? Yes No e16
If yes, in what way? _____ e17

Get in and out of a car? Yes No e18
If yes, in what way? _____ e19

Do you have a licence to drive

A car? Yes No e20
If yes is it full or provisional? _____ e22

Motorcycle or moped? Yes No e23
If yes is it full or provisional? _____ e24

If you have a licence, how recently have you driven? In the last...

Week ☐ **Month** ☐ **Year** ☐ **2–5 years** ☐ **6–10 years** ☐ **More than that** ☐ e25

If you do not hold either licence, have you held one in the past? Yes No e26

If yes what type?

PSV ☐ **Car** ☐ **M/cycle** ☐ e27

how long ago?

1 year ☐ **2–5 years** ☐ **6–10 years** ☐ **More than that** ☐ e28

Do you have the use of a car when you want it either to drive yourself?

Always ☐ **Usually** ☐ **Sometimes** ☐ **Hardly ever** ☐ **Never** ☐ e29

in which someone else drives you?

Always ☐ **Usually** ☐ **Sometimes** ☐ **Hardly ever** ☐ **Never** ☐ e30

Are you independent when going out or are you generally taken and accompanied when you are going out

As a pedestrian? *(tick next to best answer)*

- ☐ Independent
- ☐ Independent but often with company
- ☐ Dependent on being taken or accompanied
- ☐ Never go/use (ie do not walk outside)

e31

On public transport?

- ☐ Independent
- ☐ Independent but often with company
- ☐ Dependent on being taken or accompanied
- ☐ Never go/use

e32

By car/taxi?

- ☐ Independent
- ☐ Independent but often with company
- ☐ Dependent on being taken or accompanied
- ☐ Never go/use

e33

Are you registered disabled? ☐ Yes ☐ No **e34**

Do you have:

A bus or metro concessionary pass	☐ Yes	☐ No	**e35**
A normal bus or metro pass	☐ Yes	☐ No	**e36**
A disabled person's pass	☐ Yes	☐ No	**e38**
A Rail card	☐ Yes	☐ No	**e39**

Accident History

Have you been involved in any of these types of accidents in the last 3 years?

Accident type:

Accident as a driver?	Yes/No _____ If Yes, How Often? _____ If Yes, did you suffer injury which was: Serious Y/N _____ Slight Y/N _____ } tick as appropriate No injury Y/N _____	f1
Accident while car passenger?	Yes/No _____ If Yes, How Often? _____ If Yes, did you suffer injury which was: Serious Y/N _____ Slight Y/N _____ } tick as appropriate No injury Y/N _____	f2
Accident while cycling?	Yes/No _____ If Yes, How Often? _____ If Yes, did you suffer injury which was: Serious Y/N _____ Slight Y/N _____ } tick as appropriate No injury Y/N _____	f3
Accident as a pedestrian when you were hit by a motor vehicle?	Yes/No _____ If Yes, How Often? _____ If Yes, did you suffer injury which was: Serious Y/N _____ Slight Y/N _____ } tick as appropriate No injury Y/N _____	f4
Accident as a pedestrian when you were hit by a cyclist?	Yes/No _____ If Yes, How Often? _____ If Yes, did you suffer injury which was: Serious Y/N _____ Slight Y/N _____ } tick as appropriate No injury Y/N _____	f5
Fall on public transport?	Yes/No _____ If Yes, How Often? _____ If Yes, did you suffer injury which was: Serious Y/N _____ Slight Y/N _____ } tick as appropriate No injury Y/N _____	f6
Fall in the street due to tripping or bumping into something?	Yes/No _____ If Yes, How Often? _____ If Yes, did you suffer injury which was: Serious Y/N _____ Slight Y/N _____ } tick as appropriate No injury Y/N _____	f7

Concerns/anxieties

These questions are designed to discover people's level of concern about several broad areas.

How do you feel about the following *(tick the answer)*	**Doesn't bother me**	**Personally concerned**	**Anxious**	
Violent crime.				**g1**
Changes in the environment due to pollution.				**g2**
The state of the pavements.				**g3**
As a pedestrian, having to compete with traffic to cross the road.				**g4**
The level of unemployment.				**g5**
Traffic accidents.				**g6**
The 'cost of living'.				**g7**
The amount of traffic.				**g8**
House theft.				**g9**
Standards of education.				**g10**
Provisions in the Health Service.				**g11**
International events and conflicts.				**g12**
The maintenance of a good local transport system.				**g13**
Traffic speeding in residential or shopping areas.				**g14**

Feelings/experiences

These questions are designed to give some indication of how people feel as pedestrians crossing the road. Circle true or false depending on how you feel yourself, rather than what you think others might expect.

When crossing the road I often feel nervous.	**True**	**False**	**h1**
At a pedestrian lights-controlled crossing, I feel it is better to cross between traffic when I can rather than to press the button and hold up the traffic.	**True**	**False**	**h2**
I mainly tend to go to a proper crossing point *only* when it isn't out of the way or if the traffic is particularly bad.	**True**	**False**	**h3**
I am quick to take what seems a reasonable opportunity to cross rather than wait.	**True**	**False**	**h4**
I am conscious of being slower than most people when walking across the road.	**True**	**False**	**h5**
When I cross the road I worry that I might fall.	**True**	**False**	**h6**
At a lights-controlled crossing, I feel that the safest thing is to wait for other people to start crossing than depend on the lights.	**True**	**False**	**h7**
If it seems possible, I would rather cross traffic than use a pedestrian subway.	**True**	**False**	**h8**
I am more confident about crossing at a busy place when I see other people waiting to cross at the same time.	**True**	**False**	**h9**
I occasionally need someone to help me to cross a busy road.	**True**	**False**	**h10**
I become anxious if I need to cross and the road is busy with no pedestrian crossing facilities near enough.	**True**	**False**	**h11**

There are some lights-controlled crossing places I am unsure about because you cannot tell which traffic will go next.	**True**	**False**	**h12**
If the lights at a signal-controlled crossing place take too long before letting the pedestrian across, I often end up taking a decision for myself.	**True**	**False**	**h13**
Sometimes I take a risk when crossing and feel a little pleasure in succeeding.	**True**	**False**	**h14**
I sometimes enjoy the challenge of crossing the road.	**True**	**False**	**h15**
If I am in a side-street, I feel I can be more relaxed about how I cross.	**True**	**False**	**h16**
I occasionally realise I forgot to look some way when crossing a side-street.	**True**	**False**	**h17**
I avoid crossing the road at some junctions because you cannot tell which traffic will go next.	**True**	**False**	**h18**
The beeping sounds at some pedestrian crossings are a warning that no more people should cross.	**True**	**False**	**h19**
It is always safer to avoid crossing among parked cars.	**True**	**False**	**h20**
It is safer to cross the road when there are parked cars at either side, making the road narrower.	**True**	**False**	**h21**
When crossing an ordinary residential street, I deliberately cross some way from a junction if there is no crossing.	**True**	**False**	**h22**
At lights-controlled pedestrian crossings, the green man usually gives me enough time to cross.	**True**	**False**	**h23**

Pedestrian Events

Most of us take some risks but avoid the experience of being run over. As a pedestrian, as far as you can recall, would you say the following have happened to you?

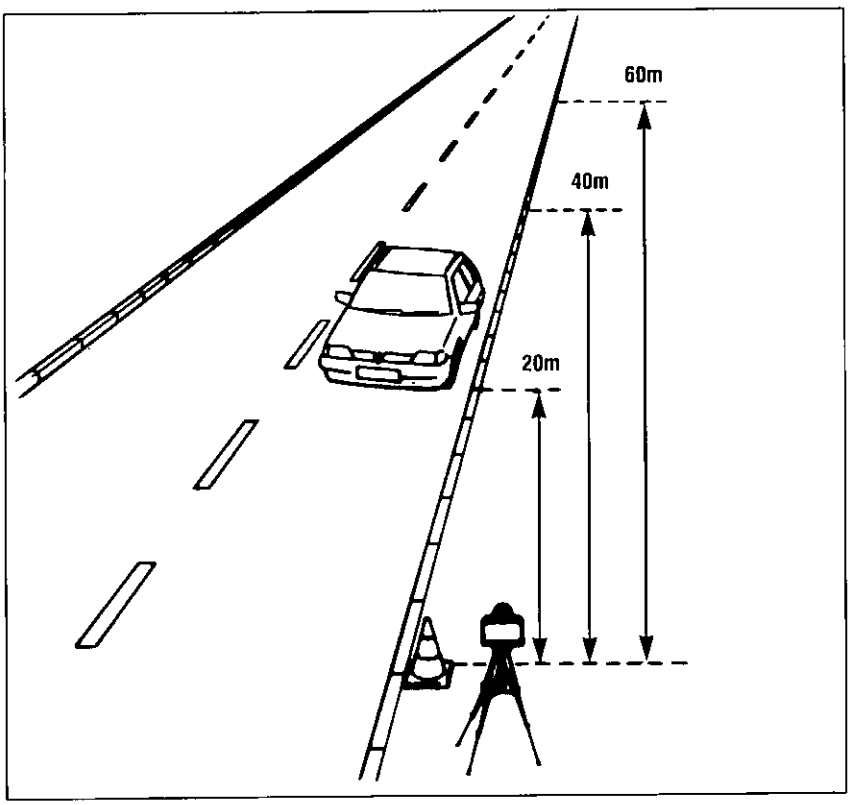
	In the last 3 years				
	Often	Sometimes	Only 1 or 2 times	Not in that time	
Just avoided being run over because of not checking carefully before crossing? Perhaps you didn't expect a vehicle.					m1
Just missed being run over when a driver failed or almost failed to stop at the lights or crossing?					m2
Just missed being run over because you tripped or dropped something as you were crossing the road?					m3
Just avoided getting run over because you looked but didn't or couldn't see the vehicle coming?					m4
Just avoided getting run over because other pedestrians cut across your path?					m5
Just avoided getting run over because a driver was in a hurry to get away after the lights changed?					m6
Just avoided getting run over because a safer crossing place was too far out of your way?					m7
Just missed being run over because a vehicle began overtaking or changed lanes as you crossed?					m8
Just missed being run over because a driver failed to signal before turning?					m9
Felt close to being in an accident because either the lights or a driver didn't allow you enough time?					m10
Just avoided being in an accident because someone pulled you back at the last moment?					m11
Just avoided being in an accident because you were tired, pre-occupied or your mind was elsewhere?					m12
Just missed being run over at a junction because a driver turning didn't give way?					m13

	In the last 3 years				
	Often	**Sometimes**	**Only 1 or 2 times**	**Not in that time**	
Just avoided being run over because you were engrossed in conversation or play?					**m14**
Just avoided being in an accident because of starting to cross after the pedestrian lights began to flash?					**m15**
Just avoided being in an accident because there were parked cars where you wanted to cross?					**m16**
Just avoided being involved in an accident after crossing in front of a bus (for example, after getting off)?					**m17**
Been narrowly missed by a vehicle being driven dangerously or carelessly?					**m18**
Narrowly missed being run over because a vehicle accelerated more quickly than you expected?					**m19**
Almost been involved in an accident because it looked clear when you started to cross and then it suddenly changed?					**m20**
Narrowly missed being run over because a vehicle mounted the kerb on the corner near where you were waiting?					**m21**
Just missed being involved in an accident after you had been drinking?					**m22**
Just missed being run over by a driver unexpectedly starting to reverse?					**m23**
Just missed being run over by a cyclist on the road you did not expect?					**m24**
Just missed being run over by a cyclist on the pavement?					**m25**
Just avoided being in an accident because you were in a hurry?					**m26**
Just missed being run over because the traffic was too fast?					**m27**
Just missed being run over because you felt that the road layout or traffic flow was too complex or confusing?					**m28**
Just missed being involved in an accident because you had to look too many ways at once?					**m28**

Appendix C: Specification of the four videos

For the experimental trials, VHS cassette tapes, with VIDCHRON timecodes for exact timing, were produced in four stimulus videos: A, B, C, and D described below.

The filming location for these trials was a relatively deserted long, straight road (Rothbury Terrace, Newcastle upon Tyne) with an unobstructed view. Filming was carried out between 10.00 and 12.00 noon with the light and weather variables chosen to be relatively constant across filming sequences. The camera height and angle were positioned to provide a view up the road similar to that of a pedestrian, waiting at the roadside to cross (see figure below).



In front of the camera was placed a red and white traffic cone at a distance of three metres with a further three luminous markers at distances of 20, 40 and 60 metres beyond the cone. Six approach speeds were recorded with a white, hatchback Vauxhall Astra car (previously calibrated for speed accuracy) as the test vehicle, at speeds of 20, 25, 30, 35, 40 and 45mph.

Video A comprised 12 trial clips plus titles with two trial clips for each of the six approach speeds. Each trial clip depicted the test vehicle approaching from a distance and passing the traffic cone in front of the observer. The duration of each trial clip thus depended on the speed of the approaching vehicle so these visual presentation times varied from 14,720msecs to 8,120msecs with a constant intertrial gap of 22secs. Total duration of Video A was 294secs.

Video C similarly comprised 12 trial clips plus titles again with two clips per six stimulus speeds. However, in this video each visual trial depicted the test vehicle approaching from a distance for a standard seven seconds duration, when the test vehicle was either 20 or 60 metres from the traffic cone, after which the visual trial was ended and the video screen was blanked. The intertrial interval and the overall duration was identical to Video A.

Videos B and D each comprised 16 trial clips with titles. Each trial depicted the test vehicle approaching from the distance for a duration of either three or five seconds, with these times alternated over successive trial clips. The visual presentation was ended and the screen blanked when the test vehicle was a standard 20 metres from the cone. (This procedure was to maintain the size of the retinal image at a constant at trial termination so that the judgement

response of participants was based on the speed of approach rather than size of retinal image.) Each clip showed the vehicle approaching at a different speed to the vehicle presented in the previous trial clip. In these videos there was a standard intertrial interval of 15secs with each video lasting for a total duration of 270secs.

Videos B and D involved special considerations. In order that all the six speeds specified above could be compared, each speed with every other speed, required some 30 comparisons. The sequence order of these comparison speeds was appropriately randomised. So that the 31 trials to carry out these comparisons would not be too onerous on the subjects' sustained attention and concentration and therefore judgement, the trials were divided into two separate video sets, comprising trials 1–16 (Video B) and trials 16–31 (Video D).

Appendix D: Record Sheet for Observational Study

Observation no: Date: Time:

Number of pedestrians			
	Child	Adult	Old
M			
F			

Features of pedestrian(s)					
Bag	Stick	Pram	Dog	Help	

Mobility (1=poor : 5=good)	
Approach	Crossing

Conflict?	
Y	
N	

Confident?	
Y	
N	

First half of crossing

Looking?		
	Kerb	Other
No		
Right only		
Both once		
Both often		

'Opportunity' scale		
Several missed opportunities		First opportunity to cross

Comments:

Pedestrian crossing		
	Arrival	Crossing
R		
G		
FG		

Second half of crossing

Looking?		
	Centre	Other
No		
Right only		
Both once		
Both often		

'Opportunity' scale		
Several missed opportunities		First opportunity to cross

Comments:

Pedestrian crossing		
	Arrival	Crossing
R		
G		
FG		

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