Drivers' Perception of Pedestrians

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1. Introduction

Three different perspectives can be taken in investigating the interaction between various road users:- (a) an attempt can be made to observe or film the whole scene, usually from a distance and from above, so that it is in principle possible to trace the development of conflicts and how they are resolved; (b) a position at ground level can be selected close to the point of crossing or the pedestrian can be tracked as s/he proceeds across the road; and (c) a view can be taken from inside the vehicle by the driver, by an observer/passenger or by video recording. Both studies to be reported take the latter perspective and try to integrate the information from all three sources.

Objective data for each drive of an urban route was obtained by videofilming and human observation to allow for limitations of view with each technique. Videofilming had a further use in the second study as a prompt for drivers to give accounts of the problems they encountered and strategies they adopted during their drive. Interviewing drivers immediately after completing their drive can be time consuming but it has been shown in the context of motorway driving and on primary distributor roads (Saad, 1996a) that these verbal report techniques are effective in eliciting a detailed subjective view of events that can then be directly compared with the objective data.

The reactions of drivers to the successive events they encounter can be regarded as a function of the incoming information they process (attention), their accumulated experience (memory) and the criteria they apply to control the vehicle (decision making). If they are unaware of or decide to ignore relevant information, the probability of conflicts or accidents involving other road users is likely to increase. In particular, since it provides the base for subsequent processing, the content and sequence of visual search may be critical in allowing the driver sufficient time to react in an emergency. The laboratory study of the processes of visual search can be traced to the experiments of Neisser (1963) and are more recently summarised by Rabbitt (1984). In this context search is defined as an active interrogation of a scene from which drivers can very quickly decide where to look first and in what sequence to look for further information. It is predicted that the more experience they have, the better they will be able to optimize their scanning strategies and improve their speed of detection of relevant information.

One salient question thus concerns how well drivers process incoming information about pedestrian behaviour. It may be that such information is well processed but disregarded or that insufficient processing occurs in relation to the demands for very rapid reaction to emerging conflicts with pedestrians. Morever, they may be important differences related to the age, experience and gender of the driver. A large cohort study by Forsyth et al. (1995) indicated a much increased risk of accident for young male drivers in the first two years after passing their test. However, casualty figures involving pedestrians by age of driver are not easily available and are not often reported. Evans (1991), using FARS data, shows very large age and gender differences of driver threat to other road users but their interpretation is complicated by variable levels of exposure and that accidents may not be proportional to the annual distance travelled (Maycock et al., 1991).

2. Method

2.1 Study A

The focus of the relevant part of the first study was a route of 36km., chosen to include a wide range of conditions found on urban roads in the UK. The 207 drivers who lived on or close to the route were split into twelve age groups by age and gender. They were asked to give ratings of perceived risk on a ten-point scale at up to 147 specific locations and there were two in-car observers. In order to remove unwanted variation related to individual drivers preferring to use higher or lower parts of the scale, the data were standardised to express the different risk ratings in standard deviations from a mean set at zero (MSR). Full details can be found in the report by Carthy et al. (1993).

2.2 Study B

The second study that is still underway involves a sub-section of the initial route (13km.) selected to maximise the extent of pedestrian interaction at locations within the City Centre and other areas close to a hospital, the University of Newcastle and a local shopping area. The intention is to complete 80 drives of the route by male drivers aged between 17 and 30. Two types of objective data are collected for each drive (i) a videorecording using a Sony Handycam Hi8 fitted with a wide-angled lens and (ii) drive records completed by an in-car observer that particular focus on relevant events outside the range of the camera. The drive forms the first phase of the test session followed after a short break by the interview phase when the videorecording is replayed on a large colour TV screen (59 x 59 cm) in order to facilitate the driver's recall of incidents at specific locations. The system allows for S-VHS quality feedback using Hi8 quality camcorder cassettes.

The techniques for assisting subsequent verbalisation are based on the work of Leplat and Hoc (1981) and make it possible to prompt with the precise conditions that led to particular decisions. Responses to a set of standard questions, with opportunities for elaboration when necessary, were recorded by the interviewer and an audiotape was

made in order to allow more detailed analysis of selected incidents. In particular, this made it possible to compare objective and subjective data across specific locations and also to develop case studies for individual drivers.

3. Results

3.1 Study A

In the first study the accident data for each location were correlated with the mean risk ratings and there was a moderate level of correlation ($r = 0.42$, $p < 0.0002$). A more detailed analysis of the accident data separated the type of road user into vehicles, cyclists and pedestrians and whether accidents that resulted from driving in the same direction as the drivers

In the table of correlations below A = Motor vehicles; B = Pedestrians; C = Cyclists;
1 refers to the same direction of driving the route and 2 refers to any other direction.

	A1	**A2**	**B1**	**B2**	**C1**	**C2**	**Total**
MSR	0.41	0.37	0.04	0.09	0.30	0.24	0.42

So the risk ratings were predictively accurate in the case of vehicle-vehicle accidents but the same ratings were poor predictors of pedestrian-vehicle accidents. A multiple regression analysis, carried out to clarify which particular characteristics most influenced the drivers' perception of risk, showed that competing traffic flow was the most important factor and that competing pedestrian activity was one of the factors that had no significant effect. Because other vehicles pose the most potent source of threat and driving is regarded to some extent as a competitive activity, it is not surprising that the number and position of other vehicles should contribute very significantly to ratings of risk. More competitive driving behaviour was associated with younger drivers, both male and female.

3.2 Study B

The data for 40 out of the 80 drivers in the current study have been coded and illustrative descriptive analysis of two types are presented with respect to
(i) categorising the drivers according to their awareness of pedestrians and
(ii) frequencies of pedestrian detection at City Centre locations by all drivers.

Initially the proportion of times drivers specified at interview they had taken into account the potential or actual crossing behaviour of pedestrians at up to 20 specific locations on the route was analysed to separate drivers into three categories of awareness of pedestrians: low, medium and high as follows:
Low = 4 (0.25 or less); Medium = 31 (0.26 to 0.74); High = 5 (0.75 or more)

The details of the age, years of driving experience and the pedestrian awareness proportion (for 12-18 locations where pedestrians were involved in crossing) for each of the 9 male drivers in the low and high groups are shown below.

LOW	Age	Years' Experience	Detection Proportion
	18	0-1	0.167
	18	1-2	0.167
	17	0-1	0.200
	18	1-2	0.250
HIGH			
	18	0-1	0.786
	20	2-3	0.867
	26	3+	0.923
	19	2-3	0.929
	23	3+	1.000

Further analysis of the locations where the low awareness group failed to detect pedestrians showed that almost all the instances involved traffic signals whereas, at the fewer locations when drivers specified that pedestrians had affected their driving decisions, there were no signals. This suggested an analysis to check whether failure to detect pedestrians generally related to age and lack of experience. The following are typical of the relationships at City Centre locations with traffic signals but it will be necessary to complete the remaining drives before levels of statistical significance can be properly assessed. Yes/No refer to whether or not drivers indicated that they were aware of pedestrians at each location.

Location: Central Railway Station Crossing

		Yes	No
Age	17-20	8	14
	21-30	10	3
Experience			
Year	0-1	2	6
	1-2	6	6
	2-3	1	2
	3+	9	3

Location: City Centre Pedestrian

		Yes	No
Age	17-20	7	15
	21-30	7	7
Year	0-1	2	6
	1-2	3	8
	2-3	2	3
	3+	7	5

The proportions clearly change in relation to driver's age and experience which are necessarily correlated. However, a tentative conclusion is that the greatest difficulty in scanning for pedestrians occurs during the year immediately after passing the driving test.

4. Discussion

If a pedestrian accident or conflict with a vehicle is viewed in terms of a number of necessary conditions being fulfilled, failure by a driver to react to the pedestrian in time to take evasive action can be regarded as one critical component. There are numerous

examples from the videotapes in Study B, particularly the low awareness drivers, indicating that avoidance of a serious conflict or an accident was probably beyond the driver's control and depended on the pedestrian stopping crossing or taking some other form of evasive action.

Some researchers have proposed that these difficulties are likely to arise when drivers have to process rapid changes in the road environment and have emphasised the effects of overloading the capacity for processing information. However, the evidence from the comparisons between the low and high pedestrian awareness groups suggest that less exceptional circumstances may result in pedestrian accidents if the driver fails to scan for their presence. The high awareness group are characterised by their anticipation of potential problems, eg. masking by other vehicles or tendencies for pedestrians to behave in unexpected ways, and in some cases can link these concerns explicitly with specific parts of a location to check. In similar conditions the low awareness group make little or no mention of pedestrians.

Compared with the early demonstration of visual search strategies in tasks like proof reading, scanning the road environment is clearly more complex since many of the components are dynamically changing their speed and position, while others are static
but contain relevant information. However, the difficulty of the driving task makes it likely the effects of practice and experience will be even greater. Study A implies that many drivers are predisposed to pay particular attention to other vehicles because of the threat they pose, and that they take far less account of vulnerable road users. Study B links lack of awareness of pedestrians more specifically to limited search strategies because of a tendency to concentrate too much on the state of traffic signals, at least in the case of young male drivers.

More generally, if inexperience is related to limitations in visual search strategies, there will be implications for other types of driving where unpredictable sources of information, like pedestrians in urban environments, are not effectively scanned. Saad (1996b), who employed similar procedures to Study B, tested novice drivers on motorways and examined problems with the lane change manoeuvre. She suggests that difficulties arise in distributing attention between current positional information that is dynamically changing and predicting future movements of other vehicles. She cites the example of a novice driver pulling into the central lane without noticing another vehicle seeking to occupy it from the other direction.

If restricted visual search patterns can be shown to operate widely, there are clear implications for driver training. It would be preferable during training to include practice of the skills required to develop rapid scanning of appropriate sources of information, especially the more unpredictable ones, than to leave them to be self-taught by experience after passing the driving test.

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