Drivers' perception of accident circumstances and opportunities for crash avoidance through technological intervention

James Lenard, Elizabeth Dodson and Julian Hill
Loughborough University

1. Summary

Questionnaire data from 953 drivers, motorcyclists, pedal cyclists and pedestrians involved in accidents is presented with a focus on the causes of accidents and the perception of safety. The material is sourced from the UK On-the-Spot Study (OTS) which carried out 1513 in-depth investigations at the scene of the accident during 2000-2003. As the group returning questionnaires is self-selected, they do not necessarily represent all persons in the OTS sample or any other accident population. Their responses indicate that other road users, the weather and the condition of the road surface are important factors, in their view, in why the accidents occurred. A closer examination of cases where the behaviour of the other road user was nominated as a factor revealed an element of agreement with the independent views of the OTS investigators at a general level but many disparities at a detailed level.

2. Introduction

The increasing pace at which active safety technologies are being developed for motor vehicles is generating renewed interest in human factors as the effectiveness of these systems depends on a complex interaction between the functioning of the devices and the behaviour of road users. This paper aims to contribute to an understanding of certain psychological aspects of road users and their views on road accidents in which they have been involved, with particular focus on the subjective perception of road safety—a theme of this conference.

The data presented here derives from the operation of the On-the-Spot study (OTS) in Great Britain from 2000 to 2003. This continuing project, which is funded by the UK Department for Transport and Highways Agency, carries out in-depth investigations at the scene of the accident using research teams from Loughborough University and TRL Ltd in two sample regions, Nottinghamshire and Thames Valley respectively. The teams are active for one shift per day, rotating between day, evening and night on a regular pattern. When the police in these regions

receive notification of an accident, OTS investigators are generally able to reach the scene within 12-20 minutes.

Subject to certain ethical considerations, questionnaires are sent to road users involved in the OTS accident sample. These questionnaires are customised to the type of road user—driver, passenger, motor cyclist, pedal cyclist or pedestrian—and seek to obtain responses on a variety of topics relating to the road user's circumstances, behaviour and experience of the incident. Many of the tables presented below are based on the questionnaires that have been returned and are intended to describe the views and experiences of the road users—their subjective world view, as it were. As a counter-balance, several tables describing the independent judgements of OTS investigators about the same group of accidents are also provided. This enables the collective opinions of the road users to be cross-checked against the more objective views of the investigators.

Although questionnaires are received from a substantial proportion of road users involved in the OTS sample (cf. Table 2 and Table 3), it is impossible in practice to achieve a 100% return rate. This automatically raises the issue of representivity, as the group who send back responses are self-selecting, i.e. they, not the researchers, decide whether to return the questionnaire. Certain groups are inevitably not represented, including those killed or very severely disabled by the accident, the very young, the illiterate, and those who are intellectually, physically or emotionally incapable of filling out the form. The question of how respondents compare to non-respondents is relevant and important and will be addressed explicitly in future publications. For present purposes it must be emphasized that *the group of people who have returned questionnaires is not necessarily representative of all road users in the OTS sample, nor of all the road users involved in accidents in the sample areas or in any wider geographical region*. Within this scope, the voices of the hundreds of road users who were able and willing to provide information offer some very interesting insights. This paper concentrates on the positive task of describing the views that are accessible, with the caveat that extrapolating these findings to a wider accident population will depend on a further examination of the demographic and other characteristics of the questionnaire respondents.

3. Results

The data tables presented in this section fall into three groups. Firstly, Table 1 to Table 3 provide an overview of the number of cases on the OTS phase 1 (2000-2003) database. Secondly, Table 4 to Table 19 describe the responses of the road users who returned questionnaires. These tables therefore represent the stated views of road users. Thirdly, Table 20 to Table 22 provide the judgements of the OTS investigators regarding the same group of accidents as commented upon by

the questionnaire respondents. This third group of tables focuses on the factors considered to have contributed to the occurrence of the accident, an important subject on which the questionnaire respondents also naturally have an opinion.

The OTS questionnaire forms contain many more items than are mentioned in this paper, however those that most directly concern accident causation are included. The assessments of the accident investigators are derived from just two sections of the complete case file, and there is a great deal of information in the files about accident causation that is not covered here. Table 20 to Table 22 therefore provide a quick cross-check of the road users' views but should not be regarded as a complete description of the investigators' findings.

A proportion of questionnaires were not fully filled out, i.e. the respondents answered some but not all of the questions. A decision had to be made whether to use these in this analysis. The approach taken here is inclusive—all partially completed questionnaires are accepted—in order to avoid discarding potentially interesting responses to a question on the grounds that the respondent did not answer a different question.

3.1. Overview of OTS database

	Single-vehicle accidents		Two-vehicle accidents							
	with Pedestrian	without Pedestrian	Car	LGV	HGV	Bus	Motor Cycle	Pedal Cycle	Multi-vehicle	**Total**
Car	88	426	402	48	71	12	87	45	100	**1395**
LGV	2	8	48	1	5	0	5	1	29	**117**
HGV	3	21	71	5	4	0	4	1	31	**146**
Bus	7	0	12	0	0	1	0	0	6	**29**
Motorcycle	0	39	87	5	4	0	0	0	13	**155**
Pedal cycle	0	5	45	1	1	0	0	0	9	**63**

Table 1: Combination of road users on OTS 2000-2003 database (1513 accidents)

The OTS project investigated 1513 accidents during the first phase of its operation between 2000 and 2003. Table 1 shows that 1395 of these involved a car, 117 involved a light goods vehicle (LGV), 146 involved a heavy goods vehicle (HGV) and so on. This table is additive across rows but not down columns, and numbers occur twice within the 'two-vehicle' category as a car-LGV accident (48 cases) for example is equally a LGV-car accident (48 cases).

	Car	LGV	HGV	Bus	Pedestrian	Cyclist	Motorcyclist	Other/unknown	**Total**
Vehicles	2093	128	156	30		64	157	50	**2678**
Humans	2933	145	161	24	117	66	166	92	**3704**

Table 2: Number of road users

The database contains records on 2678 vehicles and 3704 road users (humans) involved in the 1513 accidents. The breakdown by road user category is shown in Table 2.

Road user	Car	LGV	HGV	Bus	Pedestrian	Cyclist	Motorcyclist	Other/Unknown	**Total**
Not returned	1021	68	61	7	30	21	45		**1298**
Drivers and pedestrians	767	24	45	4	32	25	56		**953**
Passengers	139	0	1	0	0	1	5		**146**
Total	**1927**	**92**	**107**	**11**	**62**	**47**	**106**	**45**	**2397**

Table 3: Questionnaires returned

Questionnaires that were at least partly filled out were received from around 953 drivers and pedestrians and 146 passengers. (The term 'drivers' includes motorcyclists and pedal cyclists who were not passengers on their vehicles.) Missing information on the forms makes it difficult to be precise about every detail, including the number in each category. The reason for grouping drivers and pedestrians together is that they are considered to be in charge of their own movements and are therefore potentially responsible for why an accident occurs, whereas passengers are on the whole relatively passive in the process. With the focus in this paper on *accident causation*, the following series of tables present questionnaire results from the group of 953 drivers and pedestrians.

3.2. Questionnaire results

	Car	LGV	HGV	Bus	Pedestrian	Cyclist	Motorcyclist	**Total**
Male	470	21	45	4	14	19	53	**626**
Female	281	1	0	0	17	4	3	**306**
Unknown	16	2	0	0	1	2	0	**21**
Total	**767**	**24**	**45**	**4**	**32**	**25**	**56**	**953**

Table 4: Road user category by sex (reported on questionnaire)

Table 4 shows the number of males and females in each road user category. Overall about two-thirds of respondents are male.

Age	Car	LGV	HGV	Bus	Pedestrian	Cyclist	Motorcyclist	**Total**
0-9	0	0	0	0	1	0	0	**1**
10-19	25	0	0	0	10	6	8	**49**
20-29	160	4	2	0	3	2	13	**184**
30-39	179	9	14	1	2	4	20	**229**
40-49	140	1	13	1	5	4	7	**171**
50-59	127	5	11	2	3	6	3	**157**
60-69	47	2	3	0	6	1	3	**62**
70-79	26	1	1	0	2	1	0	**31**
80-120	8	0	0	0	0	0	0	**8**
Unknown								**61**
Total	**712**	**22**	**44**	**4**	**32**	**24**	**54**	**953**

Table 5: Road user category by age group (reported on questionnaire)

Most of the respondents, 80-85%, are distributed across the four age brackets from 20 to 59 years of age and almost all of the remainder are in the age brackets from 10-19 and 60-79, as can be seen in Table 5.

	Car	LGV	HGV	Bus	Pedestrian	Cyclist	Motorcyclist	**Total**
Diabetes	24	0	1	1	1	2	2	**31**
Epilepsy	2	0	0	0	0	0	0	**2**
High blood pressure	52	2	2	0	2	1	2	**61**
Low blood pressure	3	0	0	0	0	0	0	**3**
Angina	7	0	0	0	3	0	0	**10**
Heart disease	4	0	0	0	0	0	0	**4**
Glaucoma	1	0	0	0	0	0	0	**1**
Multiple sclerosis	1	0	1	0	0	0	0	**2**
Parkinson's disease	1	0	0	0	0	0	0	**1**
Encephalomyelitis	1	0	0	0	0	0	0	**1**
Other	35	0	0	1	2	3	3	**44**

Table 6: Medical conditions (reported on questionnaires)

The most frequent medical conditions reported on the 953 questionnaires are high blood pressure (61) and diabetes (31), as shown in Table 6.

	Car	LGV	HGV	Bus	Pedestrian	Cyclist	Motorcyclist	**Total**
No sensory impairment	556	12	33	4	30	20	46	**701**
Hearing impairment	9	0	1	0	1	0	0	**11**
Visual impairment	57	1	1	0	1	1	3	**64**
Other sensory impairment	1	0	0	0	0	0	0	**1**
Physical impairment	6	0	1	0	3	0	2	**12**

Table 7: Impairments (reported on questionnaires)

Table 7 shows that 64 respondents reported a visual impairment. 701 respondents stated that they had no sensory impairments.

	Car	LGV	HGV	Bus	Pedestrian	Cyclist	Motorcyclist	**Total**
Prescription glasses	208	4	9	1	3	5	9	**239**
Contact lenses	55	0	0	0	3	0	3	**61**
Sunglasses	33	0	1	0	0	0	0	**34**
Prescription sunglasses	5	0	0	0	0	1	0	**6**

Table 8: Visual aids (reported on questionnaires)

The use of visual aids at the time of the accident is shown in Table 8. 239 respondents stated that they were wearing prescription glasses.

	Car	LGV	HGV	Bus	Pedestrian	Cyclist	Motorcyclist	**Total**
Recreational drug use	4	0	0	0	2	0	0	**6**
Alcohol	91	3	0	0	2	1	6	**103**
Breath test	235	10	21	0	0	0	10	**276**
Breath test - fail	5	0	0	0	0	0	0	**5**
Blood test	17	0	1	0	0	2	2	**22**
Blood test - fail	3	0	0	0	0	0	1	**4**

Table 9: Alcohol and drug use in 24 hours prior to accident (reported on questionnaires)

According to the respondents, 5 of 276 subjected to the breath test for alcohol failed compared to 4 of 22 subjected to the blood test, as shown in Table 9. In Britain the legal breath alcohol limit is 35 µg/100 ml and the legal blood alcohol level is 80 mg/100 ml. 103 respondents reported consuming alcohol in the preceding 24 hours, while 6 reported recreational drug use during the same period.

	Car	LGV	HGV	Bus	Pedestrian	Cyclist	Motorcyclist	**Total**
To work	121	4	2	0	2	4	11	**144**
From work	106	1	2	0	2	4	17	**132**
To or from school	16	0	0	1	4	1	0	**22**
Shopping	78	0	0	0	9	0	6	**93**
Business	50	12	36	1	1	3	1	**104**
Social	239	4	0	0	7	8	18	**276**

Table 10: Purpose of journey (reported on questionnaires)

The purpose of the journey being undertaken at the time of the accident as reported by the respondents is shown in Table 10. The most frequent was social travel (276), with significant numbers travelling to work (144), from work (132), on business (104) or shopping (93).

	Car	LGV	HGV	Bus	Pedestrian	Cyclist	Motorcyclist	**Total**
Not obscured	231	6	17	0	9	11	25	**299**
Parked vehicle	23	1	0	0	4	0	2	**30**
Vehicle in front	42	2	1	1	1	1	5	**53**
Slow-moving vehicle	9	0	0	0	0	0	2	**11**
HGV or bus	13	0	0	0	5	0	0	**18**
Pedestrian(s)	3	0	0	0	1	0	0	**4**
Slope in road	5	0	0	0	0	0	0	**5**
Bend in road	31	2	2	0	0	1	1	**37**
Tree	3	1	0	0	0	0	0	**4**
Vegetation	6	0	1	0	0	1	1	**9**
Roadside furniture	4	0	0	0	0	0	0	**4**
Building	1	0	0	0	0	0	0	**1**
Roadworks	4	0	0	0	0	0	0	**4**
Bright sunlight	7	1	0	0	0	0	0	**8**
Headlights dazzle	5	0	0	0	1	0	0	**6**
Misted windows	1	0	1	0	0	0	0	**2**
Other feature	73	4	3	1	3	1	4	**89**
Not known	6	0	0	0	2	2	0	**10**

Table 11: Vision obstructed (reported on questionnaires)

The questionnaire has a series of questions on whether and how the road user's vision was obstructed before the accident. In Table 11 it can be seen that 299 answered positively that their vision was not obscured. In the other categories, 'vehicle in front' (53), 'bend in road' (37) and 'parked vehicle' (30) are the most frequent except for the category 'other' (89). Details on what they are referring to as 'other' are given as free-text comments and not further analysed in this paper. The categories 'wall', 'fence', 'icy windows' and 'broken or damaged windscreen' were also available but not nominated by any respondents.

	Car	LGV	HGV	Bus	Pedestrian	Cyclist	Motorcyclist	**Total**
Braked	187	6	9	1	0	2	12	**217**
Steered	52	2	2	0	0	0	5	**61**
Braked & steered	133	7	13	2	0	1	3	**159**
Stopped	5	1	2	0	0	0	0	**8**
Braked & stopped	10	0	1	0	0	0	0	**11**
Steered & stopped	1	0	0	0	0	0	0	**1**
Braked, steered, stopped	2	0	1	0	0	0	0	**3**

Table 12: Avoidance action (reported on questionnaires)

A significant number of respondents stated that they braked (217), steered (61) or braked and steered (159) in attempting to avoid the accident, as shown in Table 12.

	Car	LGV	HGV	Bus	Cyclist	Motorcyclist	**Total**
Brakes	2	0	0	0	1	0	**3**
Steering	2	0	0	0	0	0	**2**
Gears	1	0	0	0	0	0	**1**
Tyres	2	0	1	0	0	1	**4**
Brakes & tyres	1	0	0	0	0	0	**1**

Table 13: Vehicle defects (reported on questionnaires)

A few respondents nominated vehicle defects that in their opinion influenced the accident, as shown in Table 13.

	Car	LGV	HGV	Bus	Cyclist	Motorcyclist	**Total**
No previous experience (or no response)	54	2	0	0	5	3	**64**
Not very familiar	15	0	2	0	0	2	**19**
Familiar	48	1	6	2	3	3	**63**
Very familiar	648	21	37	2	17	48	**773**

Table 14: Familiarity with vehicle (reported on questionnaires)

Table 14 indicates how familiar the respondents considered themselves to be with the vehicle that they were driving at the time of the accident. The figure for 'no previous experience' (64) may include a significant number of instances where no answer was given to this question—further work is required to disaggregate these. There remains however a clear trend from 'very familiar' (773) through 'familiar' (63) to 'not very familiar' (19) in the other categories.

	Car	LGV	HGV	Bus	Pedestrian	Cyclist	Motorcyclist	**Total**
First time (or no response)	77	3	5	2	3	5	1	**96**
Rarely used	14	1	2	0	1	0	3	**21**
Familiar but rarely used	100	3	5	0	7	1	6	**122**
Once a month	33	1	1	0	1	2	1	**39**
Once a week	127	6	8	1	3	4	3	**152**
Once a day	411	10	24	1	17	13	40	**516**

Table 15: Familiarity with road or area (reported on questionnaires)

Table 15 indicates how familiar the respondents considered themselves to be with the road or area where the accident occurred. The figure for 'first time' (96) may include a significant number of instances where no answer was given to this question. As with Table 14, further work is required to disaggregate these. In the remaining categories, which are not necessarily mutually exclusive, the higher numbers suggest familiarity with the road or area rather than unfamiliarity, e.g. 'once a day' (516) and 'familiar but rarely used' (122).

	Car	LGV	HGV	Bus	Pedestrian	Cyclist	Motorcyclist	**Total**
Road surface	136	2	8	2	4	0	6	**158**
Weather	127	2	5	1	3	1	5	**144**

Table 16: Road surface and weather (reported on questionnaires)

The number of respondents who answered that the condition of the road surface affected vehicle handling (146) or that the weather contributed in any way to the accident (128) is detailed in Table 16

	Car	LGV	HGV	Bus	Pedestrian	Cyclist	Motorcyclist	**Total**
Careless manner	403	10	24	0	6	15	39	**497**
Confusing or ambiguous	134	4	14	1	1	5	14	**173**

Table 17: Behaviour of other road user (reported on questionnaires)

The questionnaire offered in separate questions the opportunity to say whether the other road user behaved in a careless manner or in a manner that was confusing or ambiguous. In the context of this study a high number stated that the other road user was careless (497) and many of these also said that the other road user was confusing or ambiguous (173), as shown in Table 17.

	Car	LGV	HGV	Bus	Pedestrian	Cyclist	Motorcyclist	**Total**
Road surface	128	2	9	2	0	0	5	**146**
Weather	113	2	6	1	3	0	3	**128**
Road layout misleading	31	0	1	0	1	0	0	**33**
Road signs badly positioned	26	0	3	0	0	1	1	**31**
Traffic lights not working	2	0	0	0	0	0	0	**2**
Road works	9	0	0	0	0	0	0	**9**
Other road users	327	12	26	2	4	5	23	**399**
Distracted by radio, cassette, CD	3	0	1	0	0	0	0	**4**
Distracted – looking for something in vehicle	5	0	0	0	0	0	0	**5**
Distracted – street names or road signs	12	2	1	0	0	0	0	**15**
Distracted by disturbance in vehicle	7	0	0	0	0	0	0	**7**
Distracted by mobile phone	0	1	0	0	0	0	0	**1**
Fatigue	20	1	2	0	0	0	0	**23**
Feeling unwell	11	0	0	0	1	0	0	**12**
Late/in a hurry	20	1	1	0	2	0	1	**25**
Other	134	4	9	0	1	2	6	**156**

Table 18: Factors contributing to accident (reported on questionnaires)

The questionnaire contains a list of items, shown in Table 18, any number of which could be nominated by the respondent as a factor which contributed to the accident. This is separate from the questions underlying Table 17. The highest response by far is that “other road users” contributed to

the accident (399), followed by ‘road surface’ (146), ‘weather’ (128) and the catch-all ‘other’ category (156).

A total of 569 respondents stated either that the other road user (a) behaved in a manner that was careless or confusing (Table 17) or (b) was a factor contributing to the accident (Table 18). In light of the interest of these cases to the human factors aspect of accident causation, their questionnaires were individually reviewed to see what they wrote in their own words when invited to provide further details. A summary of the key terms and expressions that they used in explaining the role of the other road user is given below in Table 19.

Key term or expression	
Did not look	31
Did not see	24
Driving without due care and attention	15
Lost concentration/distracted	7
Possibly dazzled by sun	4
Another vehicle indicated/stopped for me to go	3
Entered my path	40
Crossed my path	30
Wrong side of road	15
Too close (behind)	7
Too close (front)	6
Too close (at side)	3
(Travelling) too fast or rushing	54
Poor overtaking	29
Undertaking	3
Didn't give way/stop at junction/roundabout	27
Pulled onto road without stopping (from drive or garage)	5
Did not give way at pinch point	2
Avoiding overtake	1
Didn't stop for stationary or slow traffic	51
Through red light	14
Didn't avoid me!	3
Loss of control	22
Skidded on ice	1
Didn't alter driving for conditions	12
Impaired/drink driver	6
Stolen vehicle	4
Aggressive driving	3
Young driver	3
Misjudged speed	1
Sudden unpredictable movement	14
Did not indicate	13
Breached roundabout rules/poor lane discipline	6
Sudden braking	24
Stopped/parked inappropriately	13
Too slow/hesitant	9
Other vehicle distracted me	3
In my blind spot	2
Low visibility	2
Dazzled by headlights	1
Car hit me when crossing	2
Pedestrian ran out	3
Inappropriate crossing	3
Bicycle in wrong lane	1

Table 19: Key terms and expressions used by respondents in describing role of other road user

This list of key terms originates directly from the text provided by the respondents. To illustrate this with examples, “Obviously he never looked in mirrors” was written in a questionnaire and encapsulated as ‘Did not look’. All similar occurrences were then coded in a consistent manner, e.g. “She walked straight out in front of me without looking”, “She pulled out without looking” and “The driver who hit me was not looking at the road ahead”. The key expression ‘Did not see’ encompasses original sentences such as “He said he didn't see us in his mirror”, “The other road user said that he didn't see me” and “The cyclist didn’t seem aware of me at the time”. Comments such as “He failed to look and see me filtering up the traffic” were counted in both ‘Did not look’ and ‘Did not see’. Most original texts contributed to the count of more than one key term or expression in this way.

Not all respondents who explicitly mentioned the behaviour of the other road user provided further commentary. The frequency of the terms and expressions listed in Table 19 is therefore based on the responses of those who provided commentary. It can be seen that expressions like ‘Travelling too fast or rushing’ (54) and ‘Didn’t stop for stationary or slow traffic’ (51) were among those most often encountered in the explanations provided by the respondents who regarded the behaviour of other road users unfavourably.

3.3. Assessment of OTS investigators

	Respondents (569) who attributed fault to the other road user		Remaining drivers or pedestrians in same accidents	
	569	53%	499	47%
Driver not to blame	365	64%	204	36%
Error of judgement	76	45%	93	55%
Lost control of vehicle	18	44%	23	56%
Driver made illegal road manoeuvre	5	14%	31	86%
Driver made reckless road manoeuvre	6	19%	26	81%
Driving too fast	5	29%	12	71%
Vision obscured (weather, surroundings etc)	8	50%	8	50%
Driving whilst under the influence of alcohol or drugs	2	18%	9	82%
Deliberate action	7		3	
Distracted by something outside vehicle	4		4	
Distracted by something inside vehicle (incl. mobile phone)	1		7	
Looked but did not see pedestrian	2		2	
Dazzled by sun	1		3	
Driver fatigued	1		2	
Failed to judge pedestrians speed whilst crossing	1		1	
Driver felt ill	1		1	
Dazzled by headlights	1		0	
Vehicle fault (brakes, steering etc)	0		1	

Table 20: Crash causation codes (assessed by accident investigators)

As mentioned above, 569 respondents referred to the behaviour of the other road user as careless or confusing or as a factor in causing the accident. Table 20 shows—for the first time in this paper—

an independent assessment of the OTS accident investigators. The 569 respondents were involved in accidents involving 499 other drivers or pedestrians. They therefore constitute 53% of the road users considered to be in charge of their movements, either in a vehicle or on foot, in this group of accidents. In the 'crash causation code' section of the OTS case file, the investigators are able to attribute one of the items from the list to each road user. So for example the assessment 'Driver made reckless road manoeuvre' was made 32 times in the accidents involving the 569 respondents: 6 times for one of the respondents and 26 times for the other road user who either did not return the questionnaire or returned it without attributing fault to road users. Among the most frequent items, the respondents received more than their share (53%), so to speak, of 'Vehicle not to blame' (64%), and less than their share of 'Error of judgement' (45%), 'Lost control of vehicle' (44%), 'Illegal road manoeuvre' (14%) and 'Reckless road manoeuvre' (19%). Percentages are given in Table 20 for items that were used more than ten times.

	Respondents (569) who attributed fault to the other road user		Remaining drivers or pedestrians in same accidents	
	569	53%	569	53%
Perception	85	44%	109	56%
Judgement	44	39%	69	61%
Loss of vehicle control	18	43%	24	57%
Conflict	31	40%	47	60%
Attention	19	38%	31	62%
Impairment	5	42%	7	58%
Highway code	16	22%	56	78%

Table 21: Precipitative interactions by category (assessed by accident investigators)

Another way in which OTS accident investigators are able to record aspects of accident causation quite independently of the crash causation code is through the so-called *interactions* system. Each interaction relates a road user to the environment, a vehicle or a road user, including him- or herself. There are seven categories, including perception, judgement, attention and impairment, as shown in Table 21. The full list can be seen in Table 22 to cover a very wide range of factors. This system was an innovation for OTS developed by the project for the beginning of Phase 1. Of the many interactions that can be attributed to a road user in a single accident to describe how the incident developed, one (normally) is nominated as *precipitative*, i.e. as the key factor among all the others.

As already stated, the 569 respondents who referred to the behaviour of the other road user as careless, confusing and so on were involved in accidents with 499 other road users and therefore constitute 53% of the drivers or pedestrians in the accidents in which they were involved. Table 21 shows that OTS investigators attributed the precipitative interaction in every category to the questionnaire respondent in less than 53% of cases, indicating that the key factor in initiating the accident lay less often with the questionnaire respondent than might be expected. For example when

the precipitative interaction was considered to lie in the most frequently used category, 'Perception' (194 instances), which includes such items as 'Did not look for' and 'Looked but did not notice item in plain view', it was attributed to the questionnaire respondents in 44% of cases and to the remaining road users in 56% of cases. When the precipitative interaction lay in the other categories, it was attributed to the questionnaire respondent in 22%-43% of cases. The items included under each category in Table 21 are shown in Table 22.

Category	Item
Perception	Did not look for
	Looked but did not notice item in plain view
	Looked but did not discern
	Looked but did not see (obstruction on road)
	Looked but did not see (obstruction off road)
	Looked but did not see (carriageway geometry)
	Looked but did not see (carriageway geometry)
	Looked but did not see NFS
	Saw, but did not perceive a hazard
	Anticipated incorrectly likely path
	Anticipated incorrectly likely speed
	Anticipated incorrectly likely acceleration
	Anticipated incorrectly likely deceleration
	Anticipated incorrectly likely motion
	Misperceived road layout (NFS)
	Perceived incorrectly a likely event NFS
Judgement	Travelled above vehicle-control speed
	Misinterpreted Yield Instruction (Give Way)
	Misinterpreted Yield Instruction (Red Signal)
	Changed intention - acted beyond point no return
	Travelled excessively close
	Misjudged the established position
	Misjudged the established path
	Misjudged the established speed
	Misjudged the established deceleration
	Misjudged the established (motion NFS)
	Interpreted incorrectly information or signal
	Received information or signal (NFS)
	Misjudged own conspicuity
	Misjudged an actual event NFS
Loss of vehicle control	excessive braking
	excessive acceleration
	excessive cornering-understeer
	excessive cornering-oversteer
	excessive cornering (NFS)
	incorrect operation of controls
	(new or existing) vehicle defect
	reaction to transient nuisance
	poor surface or contaminant
	rapid change of surface
	Lost control (NFS)

Category	Item
Conflict	Accidentally / uncontrollably entered path
	Unintentionally entered path
	Intentionally entered path
	Adopted path conflicting
	Sought competition
	Behaved aggressively towards
	Purposefully precipitated conflict
	Gave appropriate information or signal
	Gave misleading information or signal
	Omitted to give useful information or signal
	Gave information or signal (NFS)
	Failed to avoid (NFS)
Attention	Suffered a distraction by a passenger
	Suffered a distraction by an internal event
	Suffered distraction due to another road user
	Suffered distraction due to previous incident
	Suffered a distraction by an external event
	Was inattentive due to panic / nervousness
	Was inattentive due to being in a hurry
	Was inattentive NFS
Impairment	Suffered non-fatal illness
	due to alcohol
	due to medicinal drugs
	due to fatigue
	local temporary visual by glare
	Was personally impaired
Highway code	Travelled above posted speed limit
	Disobeyed a Yield Instruction (Give Way)
	Disobeyed a Yield Instruction (Stop & Give Way)
	Disobeyed a Yield Instruction (Red Signal)
	Disobeyed a mandatory Lane Marking
	Legally unfit to drive due to alcohol
	Breached law (NFS)

Table 22: Detailed list of precipitative interactions

4. Discussion

Most of the tables presented in this paper describe the questionnaire responses of hundreds of road users involved in accidents for which independent in-depth investigations were also conducted. The aim is to describe the perceptions, views and (self-reported) behaviour of the road users, for the relevance this has to the potential effectiveness of active safety technologies, i.e. vehicle systems that reduce the likelihood or severity of accidents. The tables cover a wide range of areas, including medical conditions and impairments, alcohol, drugs and medication, driving patterns, visual perception and behavioural response, and a variety of environmental, vehicle and human factors that contribute to the occurrence of an accident. This up-to-date information is placed for the first time into the public domain for the use of researchers in road safety, human factors or a wider social domain.

In the context of accident causation and the subjective perception of safety, factors that stand out clearly are other road users, road surface and weather (Table 16, Table 17, Table 18). Only the first item, other road users, is analysed further in this paper, however it is likely that an examination of the other two items could also assist the development of active safety technologies that deal with road and weather conditions. Table 19, a summary of key words and expressions that the questionnaire respondents use in describing the (improper) behaviour of other road users, and Table 20 and Table 22, which give some assessments of independent accident investigators about the same group of accidents, contain very highly detailed lists of accident causation factors and the frequency with which they were considered to occur. It is intended that this information can be used in research and development to clarify, and perhaps begin to quantify, the potential benefits of active safety technology that has not yet been introduced to the vehicle fleet. Future analyses of the OTS database will be aimed directly at linking the accident studies to the potential benefits of systems for avoiding or mitigating the severity of road accidents.

It is interesting that the OTS investigators, in the data presented, tended at a general level to locate the cause of the accident proportionally more often with the group of road users who were said by questionnaire respondents to have exhibited careless, confusing or otherwise accident-causing behaviour (Table 20 and Table 22). On the face of it, this appears to support the credibility of the questionnaire respondents and perhaps suggests that what they have to say about the role of road surface and weather may also be of interest. The reasons for agreement at this general level could however be complex, or intertwined with the self-selection of the group, and so opinion is reserved until the characteristics and representivity of the group are further understood.

Focussing in on the commentaries provided by the respondents, Table 19 shows the results of the search for key terms and expressions. The most frequent claim was that another road user was rushing or travelling too fast. Based on scanning the full cases files, indications are that this was reported more often by respondents than by the investigation teams. This may be a perceptual issue of how accident participants remember sudden traumatic events but could equally reflect the innate difficulty in assessing whether vehicles were travelling at appropriate speeds based on reconstruction evidence. Failure to give way and driving through a red light seem to be equally frequently reported by respondents and investigators although road users under-report their own failures. By returning to the source data, many contradictions can be found where participants in the same accident offer differing, and sometimes opposing, viewpoints. This is a familiar situation—police for example deal with it all the time—and the real interest is in the details of how the views differ. In a simple case one respondent stated, “Other driver coming from opposite direction turned

right across me and we collided, it was my right of way", while the other driver referred to here claimed on a separate questionnaire return, "Other driver came through on a red light". Disagreements such as this reinforce how subjective data must be viewed within the context of independent investigation to make wider claims about the reality of an accident situation. Failure to stop for slow or stationary traffic is the second most frequent claim against other road users, which could be linked to speed, attention or travelling too close to the vehicle in front. This type of claim can be verified by the facts of each collision. It is interesting though that where respondents themselves shunted another vehicle, they tended to blame the vehicle in front, citing sudden braking, inappropriate stopping, and road users ahead being too slow or hesitant. This duality gives some insight into the difficulty of getting many people to accept personal responsibility and therefore to learn from their own driving mistakes. There appears to be a tendency to rate one's own ability above other road users, suggesting that intelligent active safety technologies which reduce or correct poor driving, e.g. by limiting speed or maintaining safe distances, may offer new and more effective ways to tackle the human risk element that we all bring to the road.

5. Conclusions

The data tables provided in this paper summarise information returned in response to questionnaire by hundreds of road users involved in accidents. These tables cover a very wide range of areas, including medical conditions, alcohol and drug use, driving patterns, and accident causation factors. It is intended that this data should be applicable to the development of active safety systems and wider human factors research.

According to questionnaire respondents, other road users, the road surface and weather are perceived to be the major factors contributing to road accidents.

On the specific role of these "other road users", i.e. road users who were involved in accidents with the questionnaire respondents but who themselves either did not return a questionnaire or did not mention other road users as a factor in the accident, there appears to be an element of agreement between the questionnaire respondents and the accident investigators. The underlying grounds for this tendency have however not been fully investigated and there are indications of disagreement at a detailed level between the road users and investigators. Opinion is therefore reserved on the reliability of the questionnaire respondents.

Directions for further analysis suggested by the work done for this paper include (a) the representivity of the road users who returned questionnaires, (b) the perceived and actual role of the

road surface and weather in causing accidents, and (c) the application of this data to evaluating the potential benefits of active safety technologies.

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