Eur J Ageing (2010) 7:181–188
DOI 10.1007/s10433-010-0147-3

ORIGINAL INVESTIGATION

Exploring older drivers' perceptions of driving

Charles B. A. Musselwhite · Hebba Haddad

Received: 13 February 2009 / Accepted: 29 April 2010 / Published online: 3 June 2010

Abstract This research uses grounded theory to assess the driving needs of 29 older car drivers using four data collection techniques (two waves of focus groups, an interview and a driver diary). Findings suggest that older drivers view themselves as having better driving skills and attitude towards driving compared to when they were younger and compared to other drivers. In addition, they have a good ability to adapt to their changing physiology. Nevertheless, they report difficulty in assessing their own driving ability and cite they would like help to increase self-awareness about the driving task. In addition, the participants report having increasing difficulty in not having enough time to read, compute and comprehend road signs, maintaining a constant speed at the speed-limit, increased tiredness and fatigue and increased sensitivity to glare. The findings suggest given an iterative, qualitative methodology where driving issues are focused upon, older drivers can become more self-aware of their driving limitations and discuss these aspects in the context of ageing physiology.

Communicated by Responsible Editor: Hans-Werner Wahl.

C. B. A. Musselwhite (✉)
Traffic and Transport Psychology, Centre for Transport and Society, Faculty of the Built Environment, University of the West of England, Coldharbour Lane, Bristol BS16 1QY, UK
e-mail: Charles.Musselwhite@uwe.ac.uk

H. Haddad
Washington Singer Laboratories, School of Psychology, Perry Road, Exeter EX4 4QG, UK
e-mail: H.Haddad@exeter.ac.uk

Keywords Ageing · Driver behaviour · Travel behaviour · Social psychology · Self-awareness · Older people

Introduction

Although there is great variation in the ability of older drivers, as a single-cohort drivers aged over the age of 65 begin to be over represented in at-fault road serious traffic collisions compared to those of middle-age, a statistic that continues to increase dramatically with age (DfT (Department for Transport, UK) 2001; Hewson 2006). Driving is a complex task which requires many interlinking cognitive, perceptual and physiological processes (McKnight and Adams 1970). Reductions in physical and cognitive abilities is a natural part of the aging process, and can negatively affect safety of driving in different ways (DfT 2001; Lee et al. 2003). Older drivers are involved in collisions that generally occur in daylight, at intersection and at low speeds (DfT 2001; McGwin and Brown 1999). They are less likely than other age groups to be involved in single-vehicle collisions (DfT 2001). In addition, older drivers in particular have difficulty in making critical decisions under time pressure and dealing with immense traffic conditions. Hence, many of their collisions occur when drivers become overloaded with information when performing manoeuvres (Brendemuhl et al. 1988), merging onto roads (Schlag 1993), and older drivers are over represented in at-fault collisions at junctions and intersections, especially those with no traffic control (e.g. traffic signals and lights) and those that involve right-hand turns (in the UK—i.e. across the oncoming traffic) (Hakamies-Blomqvist 1988; Maycock et al. 1991; Preusser et al. 1998). Research suggests inappropriate gap selection, high task complexity and

distraction from other road use as underlying factors that contribute to intersection and turning crashes (Oxley et al. 2006).

Previous research into older drivers has a number of limitations (see also Musselwhite 2004); for instance, there is a tendency to treat the older driver community as one homogenous group rather than look at an idiographic level for differences between drivers. Research has tended to be of a top-down approach, often using accident and collision data and statistics and as such may miss some nuance of behaviour that only the people themselves may experience and is overlooked by researchers. As such, not much is known about older driver's opinions, perceptions and attitudes towards driving. This article presents findings using an in-depth, bottom-up approach with triangulated qualitative methodology to understand how a small sample of older drivers conceptualise their own driving behaviour to see what they prioritise as key issues with regards to their own driver behaviour. A discussion will then compare findings with what researchers or technologists have traditionally researched in this area. Recommendations are then made to suggest areas of research for the future that should aim to find out whether our findings are representative and if so what should be examined to help older people overcome driver issues and maximise safe driving behaviour. The ability of drivers to conceptualise their own driving behaviour is thought to be poor and their self-awareness of their own limitations with regards to driving thought to be low, and this is especially true for older drivers (Charlton et al. 2001; Cushman 1996; Marottoli and Richardson 1998).

This article presents findings using triangulated in-depth iterative qualitative approach to help the participants focus on their driving behaviour and illuminate habitual behaviour into consciousness. There is a growing body of research that suggests that group discussions on driver behaviour, which emphasise interaction between road users, reflection on habitual and subconscious behaviour can have a positive effect on driver attitudes and behaviour by reducing habitual behaviour and raising driving behaviour into a conscious decision-making activity (Dorn and Brown 2003; McKenna and Poulter 2008; Musselwhite et al. 2010; Musselwhite and Vincent 2006). In addition, such group discussion should highlight internal inconsistencies including cognitive dissonance, emphasises norms, introduces emotive content and introduces a reflection on attitudes, values, and beliefs. Hence, it would be expected that individuals taking part in in-depth focussed research should become more aware of their own driving behaviour. Hence, this article will also present tentative findings as to whether such a methodology has a role to play in raising self-awareness amongst older drivers.

Methodology

Theoretical framework

A modified grounded theory approach was adopted, where participants become co-researchers and participate throughout the research process (Glaser 2001; Strauss and Corbin 1998). This approach suits the nature of generating and developing knowledge and meaning from a wide variety of opinions and attitudes, without doing an injustice to their diversity and depth. Therefore, a researcher does not begin with a preconceived theory in mind, rather crafting theory from the rich collection of knowledge. The aim of grounded theory is to explain the knowledge from whence it came (Glaser 2001). The emphasis is not on comparisons between people so much as examining intensive structures within each participant to ascertain the origins of attitudes and behaviour. The word 'modified' is added to 'grounded theory' in this case to acknowledge that the researchers had prior knowledge of key issues in older people's driving behaviour and used this to shape topics for discussion, rather than beginning the research with no preconceived ideas as is suggested in pure grounded theory (see Strauss and Corbin 1998; Glaser 2001 for further discussion on such a debate within the theory).

Grounded theory was chosen to allow participants to discuss freely key concepts that they themselves found important with regards to driving, rather than gaining direction from the researchers. Hence, the botom-up or needs-led approach is adopted to contrast with a traditional technocratic or academic top-down approach. Grounded theory allowed the participants key issues to emerge and hence they themselves shaped the research. The researchers became co-ordinators or moderators of knowledge to keep the overall general focus of the study on driving behaviour and not allow deviations from this focus to take control. However, within the topic, participants were encouraged to take the discussion where they believed pertinent and important. Therefore, the findings presented here are grounded in the knowledge of the individuals themselves.

Participants

Recruitment took place by approaching people in town centres in well-lit areas in the middle of the day by professional recruiters and through help of local Age Concern groups. It was critical that the sample contained a diverse range of individuals so as to maximise the diversity of the participants. It is not the aim of the sample to be representative of the older population of the United Kingdom, moreover to represent different people within the population. Using previous transport research reviews on road user safety and driver behaviour (DfT 2001; Musselwhite

et al. 2010), it was established that the sample should contain a diversity in male and female participants, a range of ages, a range of socio-economic and geographical backgrounds and a range of travel behaviour and amount of miles driven. Hence, a quota sampling procedure took place to ensure that the sample had diversity. In total, 29 participants were recruited of which 18 were male and 11 female, whose ages ranged from 68 to 90 years old (mean = 75 years old, SD = 5.7). All of the participants had a current driving licence and owned (91%), or had access to, a car (9%). Most (89%) of the participants own their home out right with 6% saying they owned their house with the help of a mortgage and 6% living in private rented accommodation. Most (69%) lived as a couple, with 27% living alone and 65% of the sample said their health was good, 15% said their health was fair and 19% of participants said that their health was excellent. Participants were recruited from urban, semi-urban and rural areas in Dorset, a largely rural county in the South of England with a large proportion of older people. On average, participants drove 111 miles per week, ranging from 29 to 220 miles. This compares favourably to the national statistics on driving in the United Kingdom; older drivers (aged 65 and over) drive around 102 miles per week on average (DfT 2006). On average, the participants made 11 journeys a week, which is just less than the 14 journeys per week cited nationally (DfT 2006).

Potential participants were given information sheets explaining about the project and how they can get involved. The research process was carried out inline with ethical codes of conduct throughout and followed British Psychological Society codes of conduct and was approved by the internal ethics committee at the university the study was undertaken. Given that a great deal of the participant's time and effort was required and as such participants were paid £30 for their involvement.

Procedure

In order to gain an in-depth analysis of driver needs and issues, four waves of data collection took place. Participants were invited to an initial (wave 1) focus group and then they took part in a telephone interview (approximately 1–2 weeks after the first focus group) and completed a driver diary (around 3–4 weeks of driving between focus groups). Participants were invited back to the wave 2 focus group at the end of the research process, approximately 1 month after the initial group. As such, the procedure was iterative and began with very open-ended exploratory questions which were gradually refined in light of key findings. Participants were divided into three focus groups based on proximity to where they lived—group 1 (urban area) and 2 (rural area) had seven participants and group 3 (semi-urban area) had 13.

Focus groups

The focus groups lasted around 1 ½ h and took place in daytime or evening with refreshments provided. Focus groups were recorded using a digital stereo Dictaphone. Wave 1 of the focus group was unstructured, so that the needs and issues raised came from the participants themselves. Driving experience was discussed including journeys made, number of journeys by car, number of journeys by other modes, reason for choice of mode, main barriers faced while driving and how such barriers are overcome. Wave 2 of the focus groups involved a discussion on giving-up driving and associated issues. In addition, scenarios and video-clips of driving situations were presented to stimulate discussion. These clips shown were issues highlighted by the participants including weather and lighting—bright sun, rain, dark, fog, dusk and poor light; issues with road conditions—right-hand junctions, roundabouts, large scale congestion, signage and passing cyclists.

Interviews

Semi-structured telephone interviews, lasting approximately 30 min were carried out with the participants. A telephone interview was favoured for ease of use and to reduce resources and time participants gave to the project. These interviews re-visited driving needs that were discussed in the wave 1 focus groups and assessed barriers to meeting such driver needs. The interview also enabled further exploration of the findings from the wave 1 focus groups at an individual level.

Driver diaries

A pro forma driver diary was completed by 24 of the 29 participants. They were asked to record details of the trip, its purpose and any particular issues or problems that arose during the trip and how they were overcome. Participants were encouraged to complete their driver diary immediately after completion of a journey creating a focused response on such issues and a reduction in recall distortion over time. Diaries were completed by hand between wave 1 and 2 focus groups. On average, participants kept such diaries for 19 days, which covered 8.2 journeys (many of them return journeys) with an average mileage of 240.7 miles (an average of 29 miles per journey or 88.7 miles per week).

Ensuring validity and trustworthiness of the research

In order to check for integrity and trustworthiness, triangulation and reflexivity were employed throughout the research. Triangulation was shown through the iterative approach which used four different methods of data collection focussing on similar issues. Consistency and difference between and within-individuals were captured during analysis and discussed with participants at the next data collection point. In addition, two researchers were involved in analysis. Reflexive research notes were made by each researcher during data collection. Data analysis was carried out by both researchers and compared for consistency (which were reported) and contention (which were further discussed with participants).

Data analysis

Data analysis ran concurrently with data collection to aid the iterative process. Reflexive notes made by researchers were combined with exact transcriptions of the data. In line with grounded theory, constant comparative analysis was employed to analyse the data and theory developed using open, axial and structured coding. (Glaser 2001; Goetz and LeCompte 1981; Janesick 1994; Lincoln and Guba 1985). Open coding produced a summary of the data from which axial coding allowed a detection of units of meaning into areas of general, relevant and essential distinction. At the end of data collection, further data analysis occurred in light of new findings and selective coding was employed to re-build, modify and establish categories.

Findings

The results suggest that there is a tendency for the participants to view themselves as having both better driving skills and a more appropriate attitude towards driving than when they were younger themselves and when they compare themselves to other drivers on the road, especially younger drivers. Further, they report that they are aware of and have a good ability to adapt their driving skills and behaviour to their changing physiology related to the ageing process. Nevertheless, a number of important driving issues and problems were encountered as a result of physiological, cognitive and psychological issues associated with getting older.

Their own driving behaviour

Initially, when first probed, on the whole, participants felt they had good driving skills. In particular, they felt experience gave them better driving skill, especially in terms of hazard perception and ability to read the road ahead. That said, during later stages of data collection, many of the participants, especially female and older participants (those aged 85 or over), felt unsure of their own ability, especially in light of media discussions and discourse suggesting older drivers are not as good as they should be.

There was mixed feelings amongst older people about seeking formal clarification on their driving ability, with some individuals welcoming such a move (especially male drivers) and some (largely female drivers) who felt it was not necessary, inconvenient and costly, with some individuals (largely the oldest participants) being worried about the potential to lose their licence. Some local authorities in the United Kingdom are providing such training for older drivers and two of the participants, both male and both from urban areas, had been on such training and felt it was beneficial and had improved their driving behaviour. In addition, four of the participants, all male, had taken Advanced Driving Test (in the UK a voluntary high level driving skills test) and the motivation had largely been anxiety over whether or not they were still good enough to drive due to their age, rather than stemming from an incident or noticeable difference in driving skill. They had all taken the test while in their younger years often following retirement, at around 65 years of age.

Self-regulation of driving behaviour was in evidence for almost all of the participants as they compensated for perceived difficulties in driving behaviour noted. This took the form of changes in driver behaviour, admitted by a wide variety of participants, that they drove slower with increased headway, for example, and travel behaviour, largely noted by female participants, where a reduction in driving at stressful times was noted, and so they did not drive when it was busy, when the weather was poor and at night.

Issues and problems with driving

During the diary keeping and the second time individuals met, all the participants became more honest and open about aspects of the driving task they found difficult and were willing to articulate where they thought ageing was a factor. Table 1 shows driving issues in order of importance as noted by the participants themselves. As in any qualitative analysis, this is not about how often the theme was discussed but the qualitative depth and importance the issue received during discussions.

External distraction—signs

Distraction was a major issue amongst the participants and appeared to be more of an issue for females and those in poorer health. An abundance of street furniture, including

Table 1 Physiological, cognitive and psychological reasons for important driving issues amongst the respondents

Importance	Driving issue	Physiological	Cognitive	Psychological	Compensatory behaviour
1	External distraction—too many signs, too small, wrong place, inappropriate	Vision: Eyes shifting to read sign	Information processing; workload	Anxiety over missing turning or missing speed limit sign	Don't read signs—so don't always read/see most appropriate and useful sign
2	Maintaining a constant speed at the Speed Limit	Stiffness in leg muscles; Vision: eyes shifting from far (road) to (near) speedometer	Less judgment of speed. Memory	Anxiety over being caught for speeding	Drive at slowest speed
3	Tiredness especially on unfamiliar routes and longer journeys	Fatigue	Decision-making: Longer to make decisions Information processing, workload	Less confidence to drive for longer times Habit, less confidence in new areas	Drive shorter distances or stop more frequently. More aware of tiredness. More time to stop Avoid driving in new areas
4	Reactions	Stiffness	Reaction time: Longer to react	Less confident in busy traffic	Drive with longer headway and/or at slower speed
5	Glare and luminance	Vision: Glare, eye sensitivity		Less confidence in bright or low light	Sun visor, slower driving, avoid night driving

road signs, event signs and road-works were seen as presenting a large distraction to the main driving focus. Participants generally mentioned that the effects of this were heightened in areas they did not know. Another major feature was that the rural and semi-urban participants felt speed-limits on roads changed too frequently which added to confusion and distraction. In addition, the participants unanimously mentioned that signs could be placed in inappropriate places, such as immediately at a junction or in area where other tasks were taking place, such as having to take a turn or even just after completing a turn,

> Worse place to put a sign – just after turn into a road (male, aged 80, interview)

Participants, especially those in urban and semi-urban areas, also felt that the language used in road destination signs to be confusing and lacked continuity. Also, signs that are not a priority to the driving task sometimes cause distraction. Participants views were mixed as to whether the distraction was due to an increasing difficulty in information processing and increase in workload due to ageing or indeed an increase in signage on the roads over the past few years, with the overall feeling that it probably was a combination of both.

Maintaining a constant speed at the speed limit

The next most problematic area for the participants was the ability to keep to the speed limit. There was a variety of reasons for this, and these varied amongst sub-groups of the participants. Unawareness of the speed limit was mentioned by those in rural areas and this was either due to the seemingly random fluctuations of the limits or poor signage. Those with poor health and older participants (aged 85 or over) mentioned having leg-pain or very stiff leg muscles meant keeping the accelerator at the required level could become problematic. A frequently cited reason by all participants was a lack of knowledge about the current vehicle speed. They stated that looking down at the speedometer and then back up and outside can cause visual problems with vision becoming blurred due to changing between near and far vision.

Fatigue and longer journeys

An increase in becoming tired earlier on in a drive was an increasing issue for almost all of the participants. Tiredness seemed to come on quicker and have a more dramatic effect on them than when they were younger. Participants, on the whole, were aware that tiredness definitely led to poorer driving, particularly judgment and decision-making which if left untreated could cause collisions. However, participants (especially male participants) tended to mention that they had a good level of self-awareness about the onset of tiredness and fatigue and were able to take extra breaks to compensate for this increase.

Reaction time

The participants of all ages and backgrounds noticed it took them longer to react when something unplanned happened on the road. Younger participants (aged 65–75 age) felt

that their experience and ability to look for extra hazards on the road coupled with leaving a larger gap to the vehicle in front helped overcome this issue. In most cases, participants felt their reactions had not reduced to such a level as to be dangerous and such compensatory behaviour more than made up for it,

> My reactions times a little slower though not much difference - I know my reactions aren't that bad I box with my grandson and he doesn't get much passed me! (male, aged 78, interview)

Glare and lighting conditions on the road

Vision was mentioned as an issue by all participants and was a particular problem for older participants amongst the sample (aged 85 or above). Visual aspects of driving were made difficult in particular by the glare of the sun, which was helped somewhat by sun visors, but not in every case. Low, bright sun (especially in the winter) was cited as particularly difficult. The glare could result in complete 'white-outs' for some participants, making driving very hazardous. This was noted as a particular problem when a manoeuvre had to be made, such as turning right at an intersection,

> You can't judge the speeds so well when the suns glaring like that, so it makes junctions and roundabouts difficult and dangerous (male, aged 81, interview)

Discussion

This research suggests the older people in this study, on the whole, although were confident about their driving ability were also aware of particular issues and problems they have in terms of driving that are related to ageing. They are concerned about losing their licence and concerned that they will be blamed following an collision which may lead to a loss of licence. These concerns may initially at least hide some of known difficulties they have with their driving. Previous research suggests drivers tend to overemphasise their driving skill and ability (Groeger and Brown 1989; McKenna et al. 1991; Svensson 1981), and this is especially true of older people (Charlton et al. 2001; Cushman 1996; Marottoli and Richardson 1998). Indeed, the older people who participated in this research emphasised what good driving skills they posed and how much better they were than when they were younger and in particular younger people on the roads today. However, in this study, using in-depth iterative methodology, participants began to reveal limitations to their driving skill and very much recognised their driving limitations and were willing to discuss when encouraged to focus and concentrate on them. It is likely that the focus groups created norms amongst participants that showed it is both ordinary and acceptable to have driving problems and issues, especially for older people. The iterative approach meant individuals were given time and context to reflect upon their own driving coupled with driving diaries which allowed focus almost in situ straight after a driving event. Hence, it is tentatively suggested that methods of data collection that allow reflection through iterative re-convened focus groups and diary collection create a situation where individuals do begin to become more self-aware and self-critical of their behaviour. This study builds on a growing body of research that suggests reflection on driving tasks can help illuminate driving skill and ability and has the potential for positively changing driving attitudes and behaviour (e.g. Dorn and Brown 2003; McKenna and Poulter 2008; Musselwhite et al. 2010).

It is pleasing to note that there is support for assessment of driving ability amongst the participants. In addition, a proportion of participants had actively sought an assessment of their driving ability and updated their driving skills, through local assessment centres and advanced driving tests. Previous research suggests this is quite typical of older people (see DfT 2001 for review) more than the general population (see Musselwhite et al. 2010). However, this study suggests it was largely male drivers who sought professional advice on their own driving ability. A more representative sample is needed to see if this pattern is true for the population of older people. Should such a pattern emerge then further research needs to investigate the barriers that women in particular face with regards to seeking driving behaviour.

A number of issues that the older people in this study had reported themselves have been found through previous accident-based research in the past, for example distraction due to signage, fatigue, increase in reaction time and dazzling from other vehicles (see DfT 2001 for a review). However, this study adds an additional problem not previously found, namely it could be that many older drivers are unable to read the speedometer due to visual problems associated with change in visual focus from scanning the road ahead to the close-up speedometer dial. Blurred vision found as the eye shifts between far (the horizon when scanning the road ahead) and near objects (the speedometer) is most probably due to accommodation, where the eye is adjusting focus between the distant road environment outside the vehicle and closer-up inside the vehicle on the speedometer. Accommodation of the eye begins to take longer as people get older (Burd et al. 1999). Furthermore, processing information takes longer, so that the speedometer has to be looked at for a longer length of time. These

cause problems with maintaining a constant speed. Previous research has not addressed this as an issue for older drivers; however, parallel research to this project has found similar needs amongst older people using a similar participatory methodology (Keith 2010; Wicks et al. 2006). This leads to the idea of introducing extra feedback on current speed-levels to the driver. As such investigations into new technology, which involve auditory or haptic feedback seem appropriate. In addition, re-appraising the speedometer may be necessary. Perhaps relocating the speedometer higher-up on the dashboard or changing the focus of the speedometer, perhaps through head-up display could reduce such a problem. Head-up display has had some success, albeit not focussing on older drivers especially, in creating driving at a more consistent speed (e.g. Liu and Wen 2004), making drivers more aware of their current speed (Sojourner and Antin 1990), and better adherence to the posted speed limit (Kurokawa and Wierwille 1991; Rutley 1975).

The study also notes that the older people in the study did not mention in any depth or level of detail anxiety or concern with intersections or turning right (in the UK—i.e. across the oncoming traffic), despite this being an area where older people are over represented in road traffic collisions (Hakamies-Blomqvist 1988; Maycock et al. 1991; Preusser et al. 1998). Discussion on intersection issues highlighted that problems arose due to other elements—being distracted by signs prior or at the intersection and being dazzled by the lights of other traffic, for example. This could be a key area where awareness training for older people could concentrate, as it seems to be an area where older people are less aware of potential danger. It could also suggest that such collisions are not caused simply by the process of engaging in the turn or manoeuvre itself but that the behaviour is coupled with other disabling factors, such as being distracted and glare, for example.

Overall, it can be seen that the participants viewed themselves as having better driving skills than when they were younger and indeed than many other road users. Despite this, they are aware of a number of failings in their ability, but feel in most cases they are able to overcome and compensate for such behaviours, either through changing driver behaviour (driving slower with increased gaps, for example) or changing their travel behaviour (not going out at night to avoid glare and luminance issues, not driving in the busiest times to avoid distraction and being overwhelmed by the environment). However, it must be noted that in an ever growing car dependent society, a question for policy makers must be to consider whether older people be able to avoid such situations in the future and the potential consequences this has on road user safety coupled with a growing older person population.

Further research is suggested to establish the certainness of these issues, through a larger more representative sample using robust and statistical techniques. The sample is small and somewhat biased towards older people who are able to travel and a key limitation of the research is that hard to reach individuals who may find driving so difficult that they are unable to drive very far and very often are not included in the sample. Nevertheless, this research has the potential to be a useful anchor for future studies that may focus on (older) driver needs. Focusing on older drivers needs and understanding how they might be met could enable older people to continue driving for longer, whilst retaining confidence in their ability, and ensure that they are safer drivers. In addition, the methodology has provided an opportunity for older people to get involved in research in a thoroughly participatory manner which has ensured that they feel able to shape the research and maximise benefits of the research outcomes for themselves and their age groups.

Acknowledgements This study was kindly funded through the Strategic Promotion of ageing Research Capacity (SPARC) initiative as part of a wider project addressing older people's mobility needs in general. See www.sparc.ac.uk. We are very thankful to our participants in Dorchester, Hamworthy and Swanage for giving us so much of their precious time and for all the interesting discussions. Thanks also go to Age Concern Dorchester and Age Concern Poole for their help in recruitment.

References

Brendemuhl D, Schmidt U, Schenk N (1988) Driving behaviour of elderly motorists in standardised test runs under road traffic conditions. In: Rothengatter J, de Bruin R (eds) Road user behaviour: theory and research. Van Gorcum, Dordrecht

Burd HJ, Judge SJ, Flavell MJ (1999) Mechanics of accommodation of the human eye. Vis Res 39(9):1591–1595

Charlton JL, Oxley J, Fildes B, Les M (2001) Self-regulatory behaviour of older drivers. Paper presented at the road safety research, policing and education conference, Melbourne, Victoria, Australia

Cushman LA (1996) Cognitive capacity and concurrent driving performance in older drivers. IATSS Res 20(1):38–45

DfT (Department for Transport, UK) (2001) Older drivers: a literature review. Department for Transport, London

DfT (Department for Transport, UK) (2006) National Travel Survey Great Britain 2005. Department for Transport, London

Dorn L, Brown B (2003) Making sense of invulnerability at work: a qualitative study of police drivers. Saf Sci 41(10):837–859

Glaser BG (2001) The grounded theory perspective: conceptualization contrasted with description. Sociology Press, Mill Valley

Goetz JP, LeCompte MD (1981) Ethnographic research and the problem of data reduction. Anthropol Educ Q 12:51–70

Groeger JA, Brown ID (1989) Assessing one's own and others' driving ability: influences of sex, age and experience. Accid Anal Prev 21(2):155–168

Hakamies-Blomqvist L (1988) Fatal road accidents involving elderly drivers. Paper presented at the commission of the European communities workshop on errors in the operation of transport systems, Cambridge

Hewson P (2006) Ageing drivers or ageing casualties? Presented at the older people in rural area (OPeRA) research conference, Taunton, 4 July 2006. http://www.plymouth.ac.uk/files/extranet/docs/HSW/HewsonTaunton0407206.pdf. Accessed 28 April 2010

Janesick VJ (1994) The dance of qualitative research design: metaphor, methodology, and meaning. In: Denzin NK, Lincoln YS (eds) Handbook of qualitative research. Sage, Thousand Oaks, pp 209–219

Keith S (2010) Designing with older drivers: seeking out aspirations and needs. Qual Ageing Older Adults 11(1):38–47

Kurokawa K., Wierwille WW (1991) Effects of instrument panel clutter and control on visual demand and task performance. Soc Inf Disp Int Symp Dig Tech Pap XXII:99–102

Lee HC, Lee AH, Cameron D, Li-Tsang C (2003) Using a driving simulator to identify older drivers at inflated risk of motor vehicle crashes. J Saf Res 34(4):453–459

Lincoln YS, Guba EG (1985) Naturalistic inquiry. Sage, Newbury Park

Liu YC, Wen MH (2004) Visual display designs of the logistics delivery lorry in-vehicle information system in Taiwan. J Ergon 6:11–20

Marottoli RA, Richardson ED (1998) Confidence in, and self rating of, driving ability among older drivers. Accid Anal Prev 30(3):331–333

Maycock G, Lockwood C, Lester J (1991) The accident liability of car drivers. TRL Research Report 315. Crowthorne, Berkshire

McGwin G, Brown D (1999) Characteristics of traffic crashes among, young, middle-aged and older drivers. Accid Anal Prev 31(3):181–198

McKenna FP, Poulter D (2008) Speed awareness: the effect of education versus punishment on driver attitudes. The University of Reading, Reading

McKenna FP, Stanier RA, Lewis C (1991) Factors underlying illusory self-assessment of driving skill in males and females. Accid Anal Prev 23(1):45–52

McKnight AJ, Adams BB (1970) Driver education task analysis, vol 1: task descriptions. Human Resources Research Organization, Alexandria, VA, Final Report, Contract No FH 11-7336

Musselwhite CBA (2004) Technological humps and having the hump with technology. Paper presented at the international conference on traffic and transport psychology, Albert Hall, Nottingham, 5–9 Sept 2004

Musselwhite CBA, Vincent C (2006) Academic centres in practice evaluation report. Institute of Health and Community Studies, Bournemouth University, Bournemouth

Musselwhite CBA, Avineri E, Fulcher E, Goodwin P, Susilo Y (2010) Public attitudes to road user safety: a critical review of the UK based literature 2000–2009. In: Proceedings of the 42nd universities transport studies group conference, University of Plymouth

Musselwhite CBA, Avineri E, Fulcher E, Susilo Y, Hunter A, Bhattachary D (2010b) Understanding the public attitudes to road user safety: final report. For the Department of Transport, UK

Oxley J, Fildes B, Corben B, Langford J (2006) Intersection design for older drivers. Transp Res F Traffic Transp Psychol 9:335–346

Preusser DF, Williams AF, Ferguson SA, Ulmer RG, Weinstein HB (1998) Fatal crash risk for older drivers at intersections. Accid Anal Prev 30:151–159

Rutley KS (1975) Control of drivers' speed by means other than enforcement. Ergonomics 18:89–100

Schlag B (1993) Elderly drivers in Germany fitness and driving behaviour. Accid Anal Prev 25:47–55

Sojourner RJ, Antin JF (1990) The effects of a simulated head-up display speedometer on perceptual task performance. Hum Factors 32(3):329–339

Strauss A, Corbin J (1998) Basics of qualitative research: grounded theory procedures and techniques. Sage Publications, Newbury Park

Svensson O (1981) Are we all less risky and more skilful than our fellow drivers. Acta Psychol 47:143–148

Wicks C, Keith S, Bradley M (2006) An appropriate interface for speeds limit advice for older drivers. Paper presented at SPARC conference workshop on transport for older people, Leeds University, 26 Oct. http://www.sparc.ac.uk/workshops/10_26_06_transport/pdf/Mike_etal.pdf. Accessed 28 April 2010