Strategic Promotion of Ageing Research Capacity

What Do Older Drivers Want From New Technologies?

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Meeting the challenges of an ageing society

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As the population in the UK ages, there are rapidly increasing numbers of older drivers on the road. Driving helps older people to remain independent, yet little technology currently exists to give them the confidence to keep driving. By involving older drivers in the design process, car designers would be able to develop technologies which would meet the needs of this group. In order for this to work properly though, this engagement needs to take place at an early stage in the design process. This study developed an approach to designing in-car technologies which placed older people in the role of experts, supported by researchers and designers as facilitators. It identified unintentional speeding and reverse parking as two issues which are of particular concern to older drivers, and investigated how technology might support drivers in these tasks. The research found that older people had a range of different needs, attitudes towards driving, engagement with technology and driving abilities.

Key Findings

- Methods which involve the user in the design process are rarely used when designing cars and in-car technologies; when they are, older drivers are excluded from this process. This study developed ways of engaging older drivers in the design process. This provided information about the real desires and needs of older drivers, which can be translated into specifications and requirements for designers.

- Information from surveys and interviews revealed the central role which driving plays in the lives of many older people. Practical exercises showed that there was a very wide diversity in older people's driving attitudes and strategies, and in the way they approach new technologies. The context in which older drivers learned to drive, and the way in which they have developed their driving skills since, can highlight very different behaviours from those of younger groups.

- Two key issues which older drivers are particularly concerned about were unintentional speeding and reverse parking.

- The development of enhanced in-car speedometer displays with visual information and warnings, potentially coupled with haptic feedback (related to touch) through the accelerator pedal, showed strong promise. This study also helped to explore how to present design concepts using static displays and a racing game, and to reveal attitudes to speeding.

- Exploring the use of new technologies to aid reverse parking provided considerable evidence for the limitations and opportunities for these technologies for use by older drivers.

Introduction

The Issues

Thirty years ago only 15% of people over 70 in the UK held a driving licence; this has grown to 51%. This trend is expected to continue.

The development of in-vehicle technologies to help driving has the potential to offer great benefits to older people. However, new vehicle technologies are targeted towards younger more technology-aware users. These often ignore the needs and interests of older drivers.

Car designers rarely consult older people in the design process. In the past, young designers have used age-simulators in order to understand the difficulties experienced by older people. These designers do not, however, want their designs marketed in a way which associates them with older people.

The Aims of the Study

The aim of this study was to investigate the wants, needs and desires of older car drivers, and to understand how new technological developments could better support their driving experience. It was also an aim to develop a methodology which recognised the expertise of older people and actively engaged them in the design process. It was felt that by using older people's experience and insights, new opportunities for innovation could be identified.

The Study

The study consisted of three core activities. Needs were identified through focus groups, and this was followed by in-depth investigations of the issues surrounding speeding and parking.

Phase 1: Focus Groups

The first part of the study explored the experiences of older drivers and the nature of their driving activities. There was a large recruitment campaign, in which a questionnaire was distributed to drivers aged over 50. This collected responses from a wide diversity of older drivers. From this, an older driver panel was created with over 230 members. The panel then took part in small focus groups, telephone interviews and usability trials. 22% of the panel were aged 50-59; 34% were aged 60-69; 33% were aged 70-79; and 11% were aged over 80. 45% of the panel were male and 55% were female.

Responses

The questionnaire revealed that daily driving was an important activity for older drivers, whether or not they were retired. Generally, the younger age groups were the most 'technology connected', although there were individuals who did not conform to this pattern. People who used personal computers appeared to be the most aware of new technology. The oldest groups, particularly women over 80, showed less interest in technology. Panel members tended not to keep their cars for long periods of time. In particular, older women were very keen on buying new cars.

Focus Groups and Interviews

Driving experiences were explored through seven focus groups. Each of these groups included three or four people, and they were followed by 18 telephone interviews to pursue emerging themes.

The discussions focussed on current and recent driving experiences set against a life-time of driving. Generally, the car was seen to be a very important way of maintaining social connections. Indeed, the main purpose of driving for those who were retired was stated as being for social and leisure activities. Some drivers were extremely active:
"I drive daily on local roads to the supermarket and visiting friends....choir practice once a week…a lot of driving on the M25 because I look after my grandchildren and that is the quickest way ….a couple of times a week, depending upon how often I am needed. I go on the motorway M6 to the Lake District at least five times a year as we have a cottage up there". (Female, 70-79)

Initial sessions revealed that there was little awareness of the latest trends in driver assistance technology. In subsequent sessions, the drivers were shown video clips to support discussion on the latest innovations. The sessions were video recorded and analysed to identify themes and findings, and to compare these with those from the questionnaire. Two key issues emerged: a fear of unintended speeding, and difficulties with reverse parking. These were then investigated further.

Phase 2: Speeding

Speeding is a criminal offence. Prosecution is likely to result in points being deducted from a driving licence and a fixed fine. With speed cameras replacing traffic police, the likelihood of being caught when speeding has increased. There was found to be a range of attitudes relating to this:
"I would be mortified if I were prosecuted for speeding";
"I think it's important not to break the law, I am a great law abider";
"I don't stick to speed limits just because they are there".

Many drivers may make their own distinctions between excessive speeding and acceptable speeding. For example, some drivers were found to judge a small infringement of the limit as being safe and acceptable:
"If you drive too fast, you're driving dangerously";
"If I got points for doing 35mph in a 30mph zone, I would feel frustrated, but if I had been doing 50 mph in a 30-mph zone, I would feel that the punishment was justified".

The task of maintaining a compliant speed is not always easy; often the vehicle is blamed:
"I find it difficult to keep to 30 mph as I have a powerful car";
"It is so easy to go up to 40 mph without realising that you've reached that speed";
"30mph in the modern car is nothing".

Speed cameras were acknowledged as being beneficial for road safety in many cases. However, many older drivers were wary of them and thought they were often there to catch drivers out and generate revenue. There was such a concern that this subject warranted further investigation into technologies that could help older drivers to *not* speed.

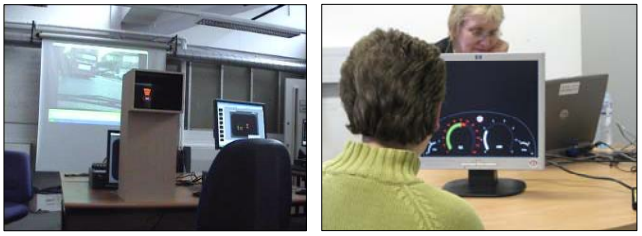
This phase also considered the difficulties that users may have identifying the potential of new technologies. Literature on the latest in-car technologies was reviewed in terms of the problems and needs identified by the user panel. Opportunities for new technologies related to speed monitoring, and also parking, were then identified and a design brief, design specification and early concept proposals were developed. This identified a number of existing advanced technology solutions which could be tested by the user panel.

The issues which contribute to speeding are very complex. Driving is a visually intensive task, and staying within the speed limit further increases this. Speed monitoring requires the driver to look away from the road to view the speedometer regularly. Other cues which may have been useful previously, such as the vibration from a revving engine, are much reduced in newer vehicles. The speed of other road users can play a part in determining a driver's speed. In addition, roads vary and this can greatly influence a driver's choice of speed.

Specification and Concepts

The initial search for technology was for a way to relieve the workload on the visual sense. Prototypes of *accelerator pedals* that vibrate and push back to warn the driver of a speed infringement were developed, but most emphasis was put on *speedometer*-based visual display indicators. The speedometer is a legal requirement and has a strong position in the existing mental model of speed control. However, design changes could make it easier to read at a glance and to distinguish compliant and non-compliant speeds. This would help to relieve visual strain, and would enable the driver to glance away for shorter intervals.

As earlier work had shown that users need a realistic context in order to be able to comment meaningfully on unfamiliar technologies, a simple, inexpensive static vehicle interior-based *driving simulator* was developed to test the effectiveness and usability of these displays.



Participants with mock-up displays

Technology Review: Intelligent Speed Adaptation

Intelligent Speed Adaptation (ISA) offers a potential solution to the problem of speed limit compliance. It uses a digital speed map, so that the speed limit is known at all times. This can inform the driver of the limit, and warn them if they exceed. Such systems could form the basis of an in-vehicle speed-limit display. However, so far, user evaluations have not involved older drivers.

Concept Simulators

Panel members were involved with these proposed developments through the use of a 'concept simulator'. This was a driving simulator which was created by adding two feedback accelerator pedals, one incorporating an off-set motor and the other a pneumatic cylinder, into a Ford Focus (donated by the Ford Motor Company; the project partner). These made the accelerator pedal vibrate or supply a counter-force respectively.

Panel members then took part in design reviews on speed control and speeding. Scripted scenarios were read out accompanied by animated displays of driving scenes. The scenarios facilitated further discussion of subjects relating to speeding:
"I don't ever go over the speed limit unless I do it accidentally";
"Yeah; you suddenly realise that you're driving at 50 in the 30mph limit and oh, whoops";
"Sometimes the speed limits, which are up on signs, are hard to see and that's the difficulty";
"There's some roads that are confusing that you think are 40 and they're not, they're only 30".
They also helped in discussions about speed control:
"Do you concentrate on your speed, do you concentrate on the road, do you concentrate on the landmarks?...Something which gives you another clue – pay attention to your speed – is useful";
"I'm sure it's a problem for everyone who drives a modern car because it's just so easy to let the speed creep up without you being aware of it".
This enabled drivers to imagine how the displays would really be used so they could give feedback on the design:
"You just look down, oh, oh, I'm over the limit";
"I really like this display. The fact that, once you exceed the prescribed limit, it all changes colour instantly: I find that a very very effective indication";
"It draws your attention, the colour change… I'd quite like that in my car";
"I found it easier. …, more comfortable, because I probably wouldn't really have to take my eyes off the view through the windscreen because within my field of view I could detect the colour change";
*"(*On digital speed display*) I feel it's a bit more difficult to almost judge your speed by looking at just a figure, 42, 37, whatever"*.

Driving Task Simulator

The simulator was linked to Racer, a computer game where the player drives around a racing track, and modified to provide a speedometer. The Ford Focus was installed with game controllers, a dash display and a custom projector screen. This was done so that the game could be controlled from within the cabin and the speedometer display viewed by the members.

Participants were given one or two introductory laps to become familiar with the circuit (one lap is around 5 or 6 minutes in length). They then drove a practice lap where they could drive at any speed they liked, followed by a test lap where they were asked to conform to a speed limit as best they could. Finally members completed a questionnaire and gave unstructured feedback.

Example speedometer displays showing speed limit and non-compliance information

Phase 3: Parking

Reverse parking was a found to be an issue for older people. This was partly due to physical difficulties such as mobility problems in turning around, and also due to visibility differences in contemporary cars. One driver explained how he had not been taught to park when learning to drive, because at that time it was not part of the driving test:
"Reverse parking is the most hairy thing about driving – I find it difficult to judge where I am";
"I need lots of space, find it difficult to judge space to the curb";
"As you get older you can't turn round, your shoulders stiffen up".

Overview

The parking assist evaluation used three activities to explore the attitudes and experiences of parking with and without technology. This helped to establish older drivers' functional and non-functional requirements.

Parking Interview

A 50 minute interview was conducted with each participant, in which they described how they performed common parking manoeuvres, how often they used these manoeuvres, and where they learned their techniques. They were encouraged to describe and sketch a unique parking scenario that they found particularly relevant or challenging. A common problem was difficulty getting into and out of the participant's front drive. Clearly, any technology would need to take account of more complex scenarios than simply the parallel parking and bay-parking manoeuvres required by the current driving test.

A miniature parking model with toy cars and several A3 parking diagrams representing typical on-street and off-street parking scenarios was used to demonstrate parking technique. Each member selected a vehicle that most represented their own vehicle's shape and size then showed how they would 'park it'.

Parking discussion

Manual Parking

Participants showed how they parked their own cars and discussed techniques, strategies and difficulties in a practical context. This activity was done in an area away from other traffic with a parking environment consisting of cardboard box props to replicate stationary vehicles and to create opportunities for parallel and bay parking manoeuvres. The manoeuvres were video recorded, and dialogue between participant and researcher audio recorded.

Toyota Prius with IPA, parallel parked, and Audi Q7 with reverse camera, bay parked

Parking Using Assistive Technology

The members used one of two vehicles fitted with parking assist technology:

- A Toyota Prius fitted with a reverse parking camera system and Toyota's Intelligent Parking Assist system that enabled the vehicle to park itself using the in-car camera and computer system;
- An Audi Q7 fitted with a reverse parking camera, audible parking sensors and graphical sensor feedback display.

None of the participants were familiar with either of these vehicles. The participants were asked about their awareness and experiences of parking assist technology and to re-enact the parallel and bay parking scenarios used in the earlier activity, the only difference being a switch from cardboard to plastic props. They were allowed time to practice manoeuvring the car along a short stretch of road and to practice parking. All of the participants quickly became familiar with the car and showed how easy it was to perform a simple reverse parking manoeuvre. Once comfortable with controlling the car they were introduced to the display screen view from the rear mounted camera and allowed to practice reversing using the camera view as well as looking around and using the mirrors. They then completed at least two attempts at bay and parallel parking.

Most participants needed several practice sessions before they felt comfortable to try the Toyota Prius Intelligent Parking Assist system. This device performed best under very restrictive requirements as it had difficulty adequately identifying the space unless the car was correctly positioned. The driver therefore had to adjust either the position of the car on the road, the representation on the screen, or both. Although the drivers were remarkably tolerant, patient and persistent, it was clear that the system was not robust enough for these simple parking scenarios. By contrast the camera view in the Audi Q7 was much appreciated as a tool to make driving safer by giving a clear view of obstructions behind. The participants appreciated the opportunity to test new technology, and the problems and successes helped to reveal more about their needs and attitudes to new devices.

Discussion and Implications

Older People as Experts

The study had two main aims: to actively engage with the needs of older car drivers and, in so doing, to develop methods for interdisciplinary user-centred research. Participation by older people was a central feature; they were acknowledged as experts in driving and design, and were involved with a wide range of activities, including steering the project and setting its agendas.

By respecting the user as an expert, research and design effort was focussed on *supporting* driving activity, and avoiding enforced choices that might detract from driving skill.

Researchers as Facilitators

The central role of the research team was preparing design concepts and prototypes that were relevant to the older drivers and with which they could interact. The study of the speed advisory system was developed in direct response to the anxiety expressed about the risks of unintentional speeding. The study of parking was in response to changes in both drivers' physical abilities and in car design. By pursuing an inclusive approach, the design team acted in partnership with older divers, identifying and responding to their needs.

Concept Development through Experience

The methods of presenting design concepts relating to speed advisory systems, through stories and simple simulations, enabled the users to articulate their long-held experiences and strategies. This investigation provided valuable information about older drivers, but did not necessarily reveal clear trends in preferences, or clarify design directions.

Evaluating New Technologies

Some of the latest technological developments, particularly in reverse parking, were explored. This was done to highlight the gaps which exist between technology and driver strategies. With the parking evaluation, drivers had an opportunity to use and review the latest commercially available technologies. This enabled observation of the drivers in the context of their own cars as well as the test vehicles and highlighted differences between the skilled performance of the drivers and the very restricted scope of the self-parking system.

Bridging Cultures

Providing opportunities to experience new technologies, helped to overcome the gap in cultural and technological experiences between the research team and the older drivers. Furthermore, these activities revealed major differences in research culture between those working in product design, and those working in human computer interaction and system developments. The methodology helped to provide ways of overcoming these differences. The experience provides important lessons for building research strategies that support a dialogue between users and researchers. This model shows how to enable the user to define the research agenda, and to move forward the processes of research and innovation.

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The Study

The study received financial support from SPARC of £55,500 and ran for 18 months ending in July 2007. Additional support was provided by Middlesex University. More information about the study can be found on the SPARC website www.sparc.ac.uk and obtained directly from the investigators and also at www.cs.mdx.ac.uk/research/projects/mod. As a result of this SPARC project, the research team has worked on a number of bids for further funding, and on consultancy for automotive manufacturers and with a preparatory network for the New Dynamics of Ageing programme.

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Disclaimer

SPARC

SPARC is a unique initiative supported by EPSRC and BBSRC to encourage the greater involvement of researchers in the many issues faced by an ageing population and encountered by older people in their daily lives. SPARC is directed, managed and informed by the broader community of researchers, practitioners, policy makers and older people for the ultimate benefit of older people, their carers and those who provide services to older people.

SPARC pursues three main activities:
Workshops to bring together all stakeholders interested in improving the quality of life and independence of older people.
Advocacy of the challenges faced by older people and an ageing population and of the contribution of research to improving quality of life. SPARC is inclusive and warmly welcomes the involvement of everyone with a relevant interest.
Small Awards to newcomers to ageing research, across all areas of design, engineering and biology and at the interfaces relevant to an ageing population and older people. In 2005 and 2006 SPARC received 185 applications for support in response to two invitations for competitive proposals of which 34 were supported.

Executive Summaries

SPARC is supporting its award holders through funding, mentoring, a prestigious dissemination platform, professional editorial assistance, international activities and provision of contacts. Each of the projects has been small, yet the enthusiasm for discovery, and impatience to contribute to better quality of life for older people, has more than compensated for the very limited funding which was provided.

This executive summary is one of a series highlighting the main findings from a SPARC project. It is designed to stand-alone, although taken with summaries of other projects it contributes to a formidable combination of new knowledge and commitment by newcomers to ageing research, with a view to improve the lives of older people. This is a tangible contribution towards ensuring that older people receive full benefit from the best that research, science and technology can offer.