Inclusive design for in-vehicle technologies: meeting the needs of the older driver

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Overview

1. The older driver
2. In-vehicle technology
3. HASTE experiment
4. Other work
5. What next?
Background

• By the year 2020, 20% of UK population will be over 65.
• Older drivers are the safest group of drivers BUT..
• …they are more at risk of being involved in a motor accident per miles driven
• They are also more at risk of being injured or killed in motor accidents
• Critical situations include:
  ➔ Intersections
  ➔ Lane changing

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Age-related impairments affecting driving performance

Visual:
- Peripheral vision – problems at intersections
- Acuity – signage, other road users
- Night vision

Cognitive:
- Reaction time – braking in time
- Concentration/attention – busy urban roads
- Dual tasking or switching between tasks – talking on the phone and driving
- Memory - navigation

Physical:
- Motion and strength e.g. due to arthritis – turning head and neck, pedals
Compensatory behaviour

- Avoid night-time driving
- Avoid driving in unfamiliar places
- Reduce speed…..

….Driving cessation

→ Reduced mobility and independence→ has been shown to be strongly correlated with symptoms of depression (Fonda, Wallace & Herzog, 2001)
In-vehicle technologies

- Advanced Driver Assistance Systems (ADAS)
- In-vehicle Information Systems (IVIS)
Advanced Driver Assistance Systems (ADAS):

- Lane departure warning systems
- Collision warning systems
- Adaptive Cruise Control (ACC)
In-vehicle technologies...

- **In-Vehicle Information Systems (IVIS):**
- Nomadic or Built-in
  - Satellite navigation systems
  - PDAs
  - Mobile telephones
- 7% of new cars fitted with ‘sat navs’ (DfT)
Advantages (?)

- Reduced stress (ACC, Navigation system)
- Warn of dangerous situations (Collision warnings)
- Driver fatigue
- Reduce pain (collision warnings)
- Frees up cognitive resources (ACC)
- Appropriate following behaviour

→ Reduces accidents  → money saving
Disadvantages

• Distracted from the driving task
• Reduced situational awareness
• Underload/overload
• Difficult to use
In-vehicle technology should

- Improve driving performance and safety
- But not at a cost to mental workload and situation awareness
- Be:
  - usable
  - acceptable
  - affordable
HASTE: HMI And the Safety of Traffic in Europe
EU-funded Project: HASTE

• Eight partners across Europe - Coordinated by ITS
• Looked at effect of IVIS in a *dynamic* setting
• Specifically looked at the *negative* effects of IVIS
• Assessed the safety implications of IVIS on driving, by examining how a ‘step by step’ increase in IVIS difficulty affects driving behaviour
EU-funded Project: HASTE

- Investigated effects of visual and cognitive demand on driving performance by means of two artificial, or surrogate, In-Vehicle Information Systems (S-IVIS).
- Compared performance of drivers at 25-50 years with ‘older’ drivers > 60 years
- 3 levels of S-IVIS difficulty
- 3 levels of road difficulty
- Simulator (Leeds), Instrumented car (Helsinki)

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HASTE S-IVIS tasks:

- ‘Arrows’ task: Visual, quick reaction time, little cognitive demand
- Auditory Continuous Memory Task (non-visual but demanding)
Visual task
Cognitive task

- Participants’ task is to maintain a count of ‘target sounds’ presented within a list, keeping a separate tally for each target sound.
- Performance is thought to deteriorate with an increase in the number of target sounds.
Main findings: Leeds Simulator

- Older drivers: 80% simulator sickness with Visual task, no problems with Cognitive task

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Main findings: Helsinki trials

• Based mainly on observation data
• Tasks had to be simplified
• Compared to the 25-50 year old group, older drivers failed to make appropriate stops at intersections or give way to vulnerable road users when performing the S-IVIS.

• Older drivers also kept an inappropriately short distance headway to the car in front when performing the S-IVIS.
Summary of HASTE results

• A step by step increase in S-IVIS difficulty showed a step by step change in driver behaviour measures for both ‘average’ and older drivers

• Older drivers were more aware of their limitations and either abandoned the S-IVIS task or changed their driver behaviour (?)

• Difficult S-IVIS task most detrimental in difficult driving conditions→ solution?

• Use of visual IVIS problematic with older drivers in the simulator.

→ Will this continue with a motion base simulator? Or is it best to use a scaled down version? Are field studies best?
Useful changes in technology

- Information systems with larger/less crowded screens
- Larger words/letters
- Use of auditory or audiovisual messages
- Less complicated navigation systems
Smart “back seat drivers”

Motorola and DaimlerChrysler:

• Driver Advocate™: an intelligent dynamic system that monitors, senses, prioritises, personalises, and sends alerts to the driver appropriate to the moment.
• Driving Coach: Drivers prompted on mirror checking, signalling etc

IBM:

• Smart Passenger: Commands using audiovisual speech recognition

Federal Highway Research Institute (BASt), Germany:

• ‘Intelligent’ gap acceptance
What next?

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