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

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Overview

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

Background

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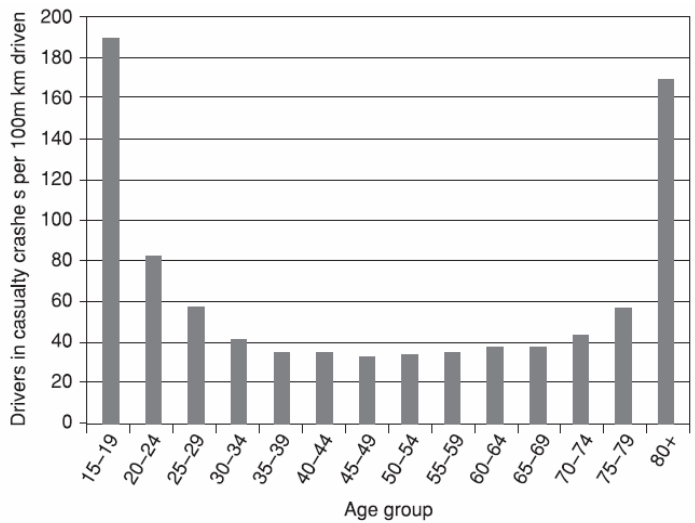
- By the year 2020, 20% of UK population will be over 65.
- Older drivers are the safest group of drivers BUT..
- …they are more at risk of being involved in a motor accident per miles driven
- They are also more at risk of being injured or killed in motor accidents
- Critical situations include:
  -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



Association between age and crash involvement per distance travelled

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Age-related impairments affecting driving performance

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Visual:

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

AAA Foundation for Traffic Safety

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

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Compensatory behaviour

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- 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

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

In-vehicle technologies…

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Advanced Driver Assistance Systems (ADAS):

- Lane departure warning systems
- Collision warning systems
- Adaptive Cruise Control (ACC)

In-vehicle technologies…

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

In-vehicle technologies...

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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

In-vehicle technologies...

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Disadvantages

- Distracted from the driving task
- Reduced situational awareness
- Underload/overload
- Difficult to use

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In-vehicle technology should

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- Improve driving performance and safety
- But not at a cost to mental workload and situation awareness
- Be:
  - usable
  - acceptable
  - affordable

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HASTE: HMI And the Safety of Traffic in Europe

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EU-funded Project: HASTE

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- 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

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- 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 > 60years
- 3 levels of S-IVIS difficulty
- 3 levels of road difficulty
- Simulator (Leeds), Instrumented car (Helsinki)

HASTE S-IVIS tasks:

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

Visual task

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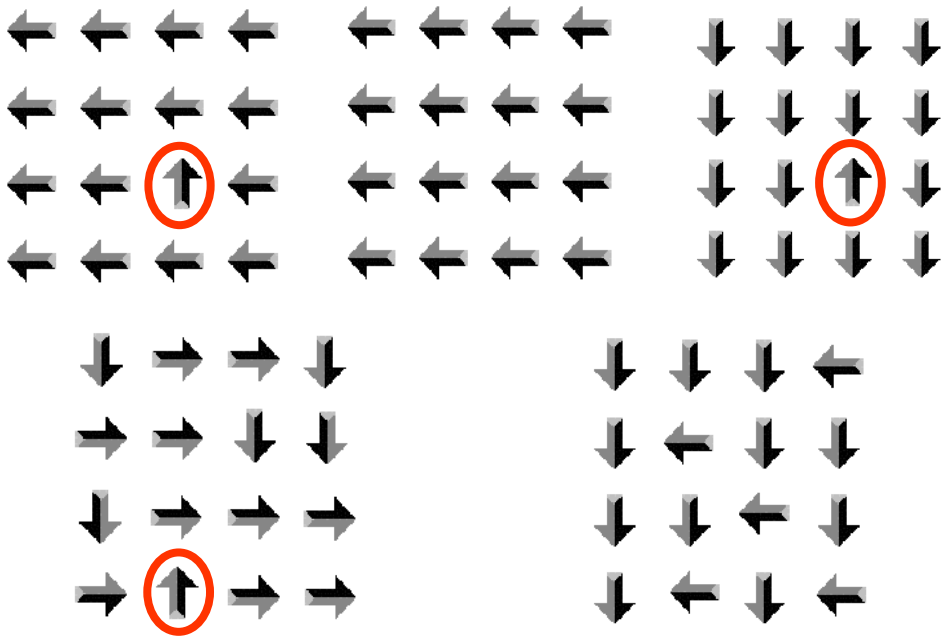

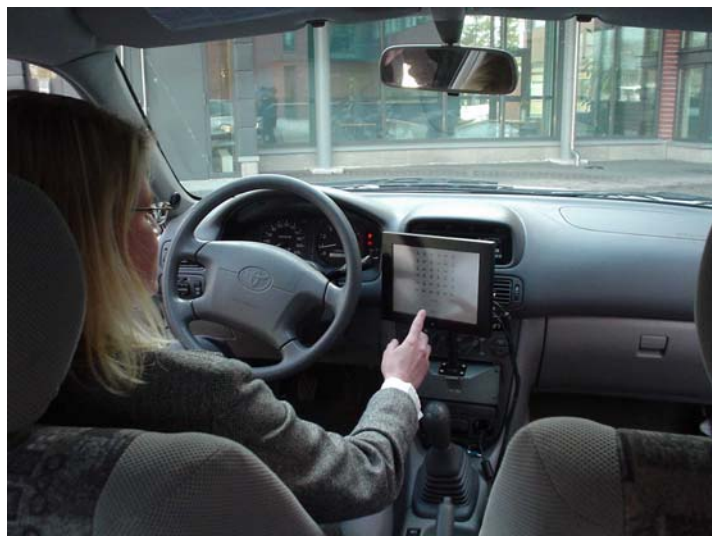

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Cognitive task

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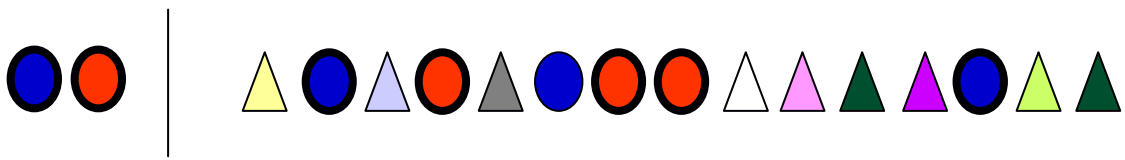
- Participants' task is to maintain a count of 'target sounds' presented within a list, keeping a separate tally for each target sound
- Performance is thought to deteriorate with an increase in the number of target sounds



Main findings: Leeds Simulator

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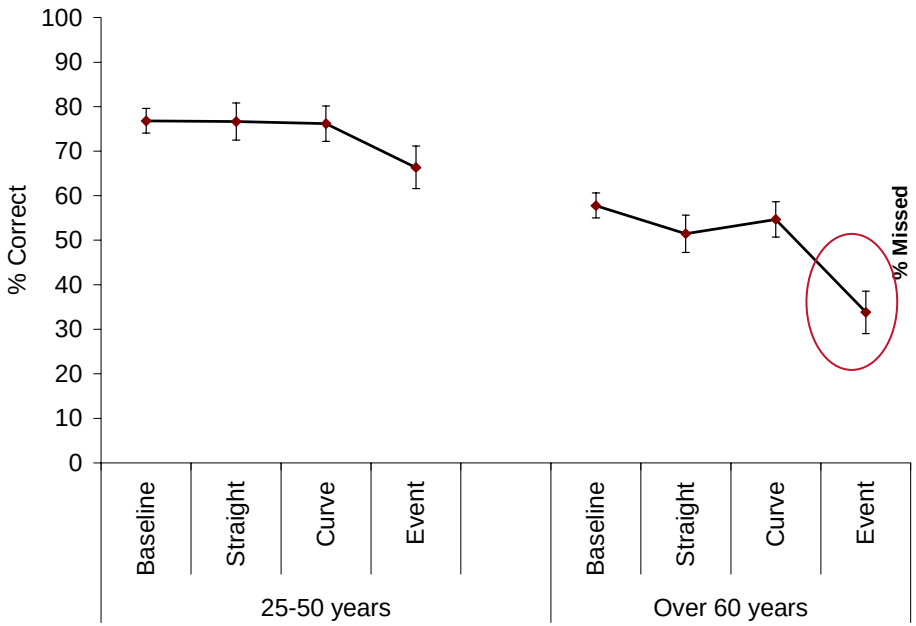
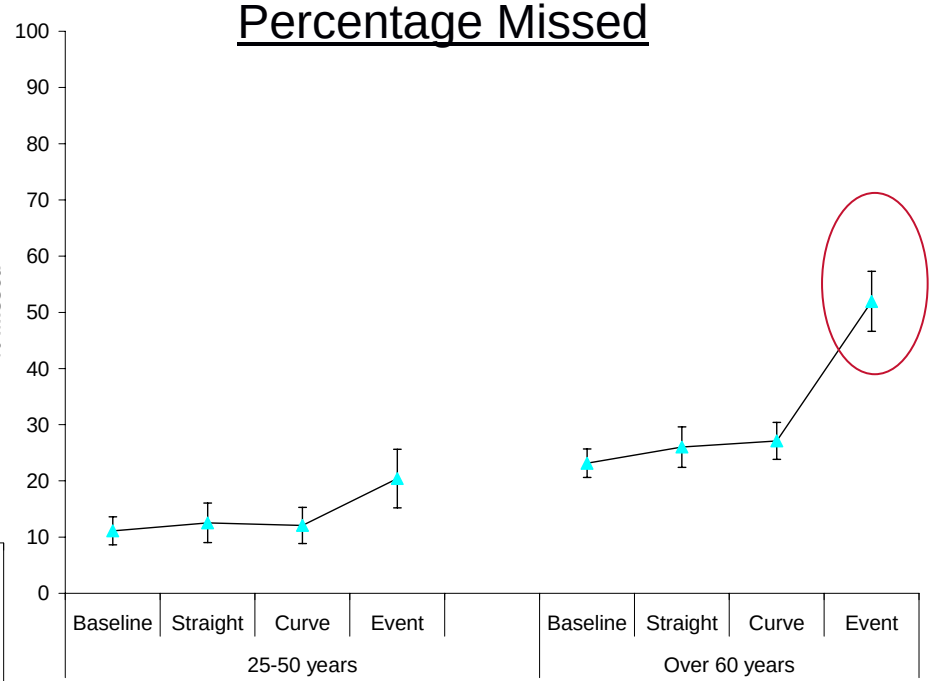
- Older drivers: 80% simulator sickness with Visual task, no problems with Cognitive task

- Percentage Correct



Percentage Missed



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Leeds Simulator cont…

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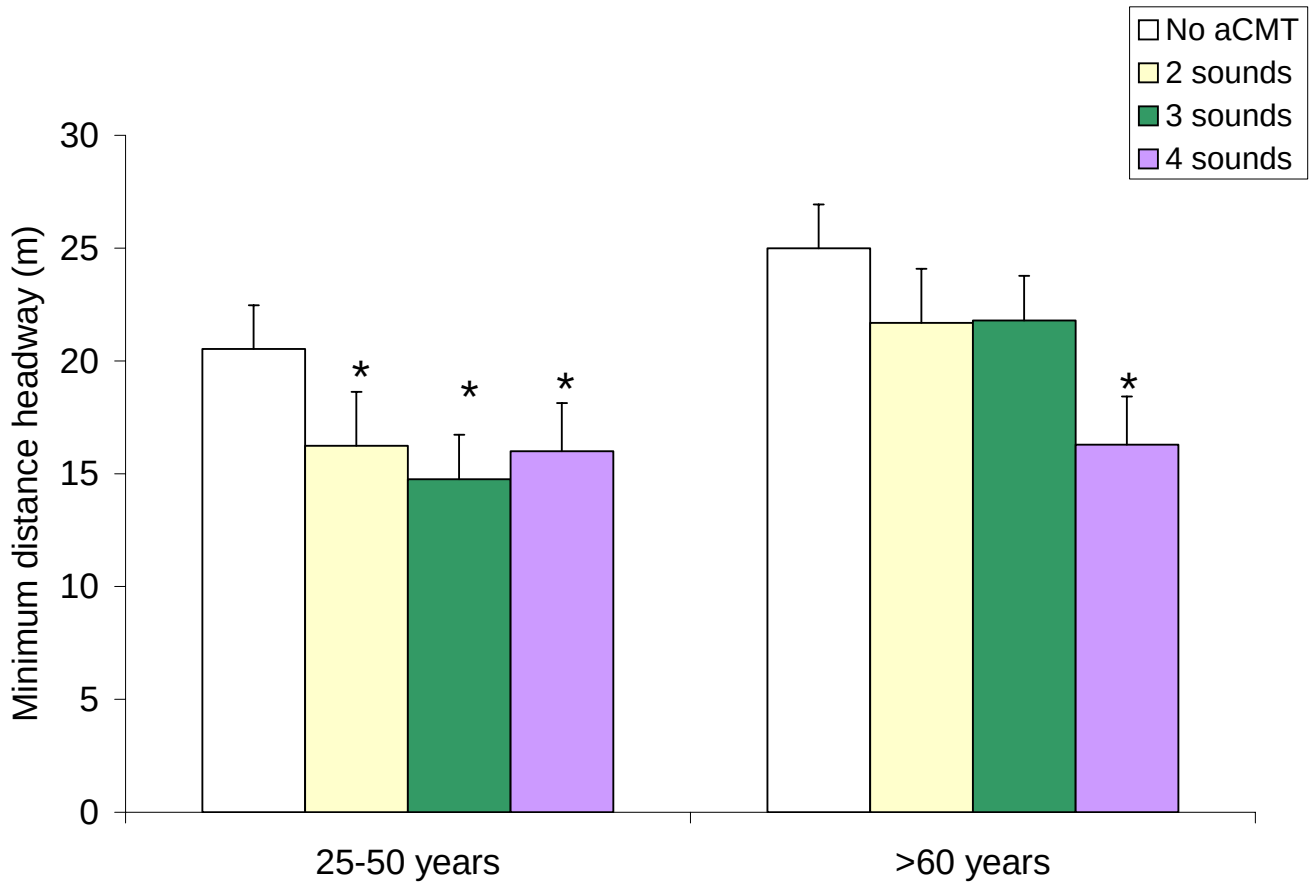

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Main findings: Helsinki trials

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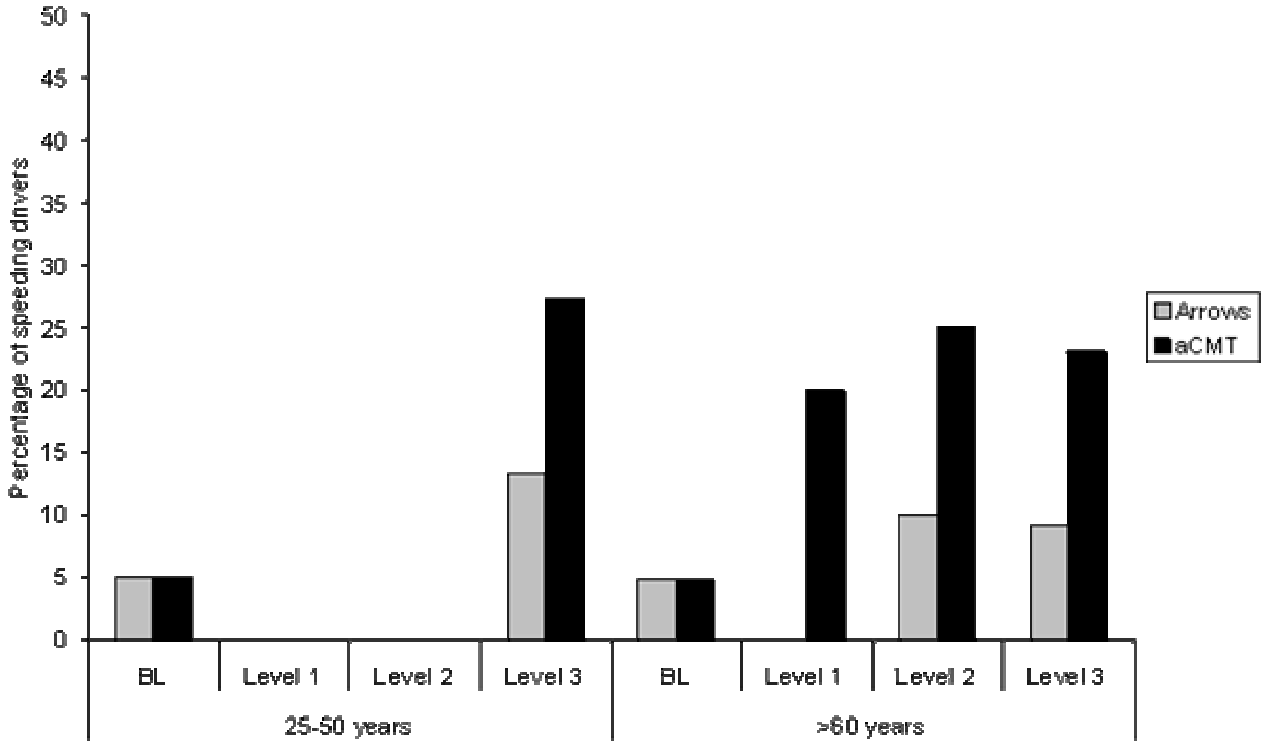
- Based mainly on observation data
- Tasks had to be simplified



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Helsinki trials cont…

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- 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

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- 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

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- Information systems with larger/less crowded screens
- Larger words/letters
- Use of auditory or audiovisual messages
- Less complicated navigation systems

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Smart "*back seat drivers*"

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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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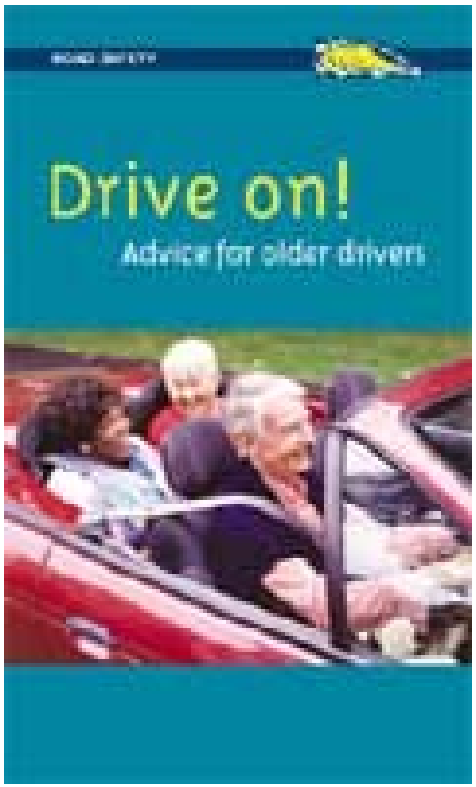

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