Cognitive and sensory factors associated with safe driving

Professor Kaarin Anstey

Dementia Collaborative Research Centre: Early Diagnosis and Prevention & Centre for Mental Health Research

Australian National University
Older Drivers

- Fastest growing segment of the driving population
- Driving is important for maintaining independence and well-being
- Driving cessation associated with:
  - Isolation & depression
  - Functional impairment
  - Transition into care
Driving in Later Life

- Older drivers speed less
- Older drivers less likely to drink and drive
- Distance adjusted crash rates are highest for youngest and older drivers
  - Exponential increase after age 75, especially for males
Age and Serious Accidents by Gender

Age Group

Serious Injury Crashes (per billion km)

Males

Females


0 50 100 150 200 250 300 350 400 450 500
Age-Related Changes

- **Visual function**
  - Visual impairment increases with age

- **Physical functioning**
  - Increased prevalence of systemic disease
  - Physical frailty, joint stiffness

- **Cognitive abilities**
  - Reaction time slowing
  - Difficulty with divided attention tasks, integrating information and planning
Critical errors by age – community sample QLD

Anstey & Wood, 2011, Neuropsychology
Factors Enabling Safe Driving Behaviour

Driving Behaviour

Self-monitoring and beliefs about driving capacity

Capacity to Drive Safely

Cognition

Vision

Physical Function

Anstey et al, 2005
Cognitive abilities required for safe driving

Visual Selective Attention
- how well a person can select and attend to relevant information

Processing speed
- how quickly a person can comprehend a situation and take in the relevant information

Visual search
- the ability to scan a scene for vital information
Working memory
The capacity to hold information in mind while processing it – the capacity to ‘dual task’

Reaction time
The time it takes to respond to a stimulus – can be measured in foot or hand

Executive function – the capacity to use all relevant information to plan a response, and plan ahead and use strategies – higher level thinking
Insight or self awareness

- This is a type of cognitive ability
- Affected by dementia
- May be the most important factor that affects driving risk
- No standard assessment
Screening vs Assessment

Driver Screening

• Brief test of factors/abilities related to safe driving
• Can be applied at population level
• Brief, often desk-based

Driver Assessment

• Test of actual driving abilities (on-road or simulated)
• Longer, and requires qualified assessor (often OTs)
Screening Measures

- **Methodological Considerations**
  - Validation
    - Tests must validly distinguish between those who are safe and unsafe
    - Sample must be representative of target population
- **Practical Considerations**
  - Duration (5-10 minutes)
  - Administration (easy to use and interpret)
  - Equipment (cost, space requirements)
  - Cultural & Linguistic factors
Current Screening Measures

- No difference in older driver accident & fatality rates between states with and without mandatory screening requirements (Langford, Bohensky, Koppel & Newstead, 2008)
- Burden of responsibility on medical practitioners, and on families, carers and drivers themselves
Emergent Screening Tools for Older Drivers

1. Useful Field of View (UFOV®)
2. Prevention of Older Persons’ Injuries (POPI) battery
3. ACT Hazard Perception Test
Useful Field of View®

- Developed by Karlene Ball and colleagues in USA in mid-1980s
- Originally, ‘the visual area in which information can be acquired’ (Ball, Beard, Roenker, Miller, & Griggs, 1988)
- One of the best lab-based predictors of older drivers’ accidents and on-road performance
- Recent focus on training & intervention
Useful Field of View®

Trial Sequence

i

ii

iii

iv

Did you see a car or a truck?

Indicate your answer by clicking on the corresponding picture

1 2
3 4
5 6
7 8

Useful Field of View®
Useful Field of View®

Which object was inside the white box?
Useful Field of View®

On which spoke was the outside object located?

Indicate your answer by pressing the button which corresponds to the direction of the target.
Useful Field of View®
POPI Battery

- Prospective Cohort Study conducted at QUT and POWMRI
- 270 drivers aged 70-88 recruited through electoral role
- Completed large battery of cognitive, physical and sensory tests, as well as UFOV®
- Validated using standardised test of on-road driving performance
POPI Measures

- Dot Motion Perception Test
POPI Measures

- Colour Choice Reaction Time (CARS)

There are four different responses for the four squares:

- Press the **left green button** if the car is in the **top left**.
- Press the **right green button** if the car is in the **top right**.
- Press the **left foot pedal** if the car is in the **bottom left**.
- Press the **right foot pedal** if the car is in the **bottom right**.
POPI Measures

- Proprioception
POPI Measures

- Sway on floor and foam
POPI Measures

- Visual Fields
POPI Battery

- Final battery included 4 measures:
  - Colour Choice Reaction Time
  - Postural Sway
  - Dot Motion Sensitivity
  - Self-reported Driving Exposure

- ROC Analysis for validation
  - Sensitivity = 91%
  - Specificity = 70%

- Better predictors than UFOV®

- Further validation planned

(Wood, Anstey, Kerr, Lacherez & Lord, 2008)
ACT Older Driver Hazard Perception Study

- Hazard perception is a critical ability for safe driving
- Easily assessed using video-based screening measures
- Most older adults have good hazard perception skills, but it may be related to unsafe driving for some.
- Hazard perception tests are part of young driver licensing procedures, but nothing for older drivers
Hazard Perception Test

- Participants respond to videos of naturally occurring traffic hazards by touching the hazard on a large touchscreen monitor.
Conclusion

- Dementia related changes in cognition, vision and general motor control will affect the capacity to drive safely
- Need for better screening, assessment
- Need for planning for driving cessation
Acknowledgements

- Dr Anstey is supported by an NHMRC Research Fellowship
- POPI study funded by the NHMRC
- Hazard Perception Study funded by ARC and NRMA-ACT Road Safety Trust
- Thankyou to all the participants