Situation awareness in simulation as a surrogate measure of road safety of older drivers

Dr Bridie Scott-Parker, Senior Research Fellow
Older driver road safety

- Ageing-related factors
  - Normal declines and deficits
    - Slower reaction times?
    - Increased frailty
  - Abnormal declines and deficits
    - Disease (e.g., dementia)
    - Disability (e.g., brain injury)

Fatality rate: traffic fatalities per billion kilometres travelled by age, Netherlands (2001-2005). Source: SWOV/Transport Research Centre, CBS.

Injury rate: non-fatal traffic injuries per billion kilometres travelled, by age, Netherlands (2001-2005). Source: SWOV/Transport Research Centre, CBS.
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Ageing population......

Populations are getting older

Percentage aged 60 years or older:
- 30% or more
- 10 to <30%
- <10%

2015

http://www.who.int/ageing/events/world-report-2015-launch/populations-are-getting-older-full.gif
Ageing population……

- **HUGE** interest in road safety skills
  - 80% of older driver crashes involve death of vehicle occupant (vs 66%)
  - Queensland, Australia 2015, drivers >74 years
    - 5.5% of licensed population
    - 14.4% of fatalities
    - Involved in 12.8% of road crash fatalities
Ageing population……

• How do we manage road risks?
  – Mandatory testing (e.g., in Australia)
    • New South Wales: Annual medical testing from age 75
    • Queensland: Medical certificate from 75 years
  – Nominated/voluntary testing
    • On-road driving assessment
  – Self-regulation
    • High-risk exposure (e.g., driving at night, driving in rain)
  – Mandatory removal of driving privileges
Ageing population......

• Situation awareness skills (SAS) are critical for safe road use
Situation awareness

• What is it?

*Knowing what is going on around you*

1. Perception
2. Comprehension
3. Projection
Situation awareness

• What is it?

Knowing what is going on around you
1. Perception
2. Comprehension
3. Projection

• Situation awareness skills are directly related to road safety
Situation Awareness Skills
Older driver road safety

• Situation awareness skills?
  – Related to driving exposure
    • Time spent driving
    • Distance driven
    • Driving contexts
    • Personal circumstances
  – But what about ageing-related factors…..
Older driver road safety

• Ageing-related factors
  – Normal declines and deficits
    • Slower reaction times
    • Increased frailty
Older driver road safety

• Ageing-related factors
  – Normal declines and deficits
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  – Abnormal declines and deficits
    • Disease (e.g., dementia)
    • Disability (e.g., brain injury)
Study aim

• Explore situation awareness skills of older drivers
• Compare their SAS to the SAS of middle-aged drivers
Middle-aged driver road safety

http://ec.europa.eu/transport/wcm/road_safety/erso/knowledge/Content/07_old/high_fatality_rate_more_crashes_or_more_severe_injuries_.htm
Measuring situation awareness skills: *Immerse* cave simulator
Method

- Verbal commentary
  - Transcribed verbatim
  - Cleaned
  - 12 drivers aged 75-84 years (7 males)
  - 12 drivers aged 43-62 years (7 males)
- Day-time driving clip
- 76.7 second clip (merging, motorway, highway)
- Situation awareness skills coding taxonomy
  - 2 independent coders
  - 1 tie-breaker
Data coding

- SAS coding taxonomy (Endsley, 1995)
  - Perception
    - Green signs; 100 k zone
  - Perception/comprehension
    - Big sign about entering the motorway
  - Perception/comprehension/projection
    - We can turn at any time but we need to take care that nothing’s coming up on my right
**Results: Left turn (%)**

- **Older female**
  - Perception/Comprehension/Projection
  - Perception/Comprehension
  - Perception

- **Older male**
  - Perception/Comprehension/Projection
  - Perception/Comprehension
  - Perception

- **Middle-age female**
  - Perception/Comprehension/Projection
  - Perception/Comprehension
  - Perception

- **Middle-age male**
  - Perception/Comprehension/Projection
  - Perception/Comprehension
  - Perception

The bar chart above illustrates the percentage of perception, comprehension, and projection for left turns among different age and gender groups.
Results: Motorway ramp (%)
Results: Motorway merge (%)

- Older female
  - Perception/Comprehension/Projection
  - Perception/Comprehension
  - Perception
- Older male
  - Perception/Comprehension/Projection
  - Perception/Comprehension
  - Perception
- Middle-age female
  - Perception/Comprehension/Projection
  - Perception/Comprehension
  - Perception
- Middle-age male
  - Perception/Comprehension/Projection
  - Perception/Comprehension
  - Perception
Results: Highway merge (%)

Perception/Comprehension/Projection
Perception/Comprehension
Perception

Older female

Older male

Middle-age female

Middle-age male

0 10 20 30 40 50 60
But is it that simple?

• **Results**: Older female drivers have the greatest situation awareness skills
  – Does this match the age-related crash statistics?
• In-depth investigation of commentary
  – Considerable differences in SAS
• Middle aged males ONLY participant group to mention
  – Checking adjacent lane
  – Keeping a safe distance
  – Looking for a gap in traffic
  – Increasing safe following distance as increase speed during merge
But is it that simple…

- SAS for males of both age groups differ considerably to females
  - Males make a greater number of observations
- SAS for females of both age groups differ considerably to males
  - Females used more general language across P/PC/PCP (not as detailed as male commentary)
    - *Okay, I’ve merged, same speed as the rest of the traffic*
Musings……

• Simulator
  – Provided safe and comfortable environment to explore road behavior
  – Use real-world footage capture by GoPro
  – Less anxiety for participants

• Need to balance mobility and safety
  – Social justice?
  – Mental health
  – Active longevity
Musings……

• Assessing on-road road safety risk isn’t straightforward
  – Does higher proportions of PCP (eg., older females on the motorway ramp) mask deficits in PCP (eg., less detailed/complete commentary in all categories)
  • Older females typically passengers of older males
    – No need to develop PCP?
      » attention, etc….
  – Fewer words uttered by females – does this mean SAS deficits?
Musings……

- Does the simulated drive approximate the real world drive (greater cognitive load etc)
  - SAS in simulator related to real-world risks?
- Identification of objects/risk (perception) is a precursor to comprehension, which is a precursor to projection
  - Do we need PCP all the time?
  - Are there occasions when P, or PC, is sufficient?
  - How does P scaffold PC, and how does PC scaffold PCP?
- Can we build PC and PCP in older drivers?
  - SAFER-Senior (Situation Awareness Fast tracking including identifying Escape Routes, for senior drivers)
Questions?

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