George Yannis, Panagiotis Papantoniou, Eleonora Papadimitriou, Sophia Vardaki, Dimosthenis Pavlou

National Technical University of Athens, Department of Transportation Planning and Engineering, Athens, Greece
Objective and structure

Objective

To provide a comprehensive review of the methodological issues concerning the assessment of driving behaviour in the elderly

Structure

- Introduction
- Older driver behaviour and safety characteristics
- Driving Behaviour Experiments
- Analysis Challenges
- Conclusions
Introduction

• Although older drivers are involved in a few accidents in terms of absolute numbers, they represent one of the highest risk categories.

• Demographic growth, increased licensing rates and increase car use lead to an increase in the number of older drivers.

• In 2013, over 6,400 elderly people died in road traffic accidents in 24 European countries.

• The number of elderly people is expected to almost double by 2050 in OECD countries.
Older driver behaviour characteristics

Older drivers have a relatively high fatality rate due to:

- functional limitations
- physical vulnerability
- low annual mileage

Particular Older Driver Behaviour characteristics

- driving habits
- social behaviour
- risk compensation
- changing behaviour over time
Cognitive functions related to safe driving

- Driving – sufficient cognitive, visual and motor skills
- **Cognitive functions** related to driving may be categorized into the following six neuropsychological domains (Reger et al. 2004):
  - mental status–general cognition
  - attention–concentration
  - executive functions
  - language–verbal functioning
  - visuospatial skills
  - memory
Cognitive functions critical for safe driving

- **Attention**
  - quick perception of the environment

- **Executive functions**
  - process multiple simultaneous environmental cues
  - rapid, accurate and safe decisions

- **Visuospatial skills**
  - position the car accurately on the road
  - manoeuvre the vehicle correctly
  - judging distances and predicting the development of traffic situations

- **Memory**
  - journey planning
  - adapting behaviour

Panagiotis Papantoniou, National Technical University of Athens, Greece, ppapant@central.ntua.gr
Driving Behaviour Experiments

- Driving Simulator Experiments
- Naturalistic Driving Experiments
- On road experiments
- In Depth Accident Investigations
- Surveys on Opinion and Stated Behaviour
Driving simulator experiments

Examination of a range of driving performance measures in a controlled, relatively realistic and safe driving environment

Advantages
• Collection of data which would be very difficult to collect under real traffic conditions
• Exploration of any possible driving scenario
• Driving conditions are identical for all drivers

Disadvantages
• Non totally realistic simulated road environment
• Possibility of adopting a different driving behaviour
• Feeling of safety
• Simulator sickness
Naturalistic driving experiments

A research method for the observation of everyday driving behaviour of road users

**Advantages**

- Large degree of control over the variables that affect driving behaviour
- Researchers study issues that cannot be investigated in a lab
- Help support the external validity of research

**Disadvantages**

- Difficult to determine the exact cause of a behaviour
- The experimenter cannot control outside factors
- Traffic incidents are very rare
On-road experiments

Studies using instrumented test vehicles to gain greater insights into the factors that contribute to road user accident risk and the associated crash factors at specific conditions.

Advantages
- Large degree of control over the variables that affect driving behaviour
- Study of actual observed behaviour

Disadvantages
- Data not collected over a longer time period and in response to selected interventions
In depth accident investigation

In-depth accident data describe the causes of accidents and injuries and aim to reveal detailed and factual information from an independent perspective on what happens in an accident.

Advantages

- Describe the accident process and determine appropriate countermeasures
- Provide a major contribution to the development of new safety policies

Disadvantages

- Insufficient reconstruction evidence
Surveys on opinion and stated behaviour

In stated behaviour surveys, a reference questionnaire is built, based on a list of selected topics and a representative sample of population is interviewed.

Advantages
- Survey design may control for external factors
- Allow to investigate new situations, outside the current set of experiences

Disadvantages
- Often hypothetical nature of questions
- Actual behaviour is not observed
- Over- or under-representation of actual behaviour
Driving performance measures

- Lateral Control Measures
- Longitudinal Control Measures
- Reaction Time Measures
- Eye movement measures
- Workload measures
- Safety measures
Methodological challenges

Reliability
- Increased variability - Older people may perform very well on one occasion and much worse on another
- Aged related health conditions change from day to day

Validity
- Differential exposure
- Difficulties in distinguishing the effects of normal age-related changes from those from age-related disorders
- Older adults may take one or more prescription drugs which may impair driving
Conclusions

• Every experiment type has benefits and deficiencies. Combination and meta-analysis of experiments results may bring more reliable conclusions.

• Sample size should correspond to the number of variables to analyse.

• Internal structure of experiments has a direct impact to the results reliability.

• Valid data analysis requires multi-annual effort to address the high complexity.
ASSESSING DRIVING BEHAVIOUR IN THE ELDERLY: METHODOLOGICAL ISSUES

George Yannis, Panagiotis Papantoniou, Eleonora Papadimitriou
Sophia Vardaki, Dimosthenis Pavlou

National Technical University of Athens, Department of Transportation Planning and Engineering, Athens, Greece