

# Do drivers prioritise primary driving tasks over secondary tasks within driving simulators?

## A comparison of simulators of varying fidelity

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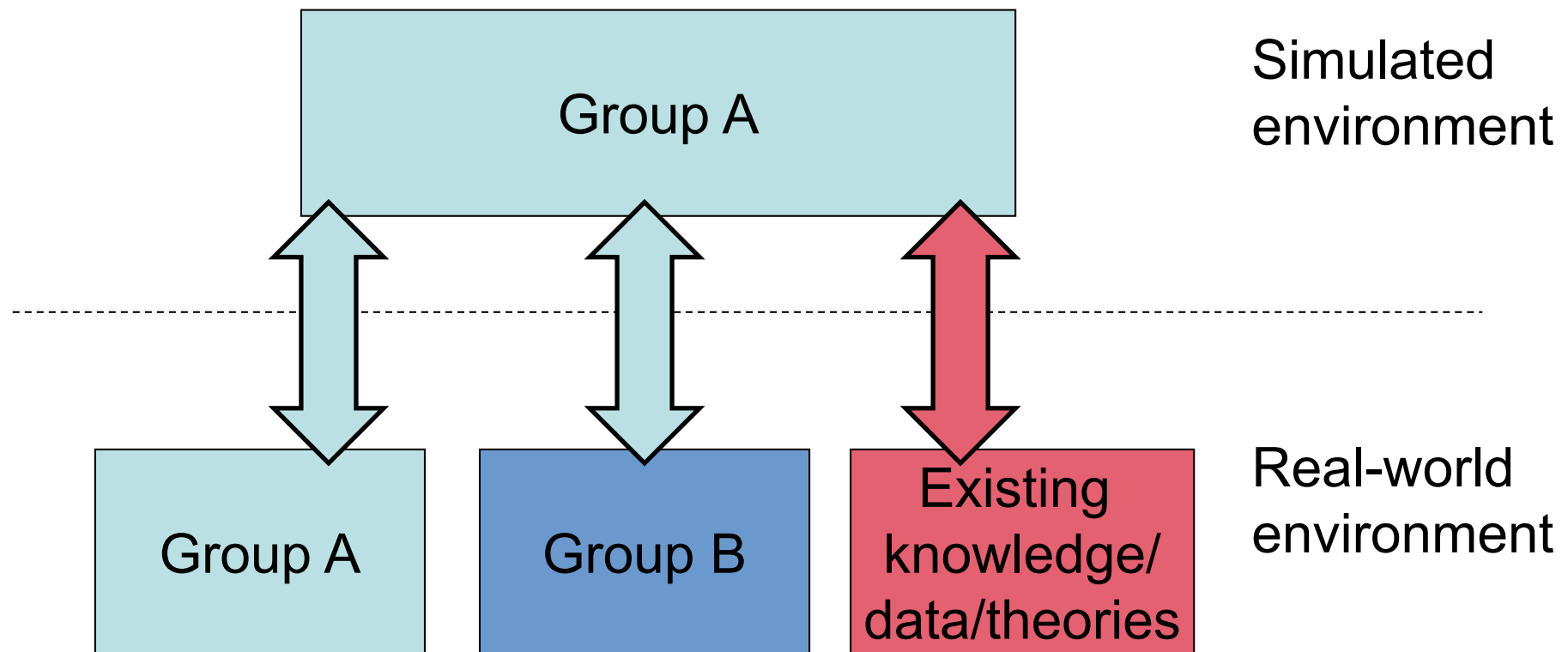


# Driver Distraction research with simulators

- Advantages:
  - ◆ Safe environment for research
  - ◆ Controlled environment for research
  - ◆ Ease of measurement
  - ◆ Cost-effective
- Disadvantages:
  - ◆ Potential for 'Simulator sickness'
  - ◆ Validity concerns (absolute and relative)....



# How do you measure the validity of a simulator for research?

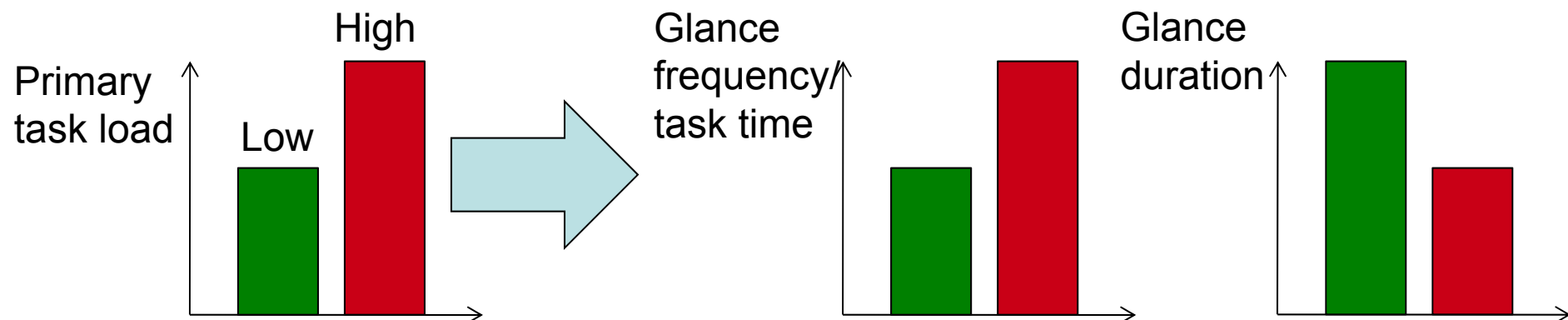


# Aims of research

1. To compare driver behaviour in a simulator with well-established on-road behaviours:
    - ◆ Need to identify suitable *behavioural indicators* from theoretical/empirical literature
  2. To develop simple, standard scenarios for use within a simulator study:
    - ◆ Enable comparison of results across/within studies
- 
- **Current study – Research question:**
    - ◆ Do drivers within simulators *of varying fidelities* exhibit the time-sharing strategies predicted by theoretical and empirical research?

# Choice of behavioural indicators for driver distraction research

- Key question for driver distraction research using simulators:
  - ◆ Are drivers *prioritising* primary/secondary tasks in a way consistent with their likely on-road behaviour?
- Previous research/theory (Rockwell, 1988; Antin et al., 1990; Lansdown, 1997; Burnett and Joyner, 1997; Wierwille, 1993):



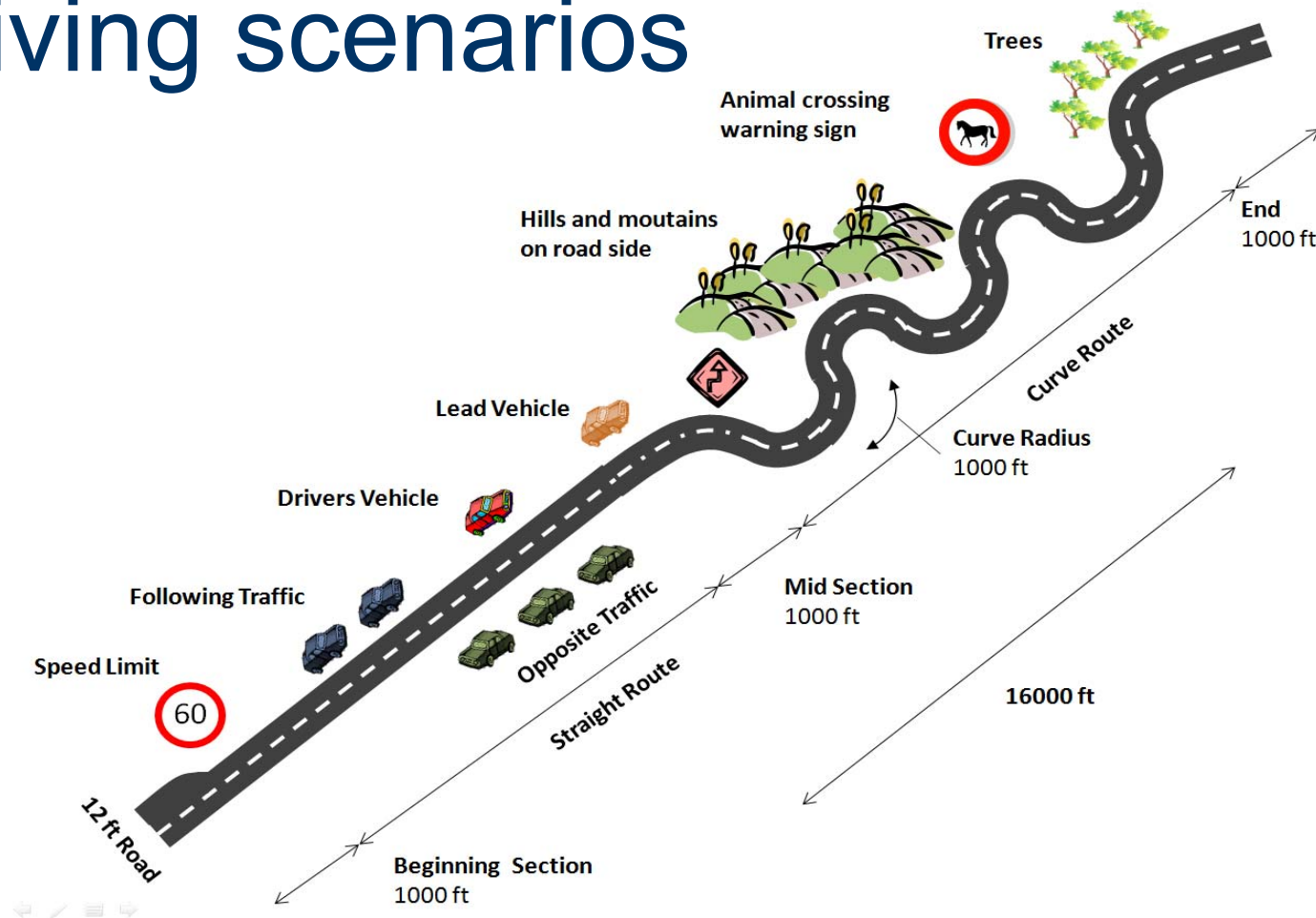
# Study method

- 24 participants
  - ◆ All experienced drivers
- All participants drove two short routes in two simulators
  - ◆ IV1 Primary task demand (High = curved road; Low = straight road)
  - ◆ IV2 Simulator fidelity (Medium; Low)
- Asked to follow a lead vehicle (50mph) at a safe distance
- Requested to carry out a simple visual/manual task at 8 specific points for each route





# Driving scenarios



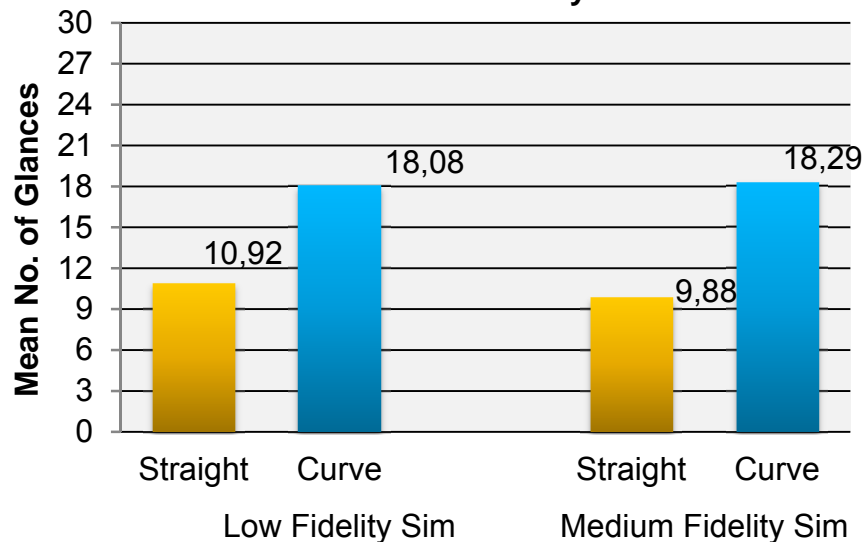
# Method - Measures

- Secondary task behaviour
  - ◆ Glance frequency
  - ◆ Glance duration
  - ◆ Secondary task time
  - ◆ Visual attention allocation (% of task time spent glancing towards display)
  - ◆ Success rate (%)
- Primary task performance
  - ◆ Speed
  - ◆ SD of speed
  - ◆ Number of lane exceedances
  - ◆ SD lane position



## Results – Secondary task behaviour (1)

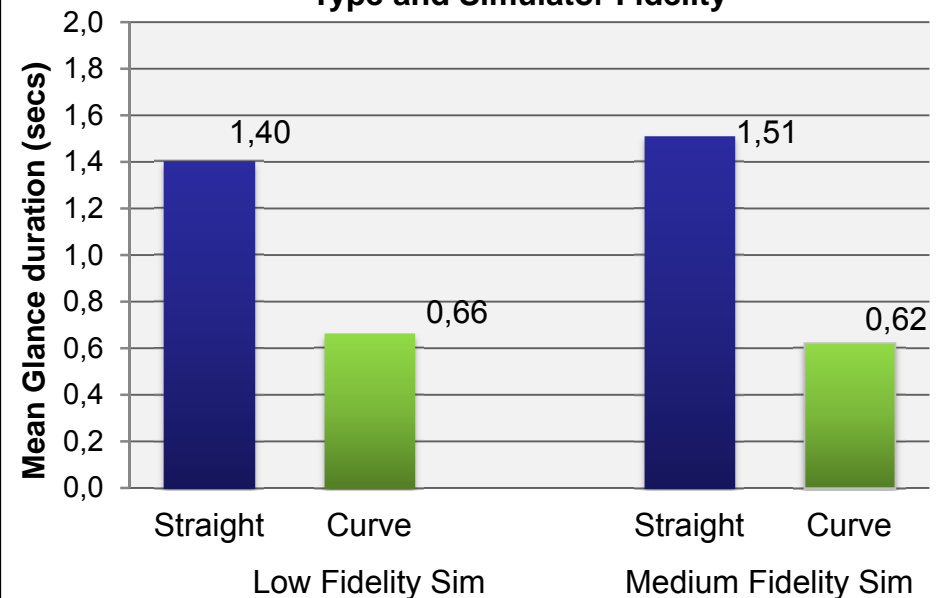
Mean No. of Glances grouped by Road Type and Simulator Fidelity



Glance  
frequency

Glance  
duration

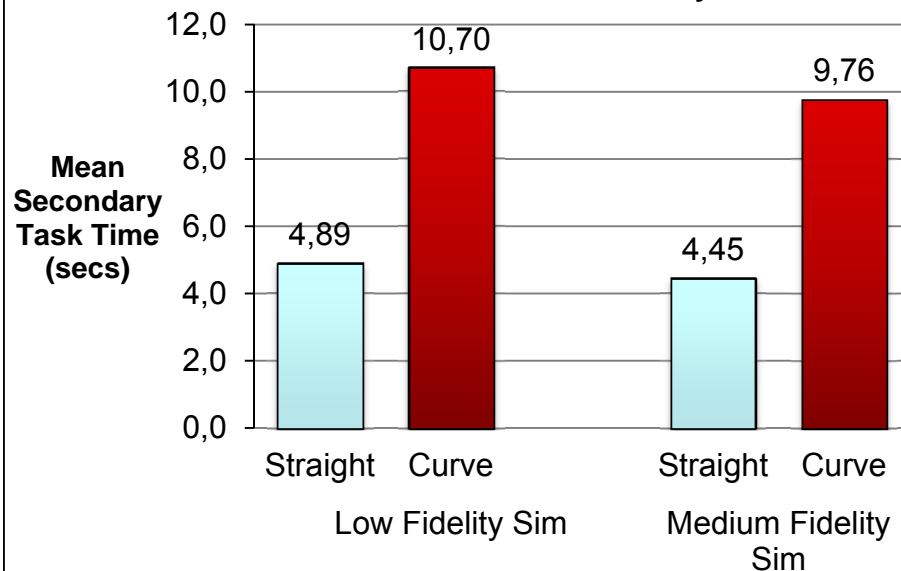
Mean Glance duration (secs) grouped by Road Type and Simulator Fidelity



## Results – Secondary task behaviour (2)

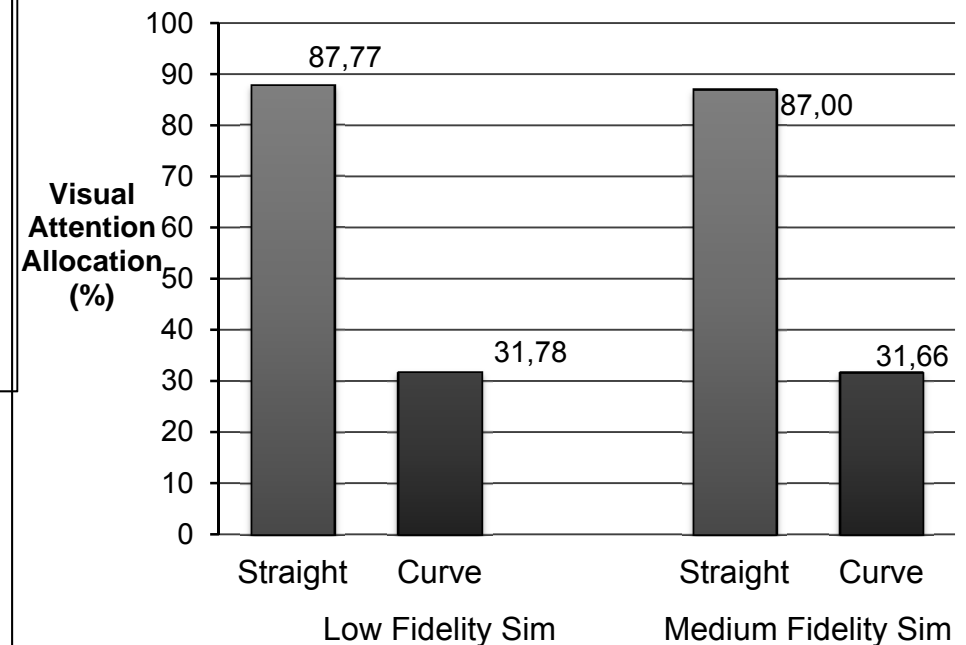
Visual  
attention  
allocation

Mean Secondary Task Times (sec) grouped by Simulator Fidelity

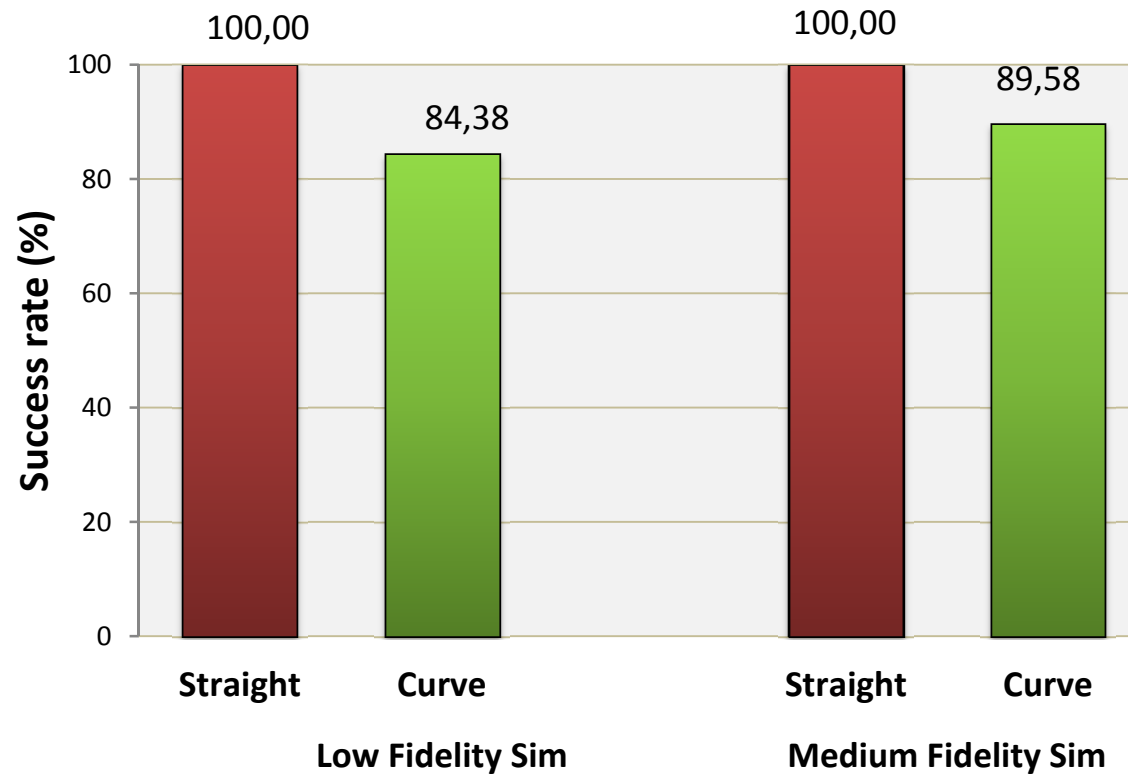


Secondary  
task time

Visual Attention Allocation grouped by Road Type and Simulator Fidelity

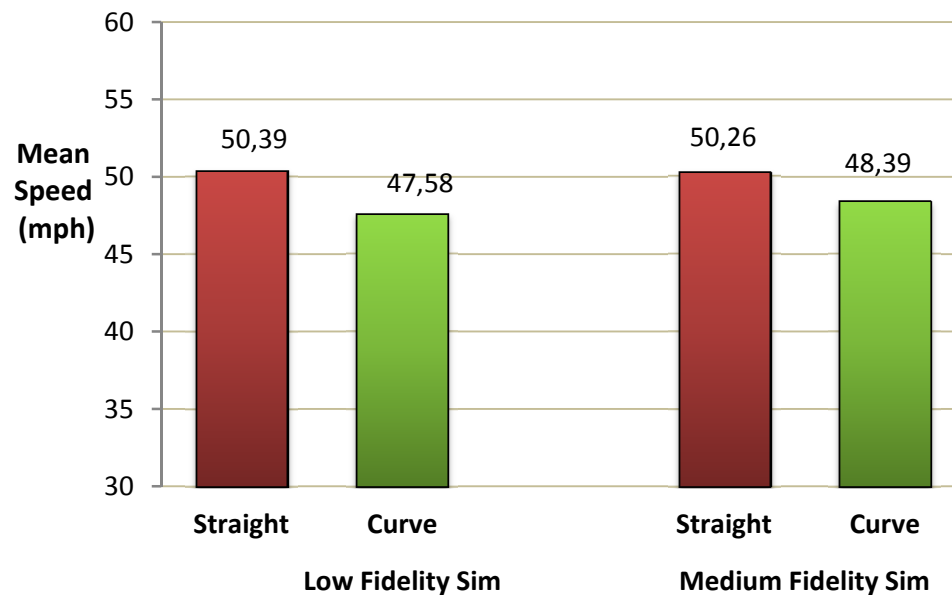


## Results – Success rate on Secondary Task



## Results – Primary task performance (1)

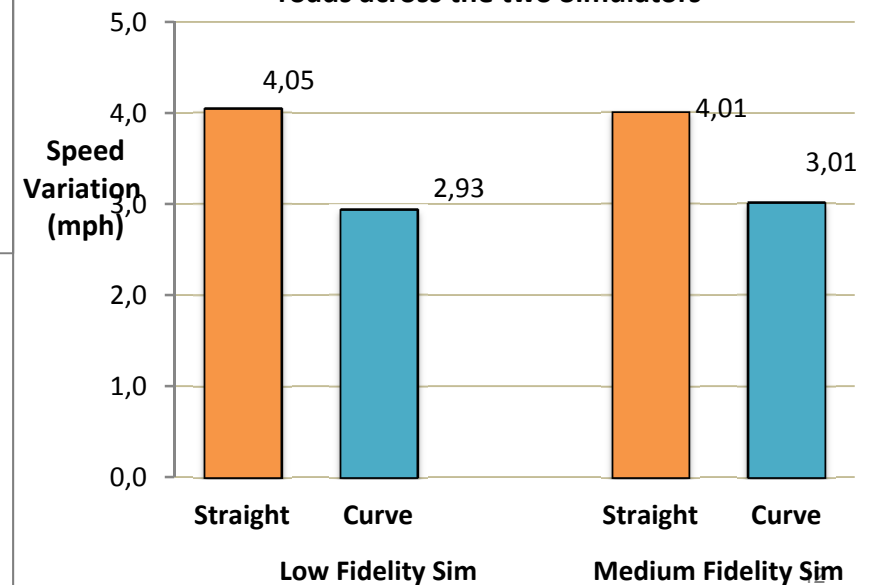
Mean speed grouped by Road Type and Simulator Fidelity



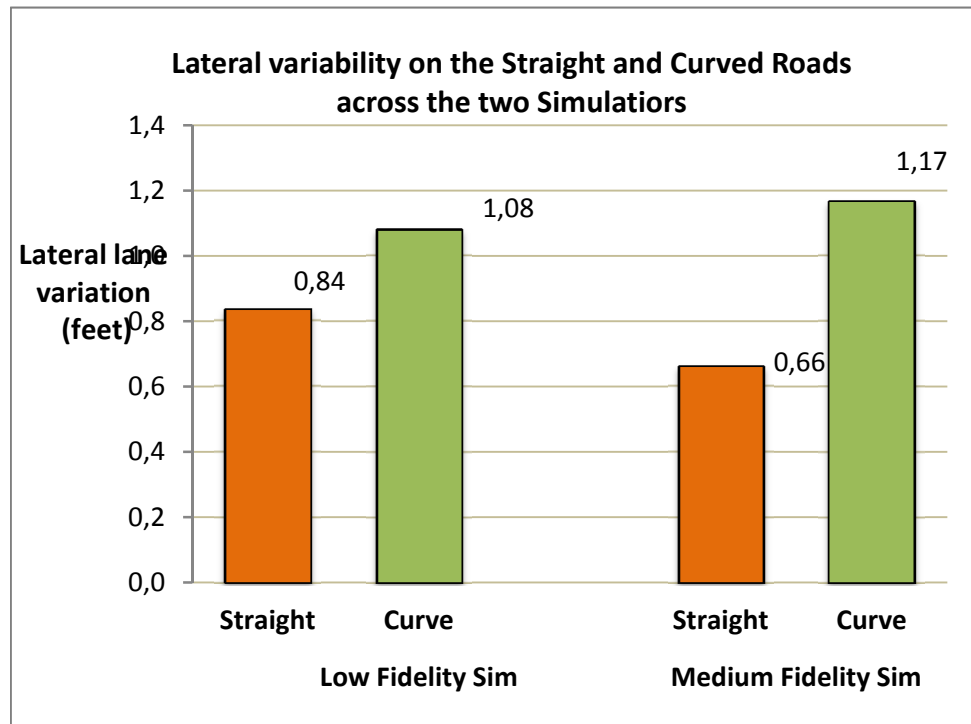
Mean speed

SD Speed

Speed Variations on both Straight and Curved roads across the two Simulators

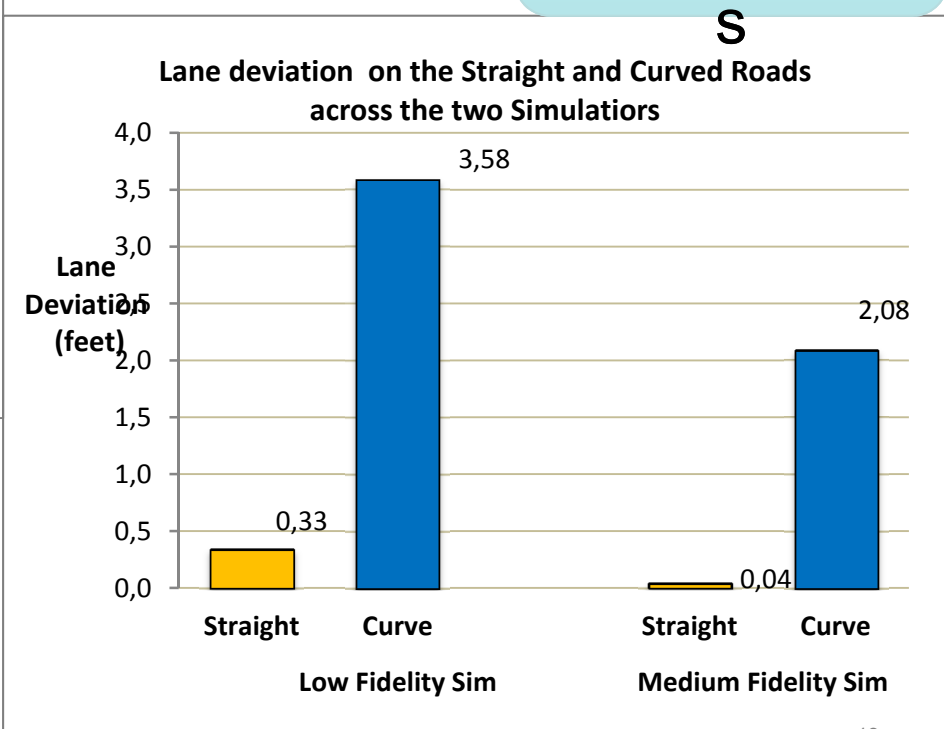


## Results – Primary task performance (2)



SD Lane  
position

No of lane  
exceedance



# Video clips – Straight vs curved road (low-fidelity and medium-fidelity simulator)



# Discussion points (1)

- Visual scanning behaviour in *both* simulators was consistent with previous on-road research and theory
  - ◆ Provides evidence that participants were prioritising primary/secondary tasks in an appropriate fashion
- Driving performance changed as a result of increased primary task demand
  - ◆ Reduced speed/speed variability – Positive adaptations
  - ◆ Increased lateral variability/lane exceedances – Negative adaptations

# Discussion points (2)

- Lane keeping performance consistently worse in low-fidelity simulator
- Why?
  - Physical fidelity (Use of small steering wheel; Reduced Field-of-view, etc.) OR....
  - Psychological fidelity?
- Does this difference in lane keeping performance matter?
  - Relative vs absolute validity

# Conclusions

- A short, simple driving scenario has been created as a potential additional component to driver distraction studies:
  - ◆ Aims to promote ‘appropriate’ changes in visual scanning behaviour
  - ◆ Allows:
    - Researchers to consider whether participants are prioritising primary/secondary tasks as they would in real-world?
    - Benchmarking/comparisons of simulators/results across/within studies
- Low-fidelity and medium-fidelity simulators seem equally suitable for use in driver distraction studies
  - ◆ ....Although if a study is focused on lane-keeping performance, a higher fidelity simulator may be more desirable

# Any questions?

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