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# Validating driving simulators for distraction research

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# Driver Distraction research with simulators

## ■ Advantages:

- ◆ Safe environment for research
- ◆ Controlled environment for research
- ◆ Ease of measurement
- ◆ Cost-effective

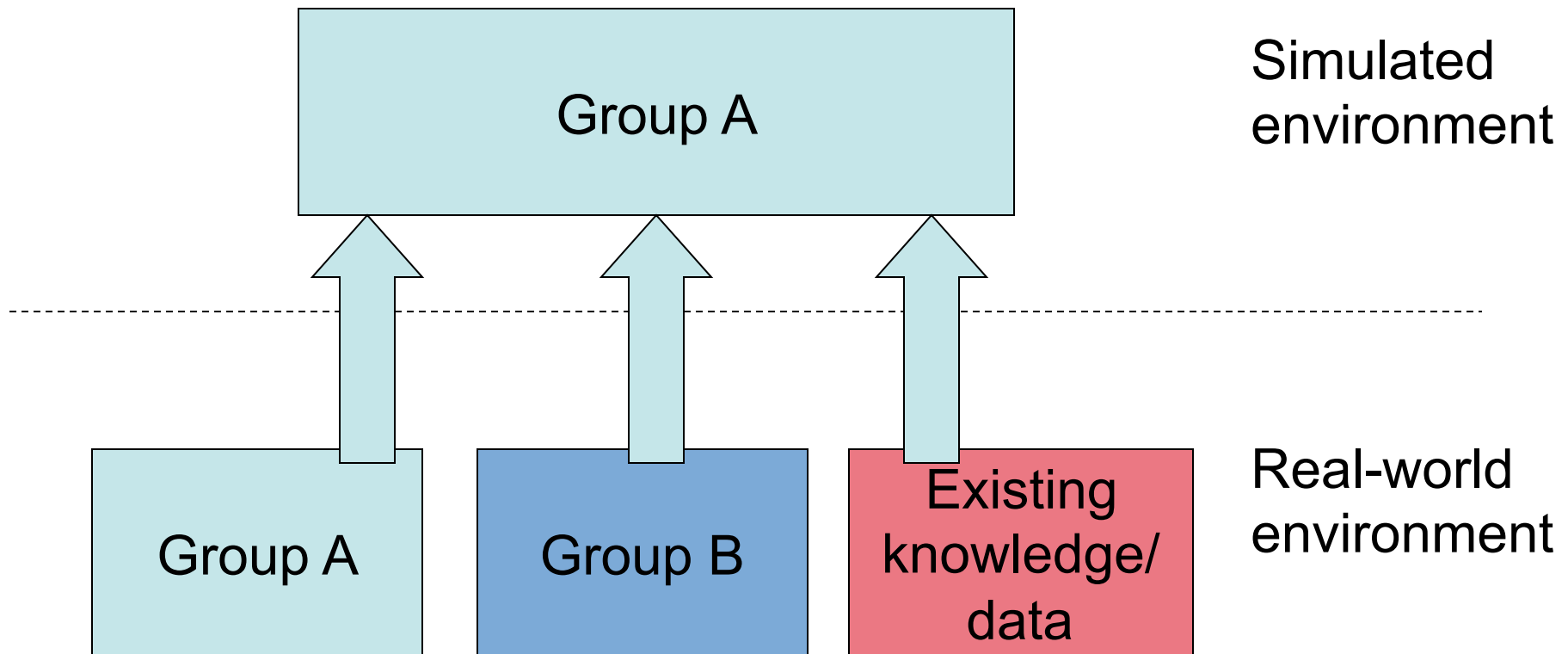
## ■ Disadvantages:

- ◆ Potential for 'Simulator sickness'
- ◆ Validity concerns (absolute and relative)....



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

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# Aims of research

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- Aiming to compare driver behaviour in simulator with *well-established* on-road behaviours:
  - ◆ Need to identify suitable *behavioural indicators* from literature
- Can we identify participants whose behaviour did not reflect truly their predicted on-road behaviour?
- First step towards developing simple, standard scenarios for use within a simulator study:
  - ◆ Compare validity of results across/within studies

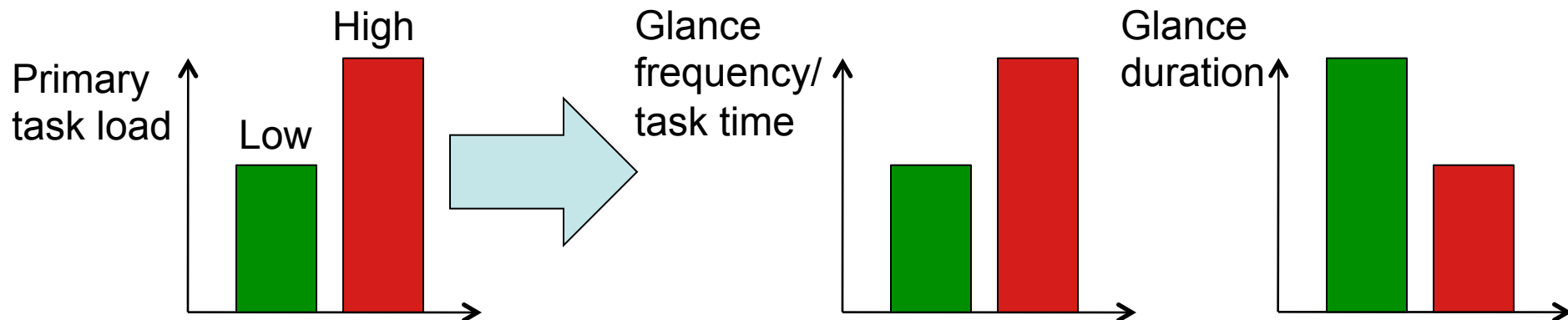
# Choice of behavioural indicators for driver distraction research

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## ■ Key question for driver distraction research using simulators:

- ◆ Are drivers *prioritising* primary/secondary tasks in a way consistent with their likely on-road behaviour?

## ■ Results of previous research (Rockwell, 1988; Antin et al., 1990; Lansdown, 1997; Burnett and Joyner, 1997; Wierwille, 1993):



# Study method

- 40 participants
  - ◆ All experienced drivers
- All participants drove two short concurrent routes in fixed-base simulator
  - ◆ High primary task demand (curved road)
  - ◆ Low primary task demand (straight road)
- Asked to follow a lead vehicle at safe distance
- Requested to carry out a simple visual/manual task at 8 specific points for each route







# Method - Measures

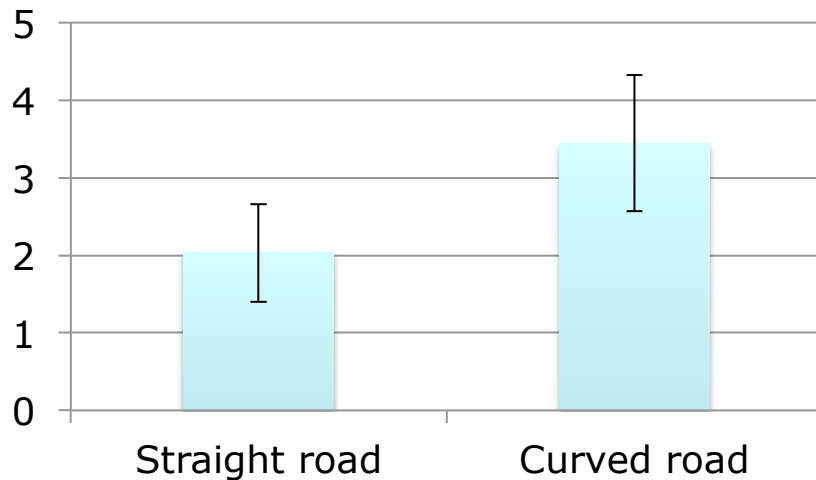
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- Primary driving performance
  - ◆ Number of lane exceedences
- Secondary task behaviour
  - ◆ Glance frequency
  - ◆ Glance duration
  - ◆ Task time
- Ratings of “presence” – subjective experience of “being there”
  - ◆ Lessister et al. (2001) questionnaire for three factors: spatial presence, engagement, and ecological validity (naturalness)

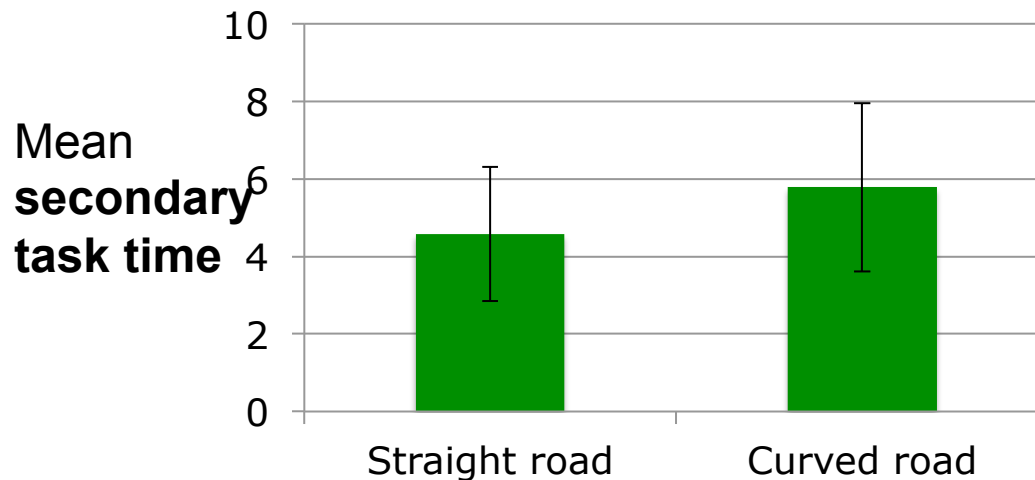
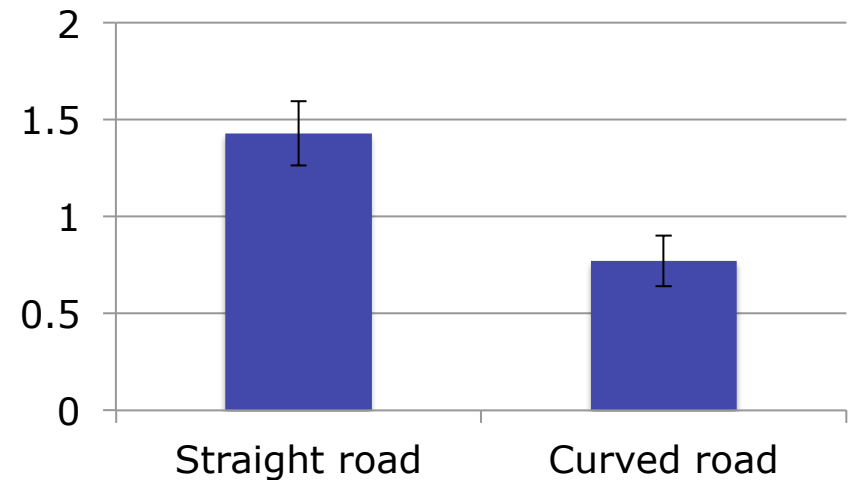


# Results – Overall secondary task behaviour

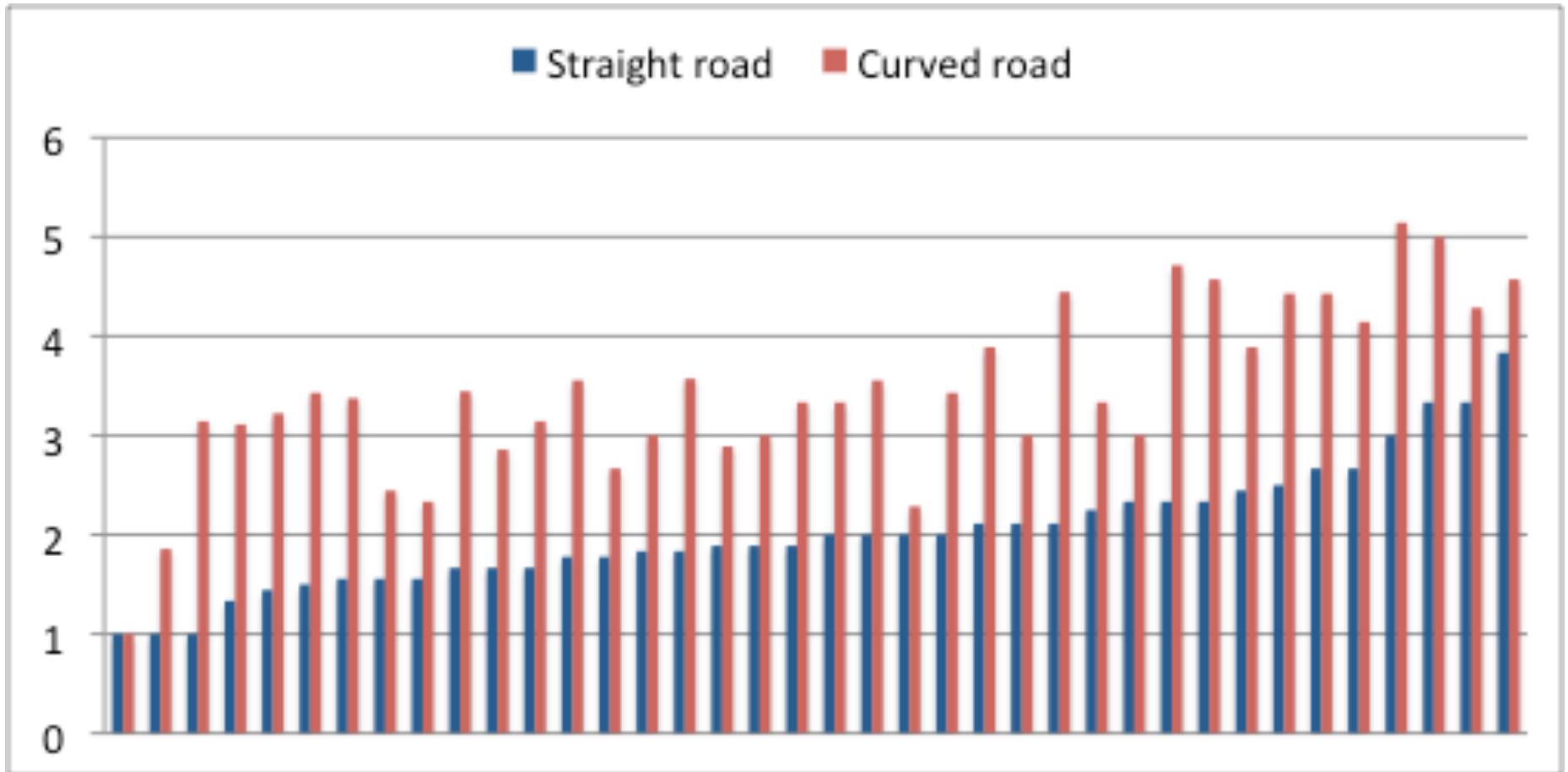
Mean **number of glances** made to secondary display/task



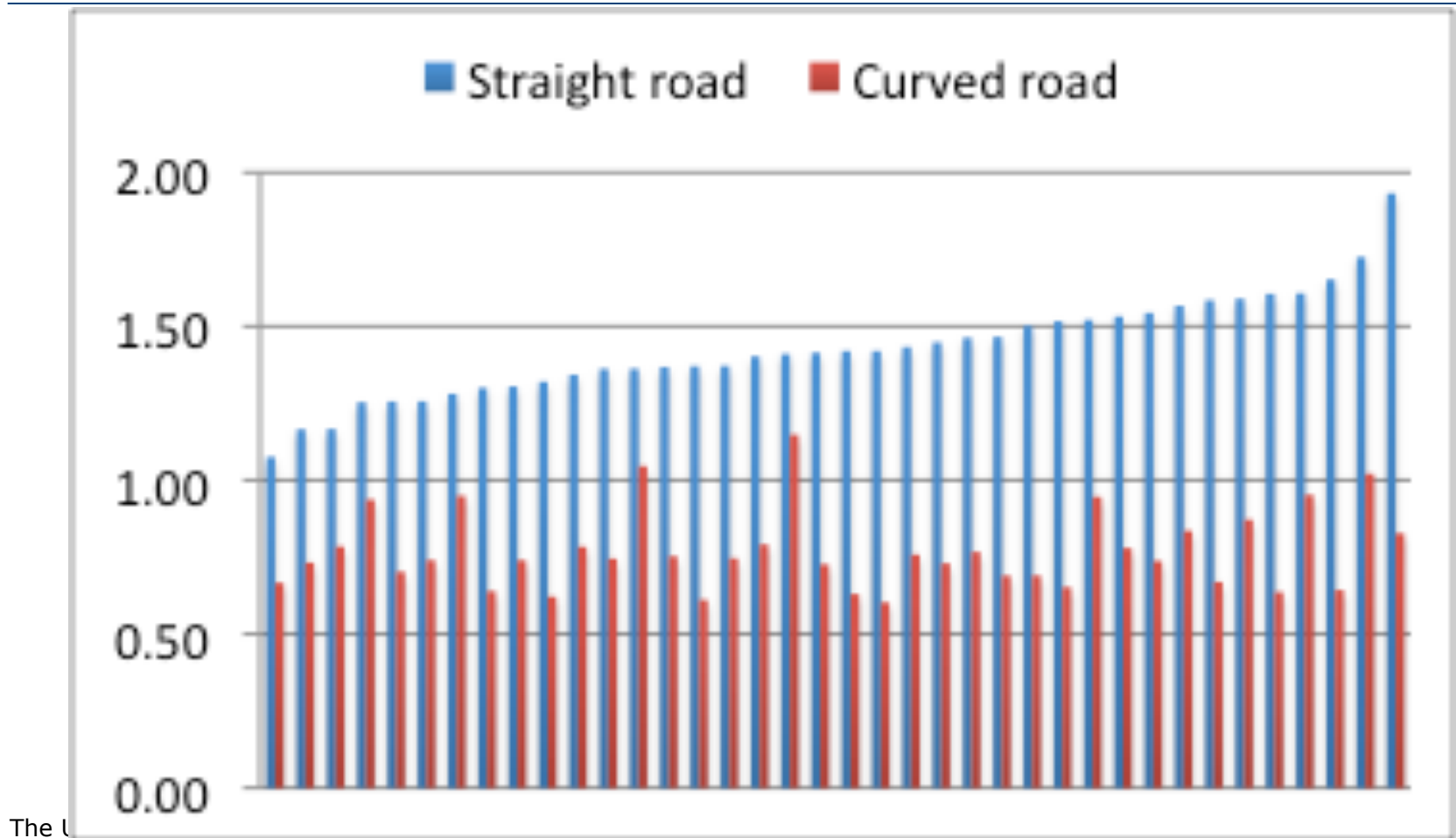
Mean **duration of glances** made to secondary display



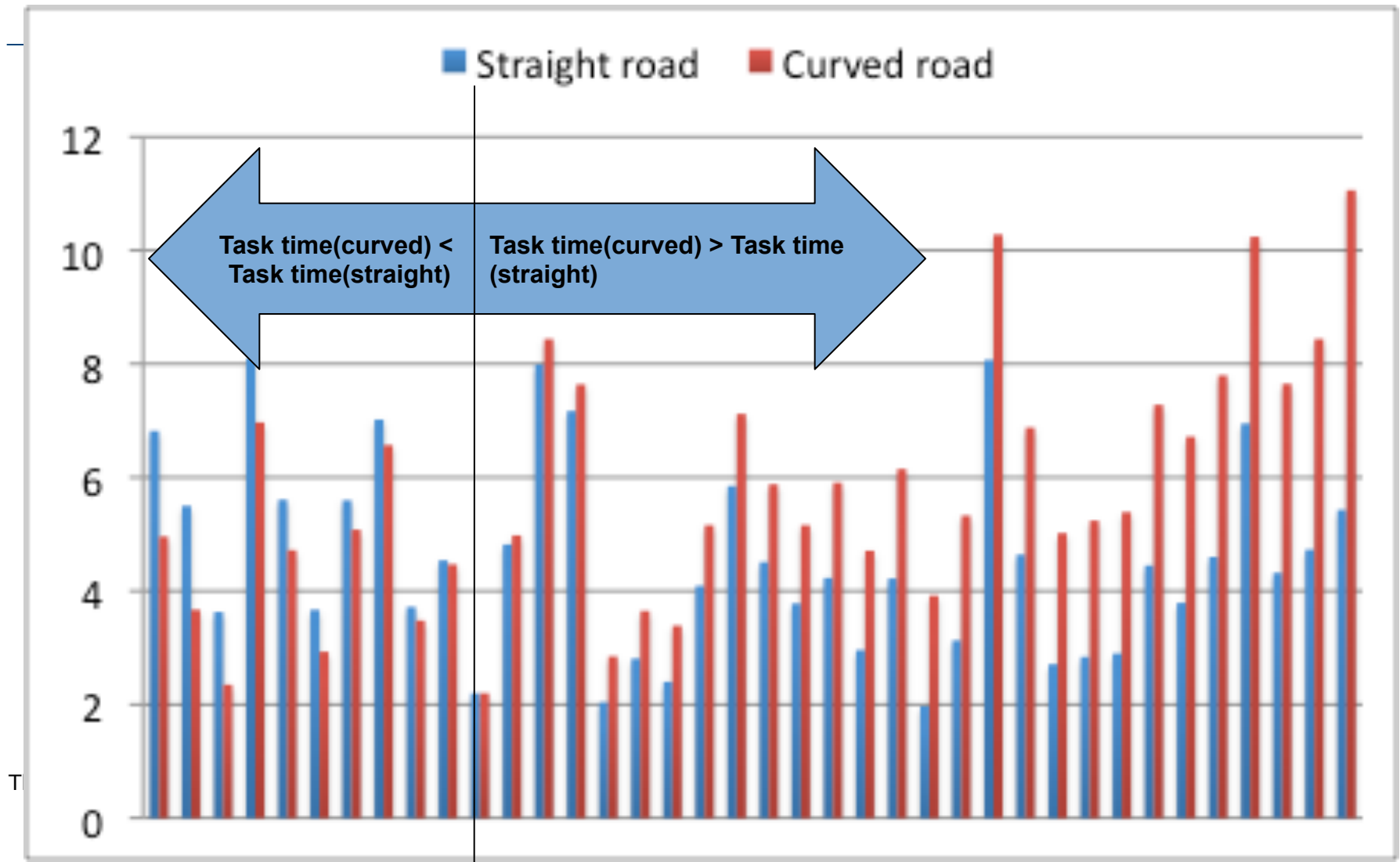
# Glance frequency – Individual data



# Glance duration – Individual data

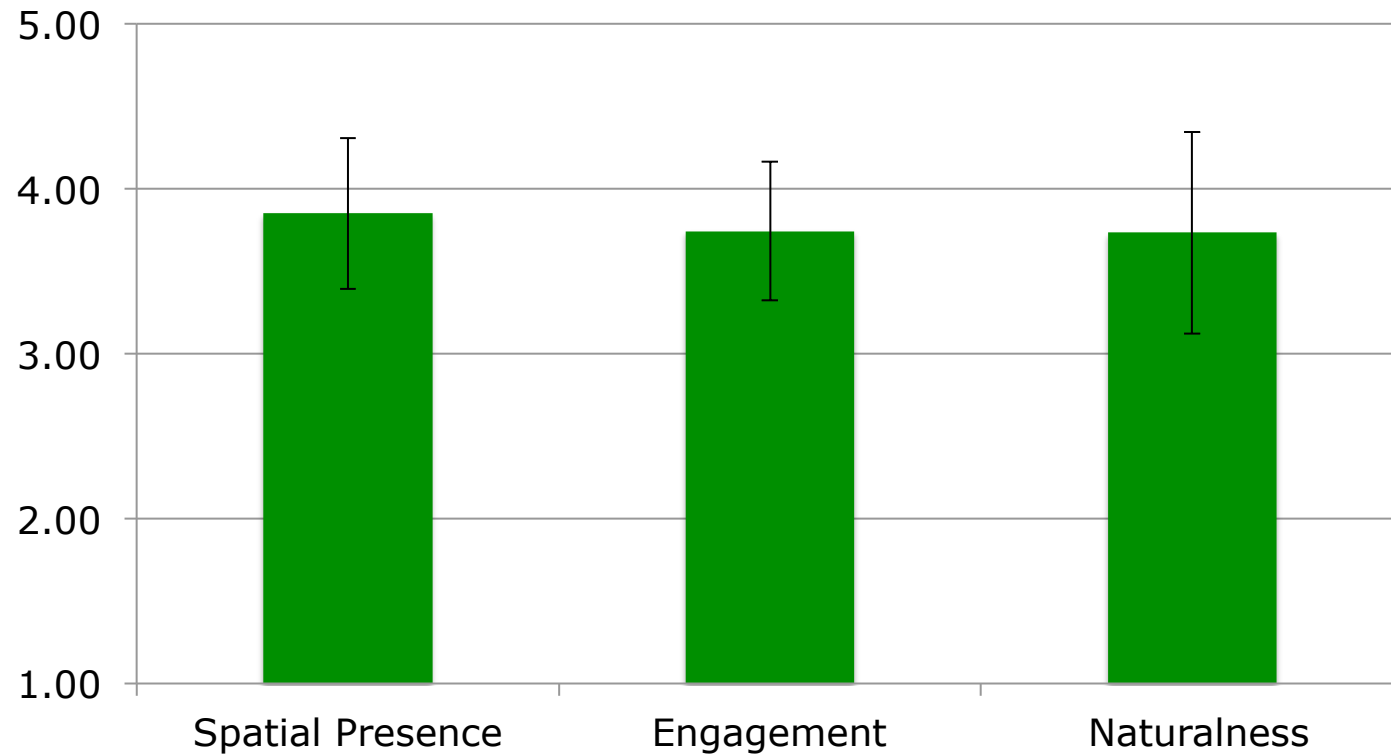


# Secondary task time – Individual data

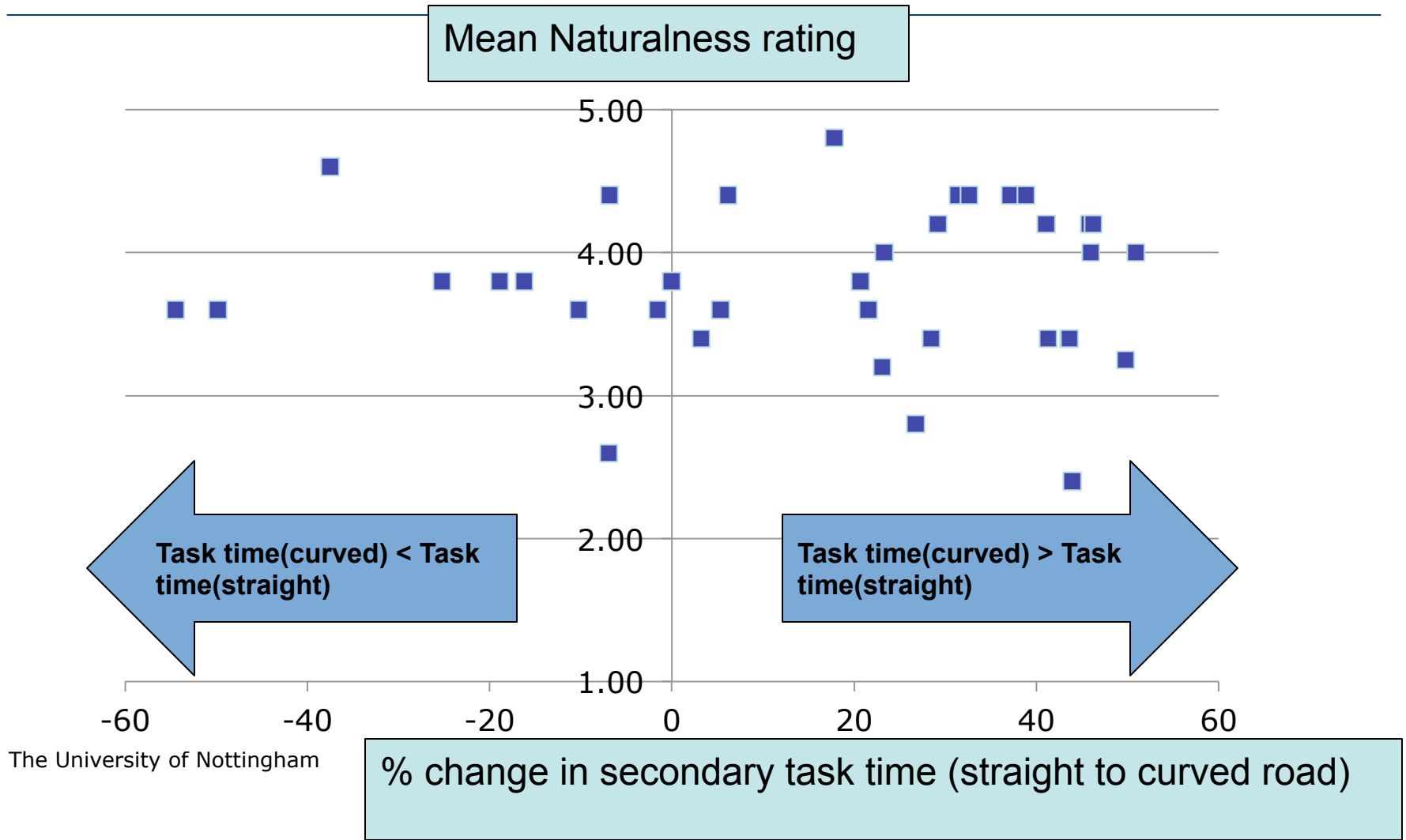


# Presence ratings - Overall

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# Example of poor correlation – Change in secondary task time vs Naturalness



# Discussion points

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- Visual scanning behaviour in simulator was consistent with previous on-road research and theory
  - ◆ Not just for group - for ALL participants
  - ◆ Provides evidence that participants were prioritising primary/secondary tasks in an appropriate fashion

BUT...

- Not all participants took longer to achieve secondary task with increased primary task demand
  - ◆ Is this behaviour actually universal? Need to conduct road trials?



# Discussion points (2)

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- Participants as a whole rated their presence to be high
- No relationship between presence ratings and extent to which participants adapted their behaviour in simulator (from straight to curved road)
  
- Evidence for ceiling effect?
  - ◆ Need for research considering different levels of fidelity for driving simulation studies
  - ◆ Need for questionnaire tailored to the driving task/simulator situation....

# Examples of questions currently being piloted for “Driving Simulator Validity Questionnaire”

	Strongly agree	Agree	Neither agree nor disagree	Disagree	Strongly disagree
I felt scared during hazardous situations...					
I was completely involved in driving the car..					
I had a strong sense of physically controlling the vehicle...					
I felt as if I had been on a journey...					
I was aware that other people were driving cars around me...					
I felt the need to obey the rules of the road...					
I remembered I was in a laboratory...					

# Conclusions

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- 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
  - ◆ Are participants prioritising primary/secondary tasks as they would in real-world?
  
- Future work:
  - ◆ Development of ‘Driving Simulator Validity Questionnaire’
  - ◆ Comparison of simulator data with on-road data
  - ◆ Consideration of different levels of fidelity for simulators

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Thanks for your attention!