Complex interactions in a badly designed world: investigating the underlying causes of collisions between distinct road users

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Background

- Collisions between different road users form a major component of the road toll

- Majority of all crashes occur at intersections (McClean et al, 2010)

- Situation awareness a key factor in collisions between different road users (e.g. looked-but-failed-to-see collisions)

- Compatibility between different forms of road user major road safety issue (Elvik, 2010)
The perceptual cycle and compatible situation awareness

ARC Discovery Project

• “An innovative theory driven approach to enhancing situation awareness among road users in Australia”

• Explore difference in situation awareness and behavior across road users and identify incompatibilities

• Use HF design approaches to design ‘inclusive’ intersection

• Test design concepts using HF methods
Phase 1 On-road study

- 78 participants (20 drivers, 20 cyclists, 20 pedestrians, 18 riders)

- 15km urban route incorporating major intersections, arterial roads, urban roads, residential roads and a shopping strip

- Vehicle instrumentation and think aloud protocols

- **Analysis of situation awareness and behaviour** at intersections and roundabouts, and along arterial roads and a shopping strip
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EAST (Stanton et al, 2005)

What road users are thinking, what they are aware of

What and who road users are interacting with

What road users are doing to achieve goals
Constructing ‘Social’ networks

- “Im just checking the traffic lights and the car behind me. Im also keeping an eye on the pedestrians to the left. The light is on green now and so im pulling away. Im just checking my speed as I do so”
Constructing situation awareness networks

- Situation awareness as a network of ‘concepts’ and relationships between them
- Constructed based on analysis of verbal transcripts

“I can see a crossing and train tracks up ahead. The lights are flashing”
The ‘negotiate intersection’ task is very different depending on mode of transport.

Some of these differences are design induced.
Social (Interaction) Networks

Different tasks leads to a different interaction

Driver interaction doesn’t necessarily take into account all forms of road user
Summary of social network analysis

- Mean number of nodes (or objects interacted with)
  

- Mean number of interactions
  

- Number of interactions unique to different road user groups e.g. road surface, button, green man, footpath
Situation awareness is different across road users....even when using the same information

Commonalities relate to lights, cars, intersection, road etc
Unique and common concepts

- **Common situation awareness concepts**: cars, intersection, red, turning, coming etc

- **Unique to drivers**: Forward

- **Unique to Cyclists**: Service lane, stay, time, hook turn

- **Unique to Motorcyclists**: Line, Gear, Hand, Hand side

- **Unique to Pedestrians**: Check/Checking, Button, Green Flashing etc
Cyclists and Motorcyclists not prominent in drivers intersection schemata

Drivers not expecting to encounter cyclists and motorcyclists

Cyclists and Motorcyclists have multiple intersection schema with range of possible behaviours

Cyclists and Motorcyclists variability in behaviour not accounted for in drivers intersection schemata

Low numbers of Cyclists and Motorcyclists at intersections

Intersection does not cue drivers to look for Cyclists and Motorcyclists

Intersection does not constrain Cyclist and Motorcyclist behaviour leading to variable/unpredictable behaviours

Drivers not looking for Cyclists and Motorcyclists

Drivers not looking in the correct places for Cyclists and Motorcyclists

Drivers may not perceive Cyclists and Motorcyclists e.g. left hand turns

Cyclist and motorcyclist behaviour variable
Conclusions & next steps

- Differences in awareness and behavior create conflicts at intersections
- Road ‘system’ creates some of the differences/conflicts
- Solution = manipulation of schemata and situation awareness through road design, training, education, road rules etc
- **On-road study 2**: Multiple drivers, cyclists and motorcyclists engaged in the same road situations at the same time
- **Cognitive Work Analysis**: design and evaluation of novel intersections
Acknowledgements