

Visual Attention in Novice Drivers: A lack of situational awareness

Melissa Dickinson

Eugene Chekaluk

Julia Irwin

Macquarie University

Young Drivers

- Over-represented in crash statistics
- Very susceptible group on the road
- Characterised by minimal driving experience and immaturity

Visual Attention in Driving

- Visual information is very important in driving
- Limited capacity
- Increases with experience
- A common factor in novice crashes is inattention

Visual Attention in Novice Drivers

- Studies focused on eye movement data
- Found that in high demand situations, novice drivers perform significantly worse than experienced drivers
- No difference in the low demand situations
- Visual attention deficit

Crundall & Underwood (1998)
Falkmer & Gregerson (2001)

Peripheral Detection

- Can measure visual attention using a peripheral detection task
- Past studies have lead to ambiguous conclusions
- Possibly due to different definitions of key terms

Experiment 1

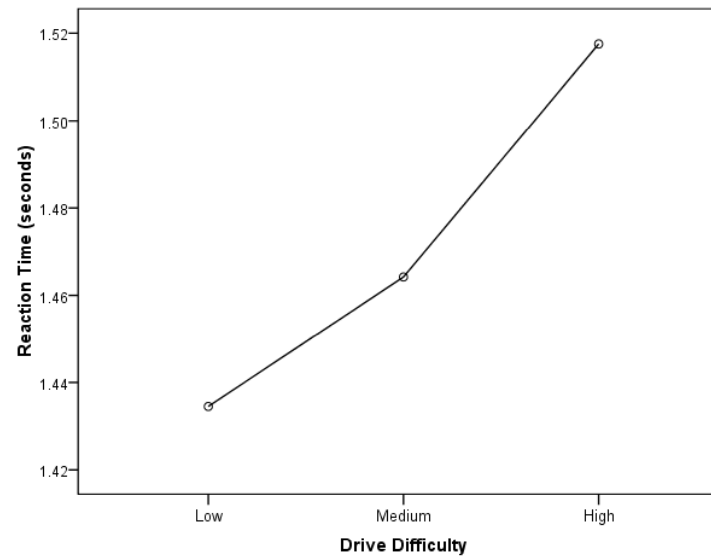
- Aimed to clear up the confusion
- Used same definitions as used in eye movement literature
- Measuring peripheral detection
- Hypothesised that novice drivers would show a visual attention deficit

Experiment 1 - Method

- Completed a drive on a driving simulator
- Three levels of demand
 - low, medium and high demand situations
- Had to respond to peripheral stimuli

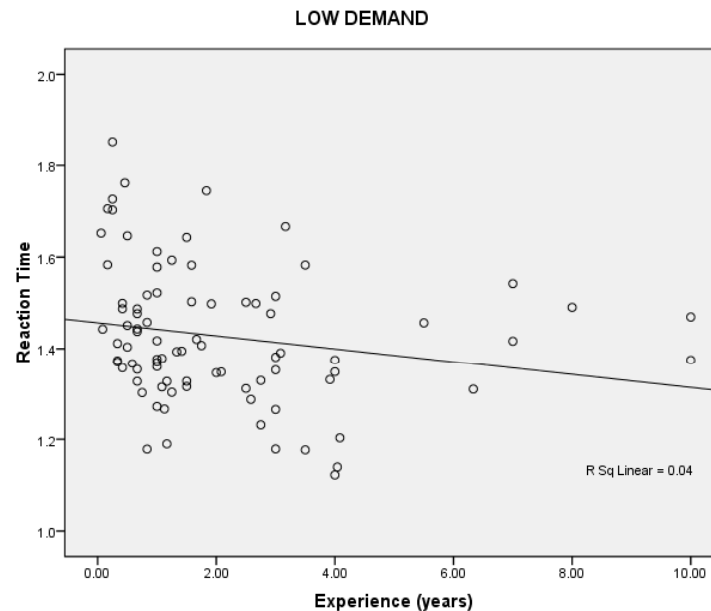
Experiment 1 - Results

- Visual attention differed under each demand level

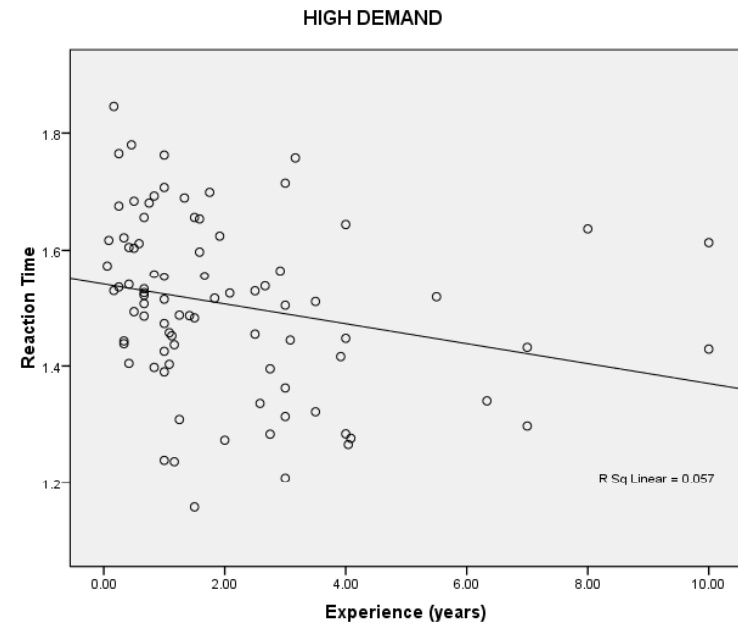
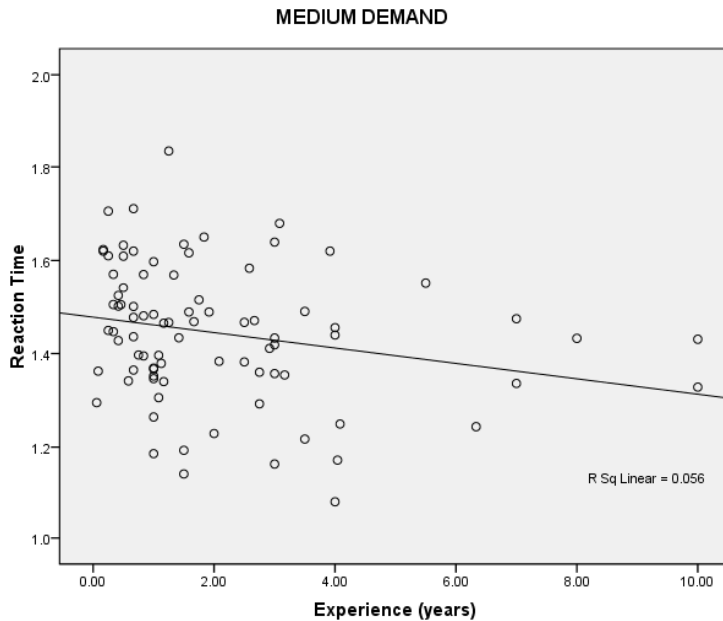


Experiment 1 - Results

- The effect of experience differed at each demand level
 - No correlation at low demand levels ($r = -.199$; $p = .067$)



- Significant negative correlation at medium and high demand levels ($r = -.237$; $p = .029$ and $r = -.239$; $p = .027$ respectively)



Experiment 1 - Conclusions

- In low demand situations, visual attention in novice drivers did not differ from experienced drivers
- However, in the high demand situations novices showed poorer visual attention skills
- Evidence of the visual attention deficit in high demand situations

Explaining the Visual Attention Deficit in Novice Drivers

- Two Hypotheses:
 - Situation Awareness
 - Cognitive Resource Limitation

Situation Awareness Hypothesis

- Novices aren't aware that certain situations need more attention and scanning
- Don't have sufficient schemas of road situations
- Evidence
 - Can train novices to identify high demand situations

Cognitive Resource Limitation Hypothesis

- Do not have cognitive resources available to scan extensively
- Cognitive resources taken up by basic driving tasks
- Evidence:
 - Addition of secondary tasks
 - Driving becomes more automatic with experience

Testing the Hypotheses – Underwood et al. (2002)

- Increased cognitive resources available
- Measured eye movements
- Participants looked for hazards
- Even with spare cognitive resources available, novices still show poorer visual attention in high demand situations
- Evidence for situation awareness hypothesis
- However, scanning patterns when specifically looking for hazards may not be reflective of actual scanning patterns when driving

Experiment 2

- Extended Underwood et al. (2002) design
- Added a condition which should increase processing the scene as though they were driving
- Hypothesised that the situation awareness hypothesis would be a better explanation for the visual attention deficit

Experiment 2 - Method

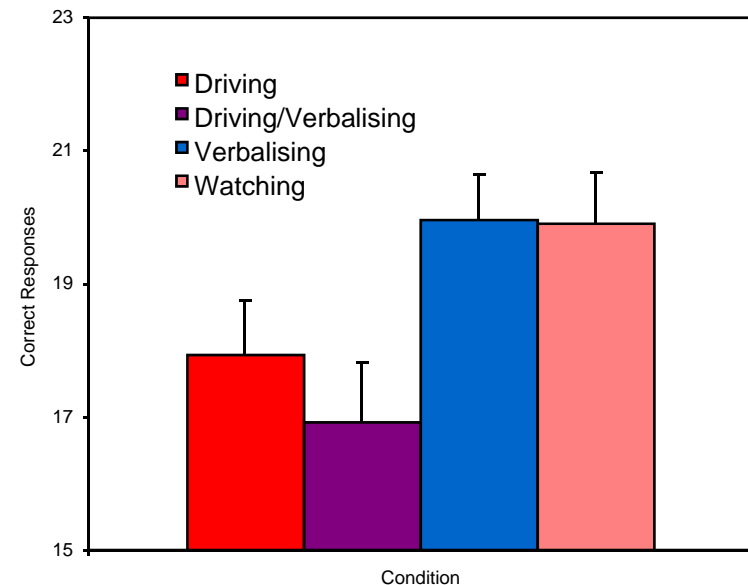
- Only used novice drivers
- Completed drive – 3 demand levels
- Randomly allocated to 1 of 4 conditions
 - Driving
 - Verbalising/Driving
 - Verbalising
 - Watching
- Responded to peripheral stimuli

Experiment 2 – Results

- Looked at performance in the high demand levels
- Significant effect of Condition

Experiment 2 - Results

- Poorer performance in Driving and Driving/Verbalising than in Verbalising and Watching
- No significant difference between Driving and Driving/Verbalising
- No significant difference between Verbalising and Watching



Experiment 2 - Conclusions

- Poor visual attention when processing the scene as a driver
- Removing cognitive task of driving does not improve visual attention
- Evidence for the situation awareness hypothesis
- No effect of merely verbalising on performance

Overall Conclusions

- Visual attention deficit is found in novices across different measures of visual attention
- Findings suggest that the visual attention deficit is due to a lack of situational awareness

Future Research

- Measure eye movements under our conditions
- Exploring facets of situational awareness

References

- Underwood, G., Chapman, P., Bowden, K., & Crundall, D. (2002). Visual search while driving: Skill and awareness during inspection of the scene. *Transportation Research Part F*, 5, 87-97.
- Falkmer, T., & Gregerson, N. P. (2001). Fixation patterns of learner drivers with and without cerebral palsy (CP) when driving in real traffic environments. *Transportation Research Part F*, 4, 171-185.
- Crundall, D. E., & Underwood, G. (1998). Effects of experience and processing demands on visual information acquisition in drivers. *Ergonomics*, 4, 448-458.