

Human Factors Issues Related to Driver Distraction From In-Vehicle Systems

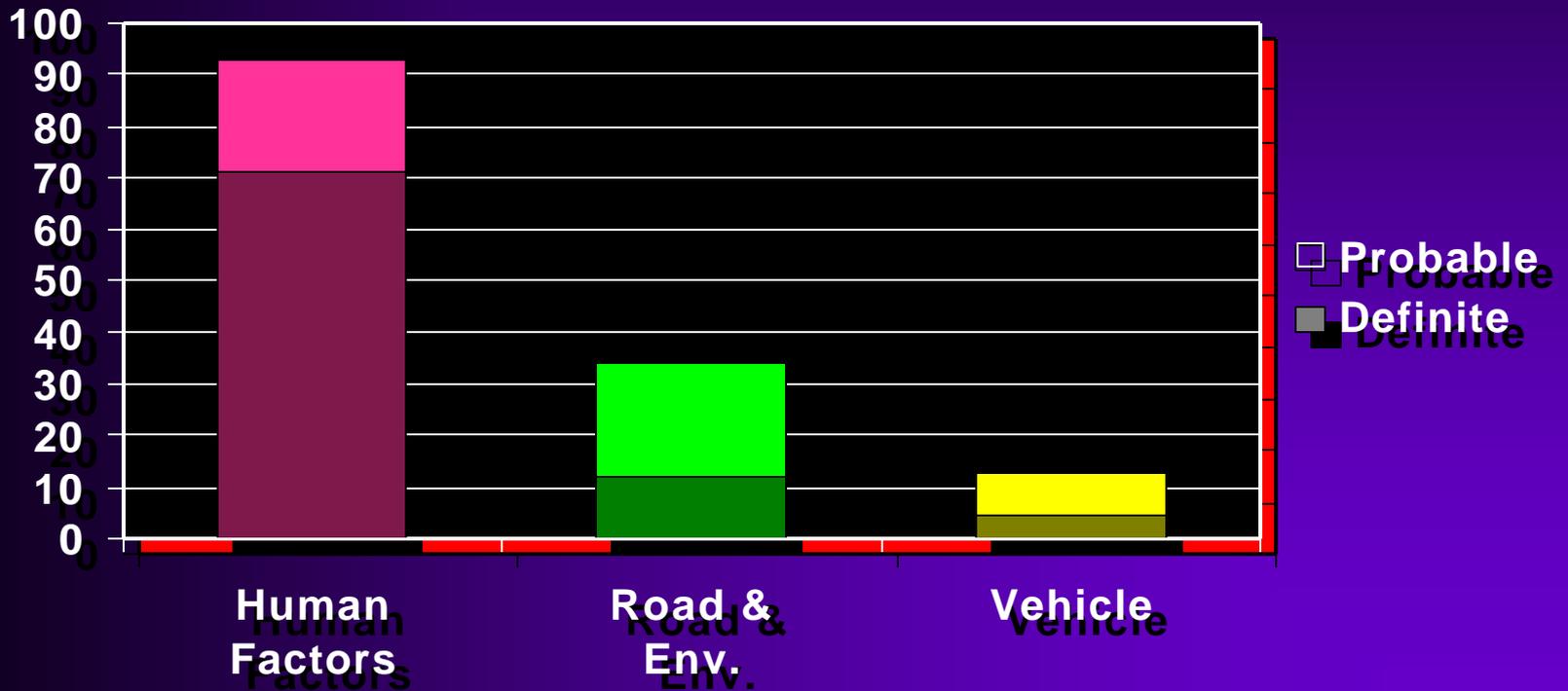
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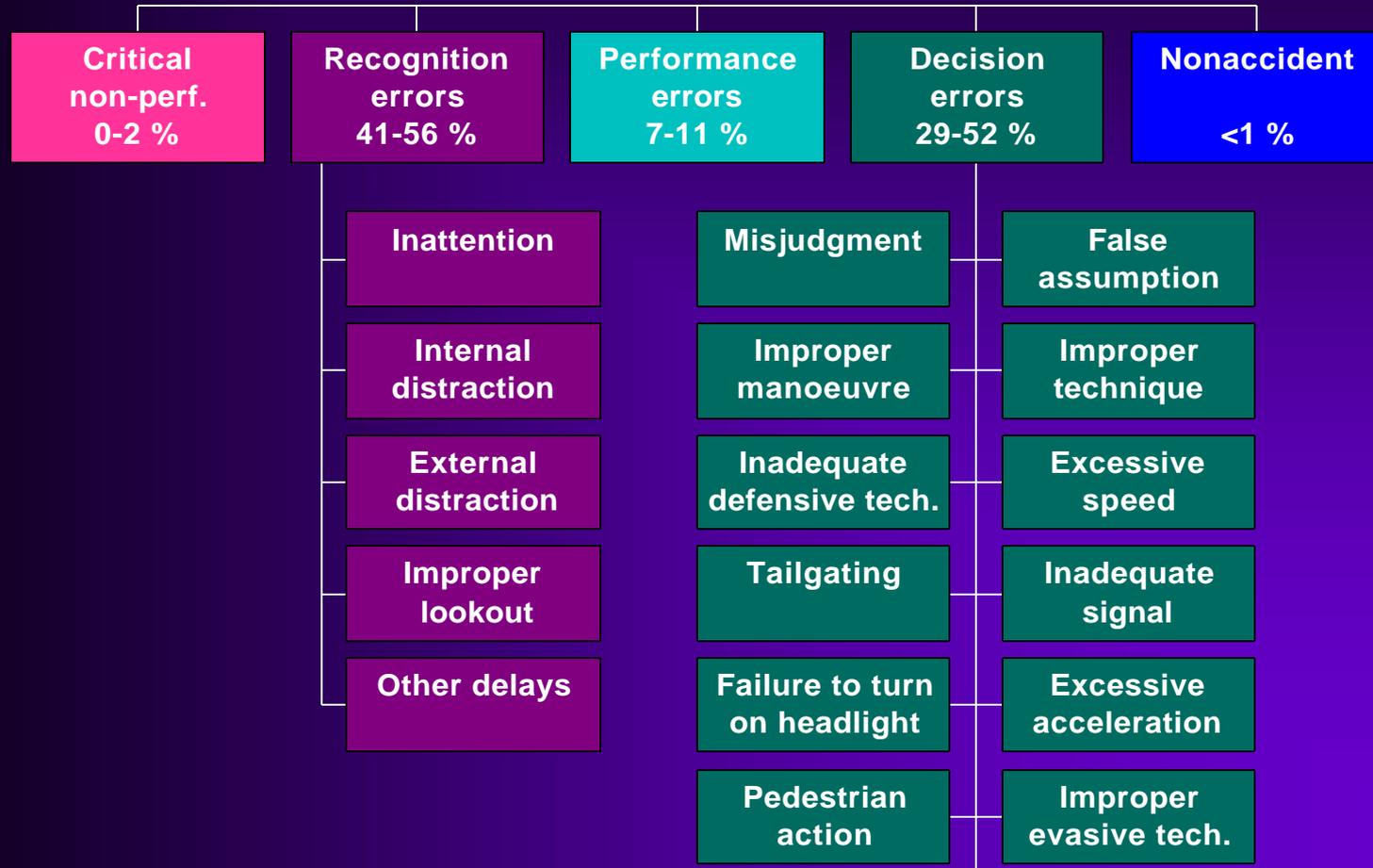


Focus on Human Error (Treat et al. 1977)



Human Direct Causes

(Treat et al. 1977)



Distraction vs. Inattention

- Distraction: shift of attention away from the driving task for a compelling reason.
 - In-vehicle task can lead to visual/cognitive lock-up
 - Inappropriate display salience can capture attention
 - cue elicits immediate response (e.g., telephone ring)
- Inattention: shift of attention away from the driving task for non-compelling reason
 - note: inattention may result from over-reliance on driver support system (reduced vigilance)



Internal Distraction (9% of human direct causes)

- event in car
- adjust radio or tape player
- adjust window, vent, heater or similar control
- conversation with passenger
- other

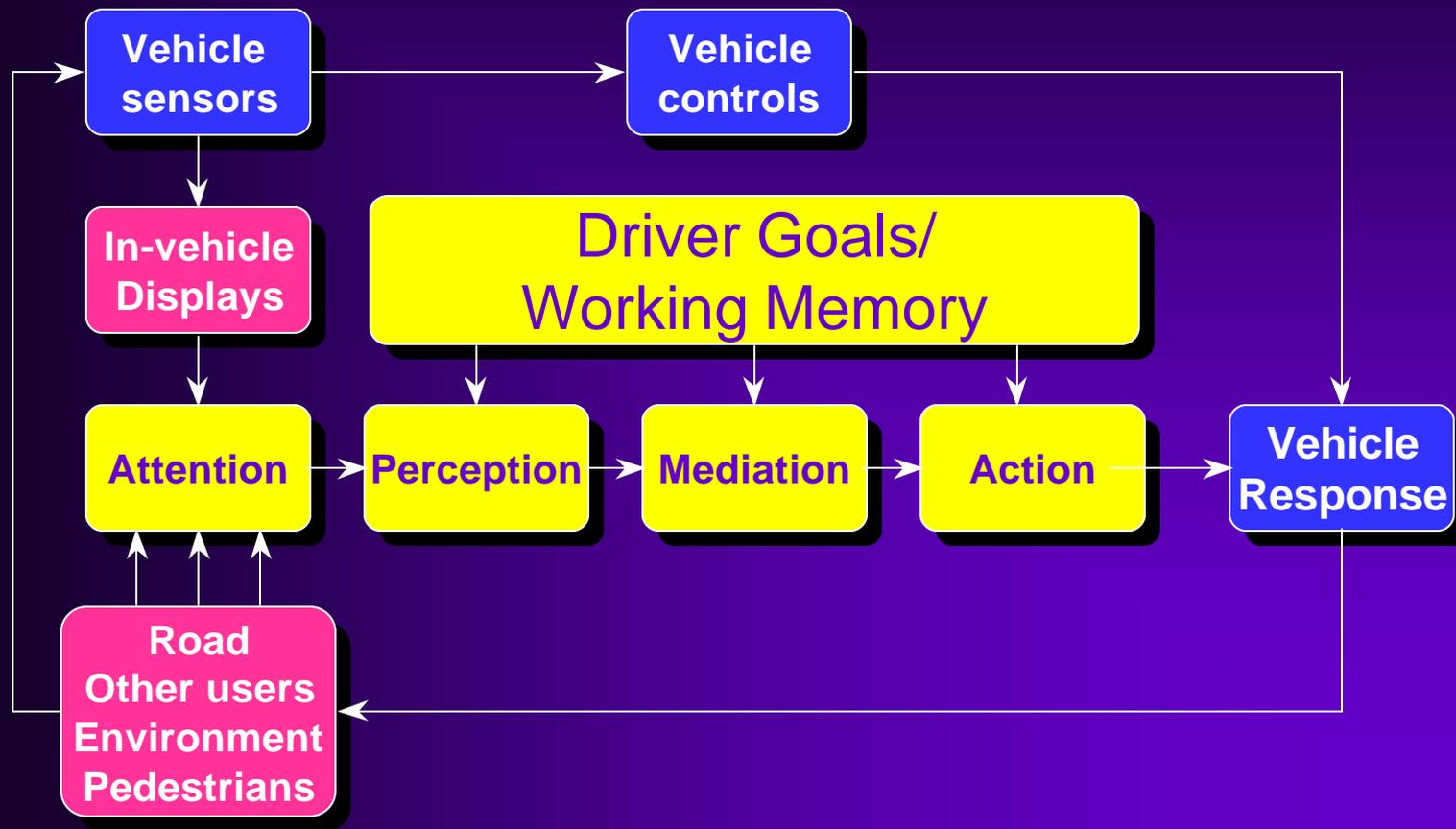


New Sources of Internal Distraction

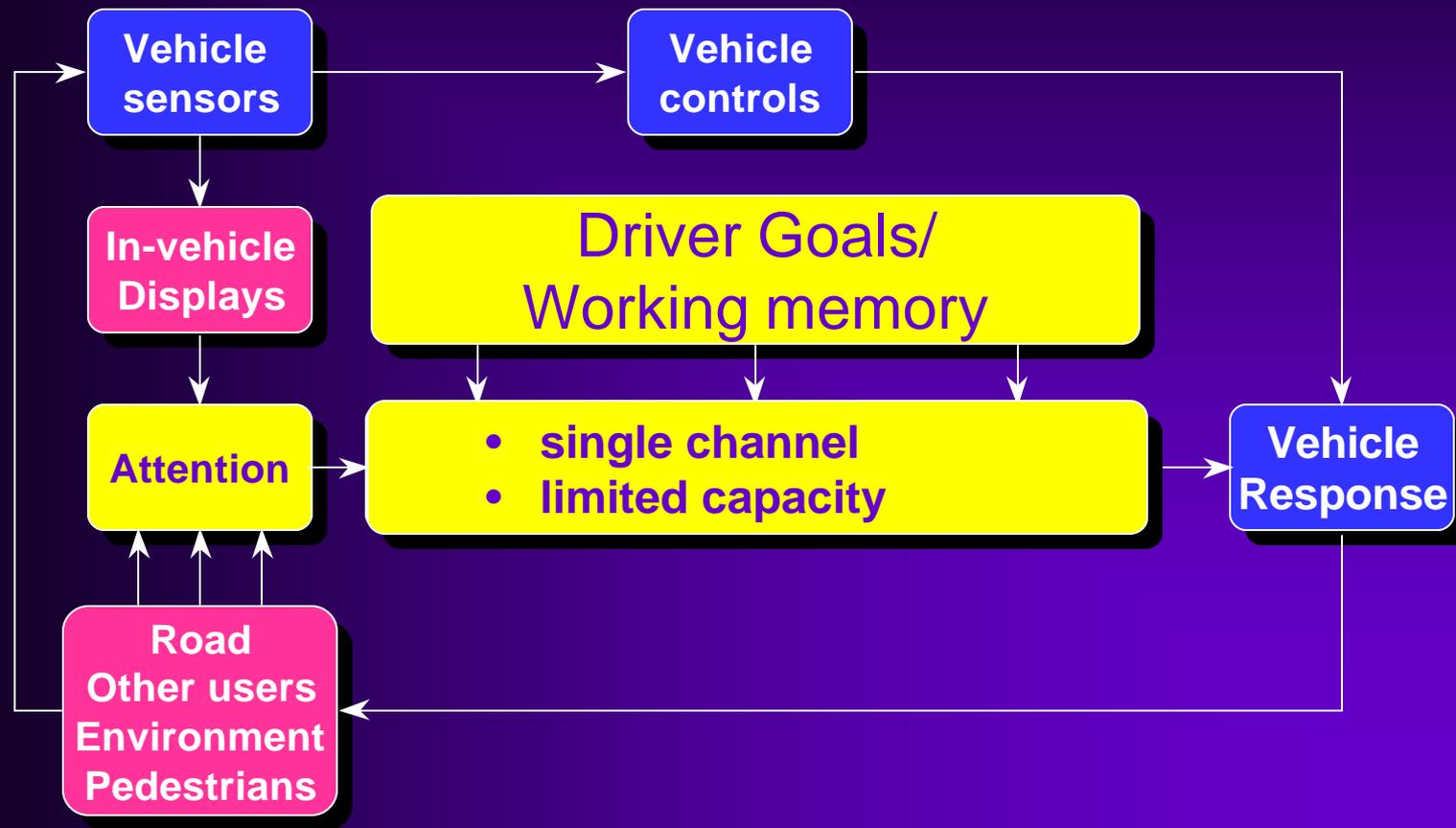
- Navigation system destination entry
- Map and other complex visual displays
- In-vehicle office tasks (e-mail, Internet)
- In-vehicle entertainment (travelogue, CD, TV)
- Warnings
- HUD's
- Wireless communication (cell phones)



Driver Information Processing



Driver Information Processing



Critical Parameters of Visual Distraction Task

- Timing of distraction in relation to driving context
- Duration of distraction
- Ease of returning to the driving task
- Working memory load between glances
- Physical location of source of distraction



Transport Canada Research

■ Distraction

- Attention and performance under dual task conditions
- Visual behaviour as indicator of situation awareness
- In-vehicle task structure effect on time sharing performance



Attention and performance under dual task driving

- Simulator study, 30 participants
- Visual auxiliary tasks
 - Perception
 - Memory
- Manipulated driving and in-vehicle task difficulty
- Measured looking behaviour, driving performance, and workload

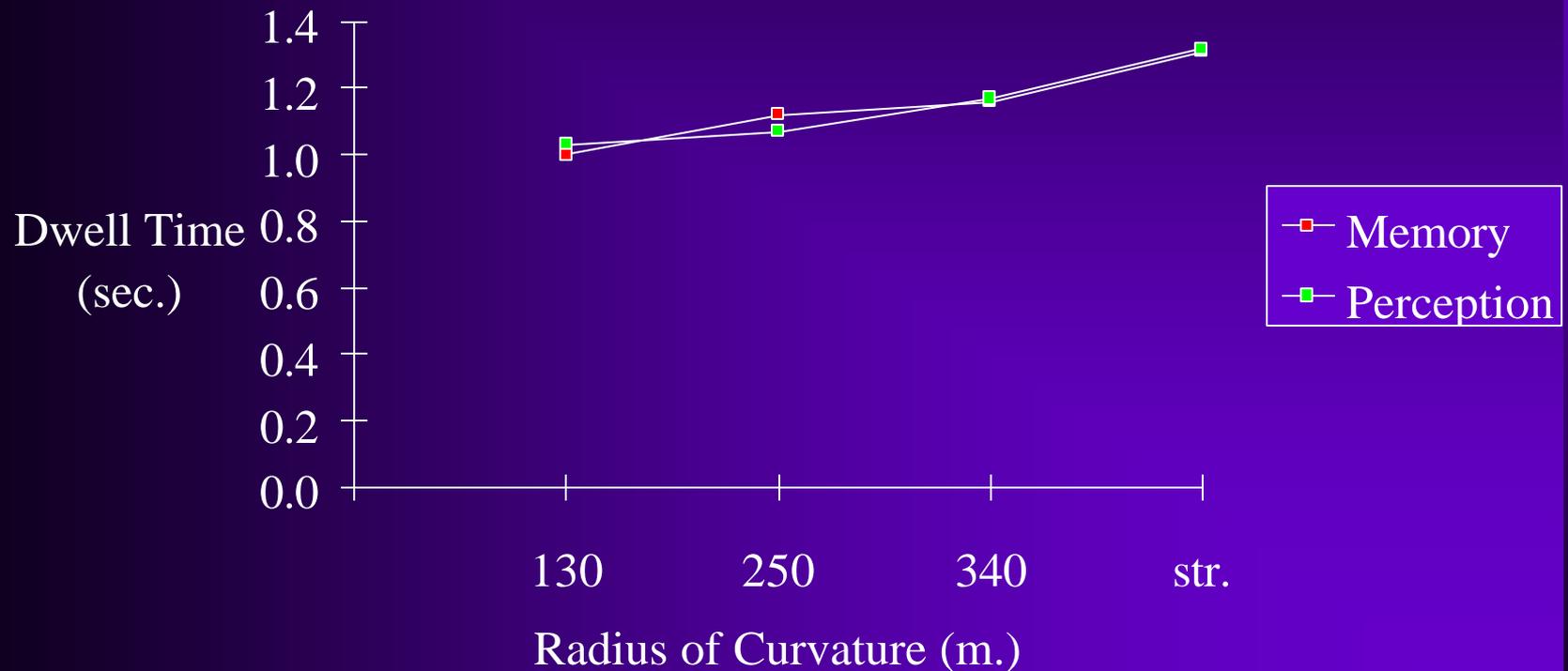


Conclusions

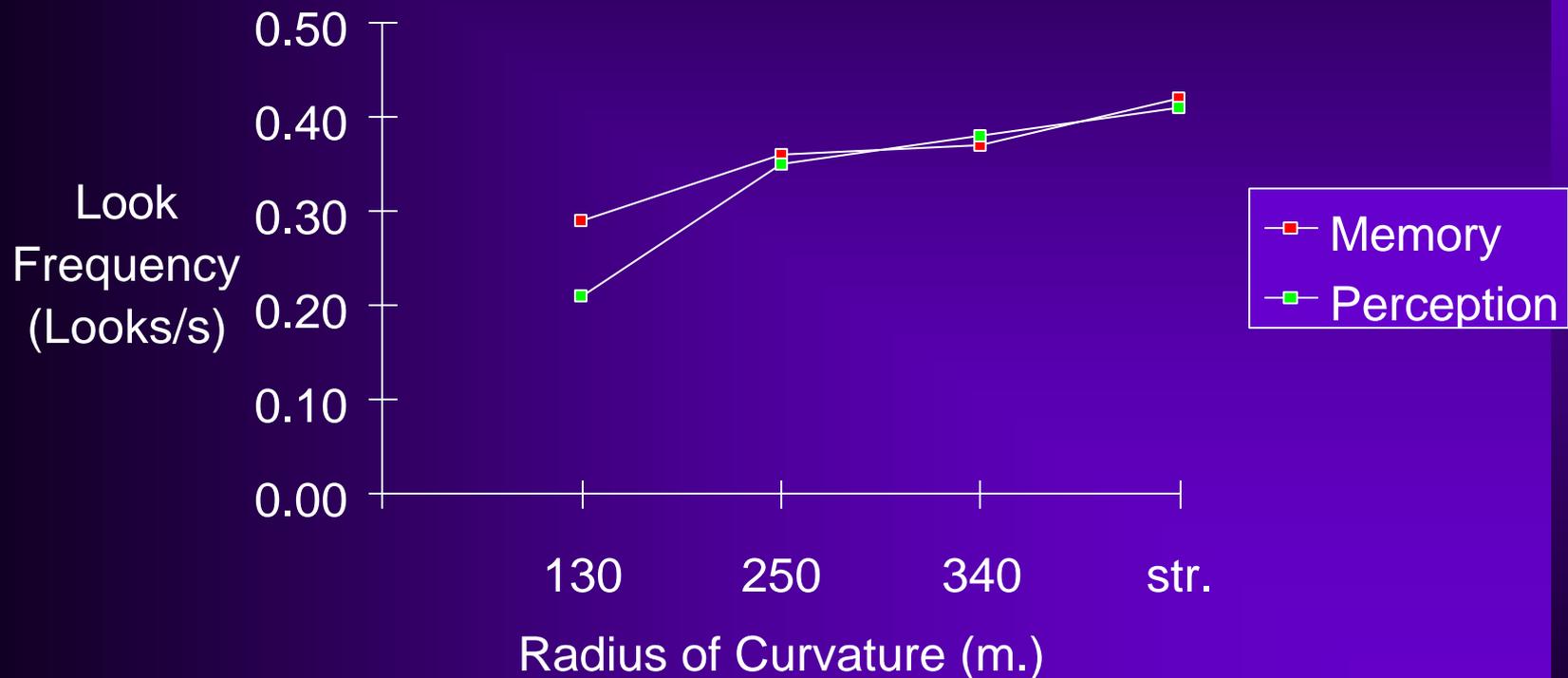
- Driving task difficulty predominant factor affecting attention and performance variables
- Drivers modified their looking behaviour in an attempt to maintain driving performance
- Despite strong adaptive behaviour, distraction from in-vehicle task caused driving performance to deteriorate



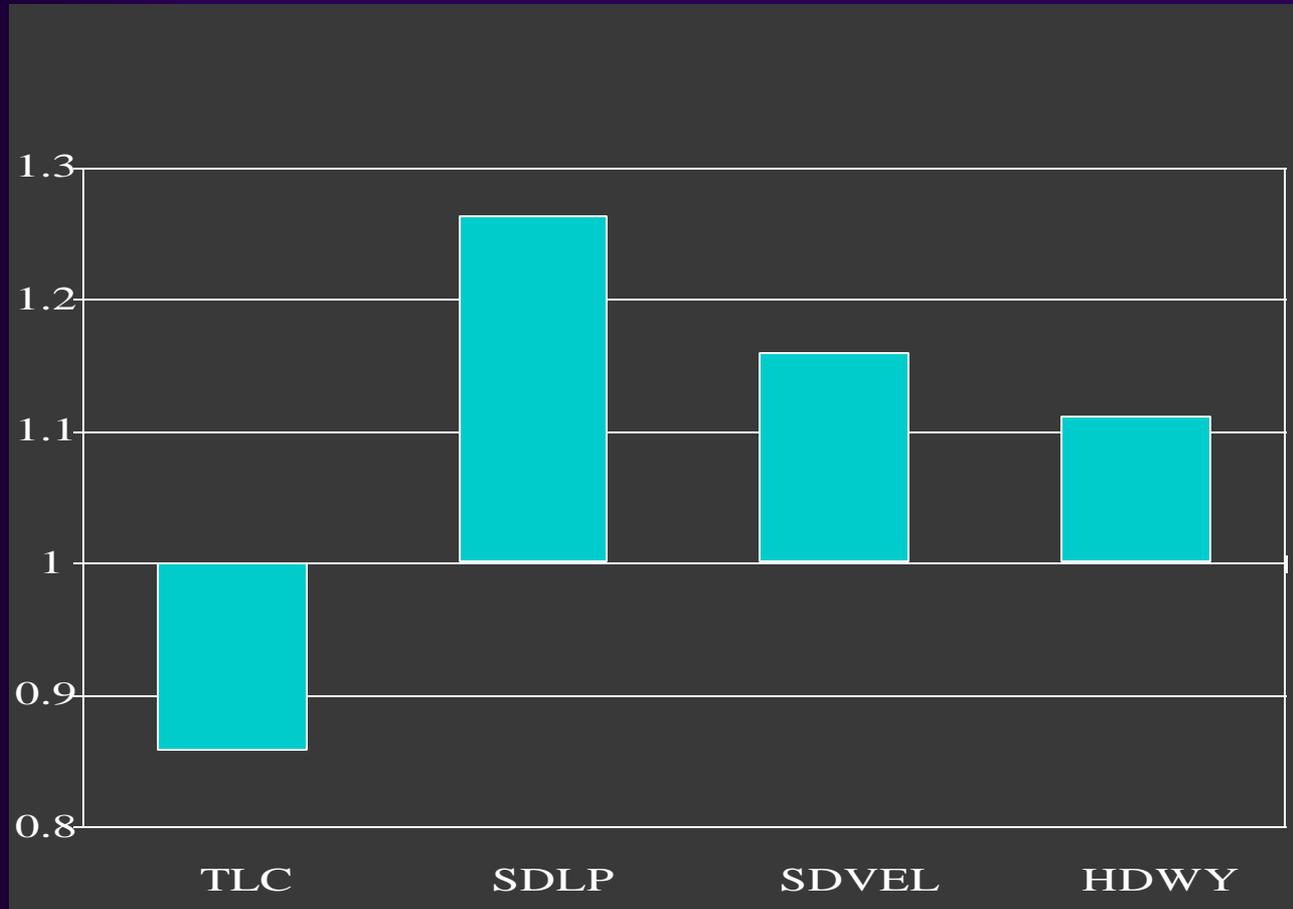
Dwell Time vs. Driving Load



Look Frequency vs. Driving Load



Performance Ratio (relative to control)



Effect of cognitive load on driver visual behaviour

- In-vehicle ITS technology (e.g., cell phones) raises concerns about distraction
- Voice communication (hands-free technology) is promoted as a solution
- Q - Can voice technology result in unacceptable increases in workload and distraction?



Visual behaviour: key indicator of distraction

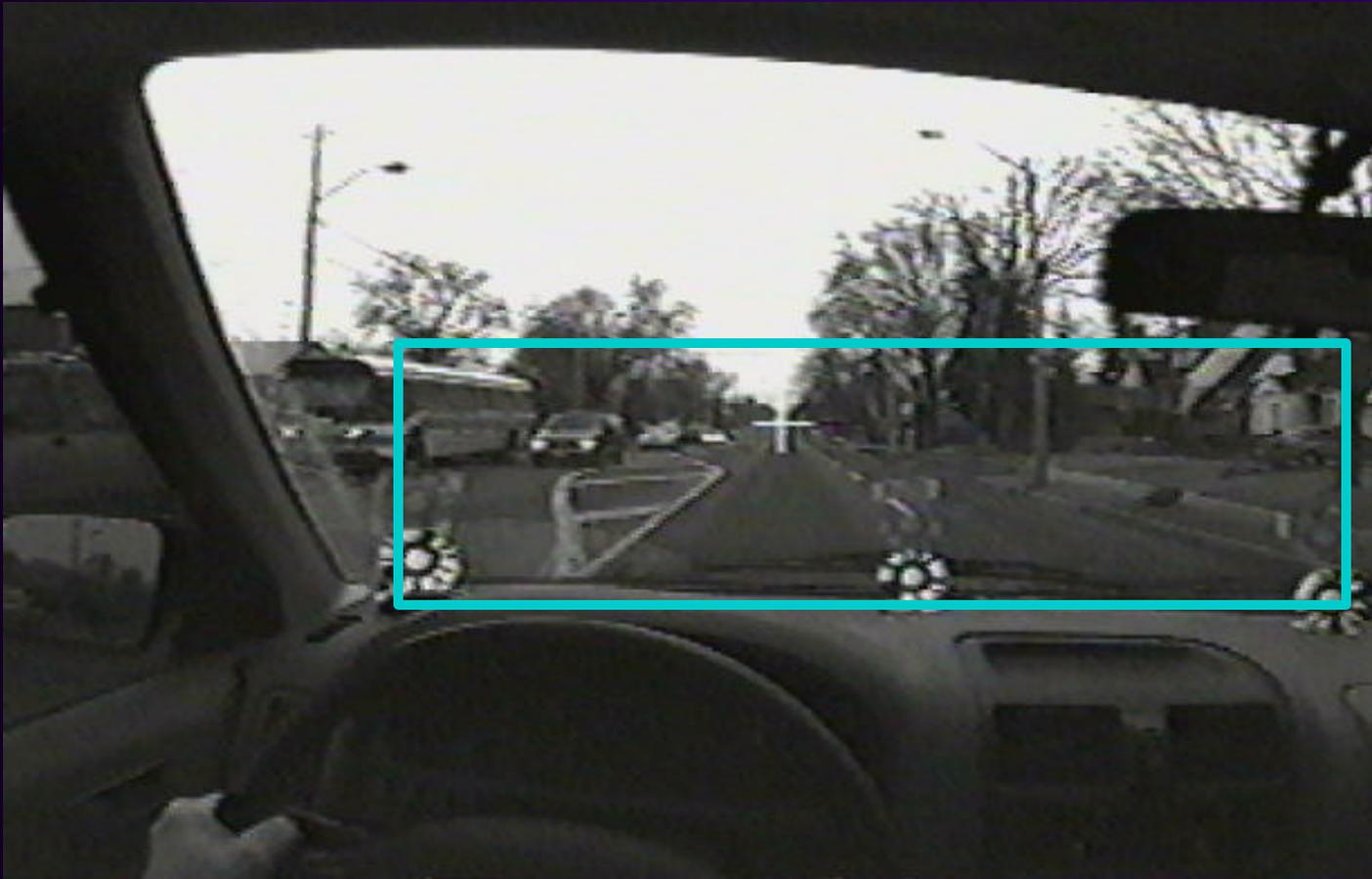
- How does voice interaction alter drivers' visual scanning behaviour and driving performance?
 - Approach: on-road study, using hands-free phone
 - participants perform mental tasks of varying difficulty (1-, 2-digit addition); control condition
 - Eye tracker to record eye movements
 - Dependent measures: visual scanning of environment, mirror checking, driving performance, ratings of workload, safety, and working memory



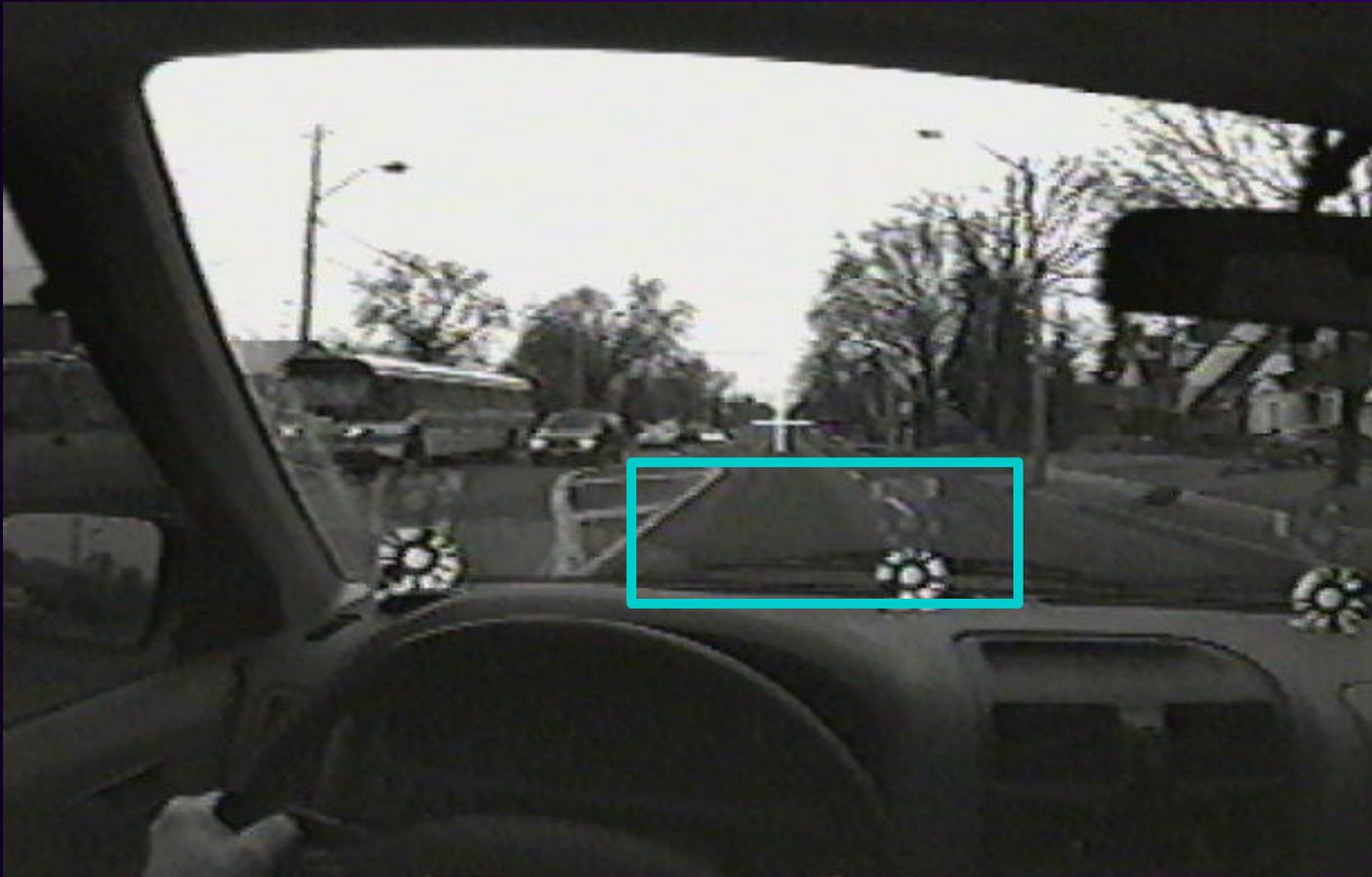
Driving: Forward View



Scanning under normal driving



Scanning while using phone



Information Chunking

- Purpose: investigate effects of task structural characteristics on distraction
- Specific interest in the ease of breaking task into discrete chunks (restart penalty) as a critical factor
- In-vehicle tasks: destination entry, read e-mail, search display, etc.
- issues:
 - can task be chunked, how finely, effect on visual attention?
 - what is the time penalty associated with chunking?
 - how does chunking affect situation awareness?

