Driving Experience and Eye Movements at Intersections: A Modified Flicker Method

by

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Research Questions

- Does experience influence where a driver looks for information?
  - Do experienced drivers know “where” to look?
- How do drivers search the scene for hazards?
  - How does this influence decision making?
- How is search/decisions influenced by complex and time demanding driving situations?

Driver Experience

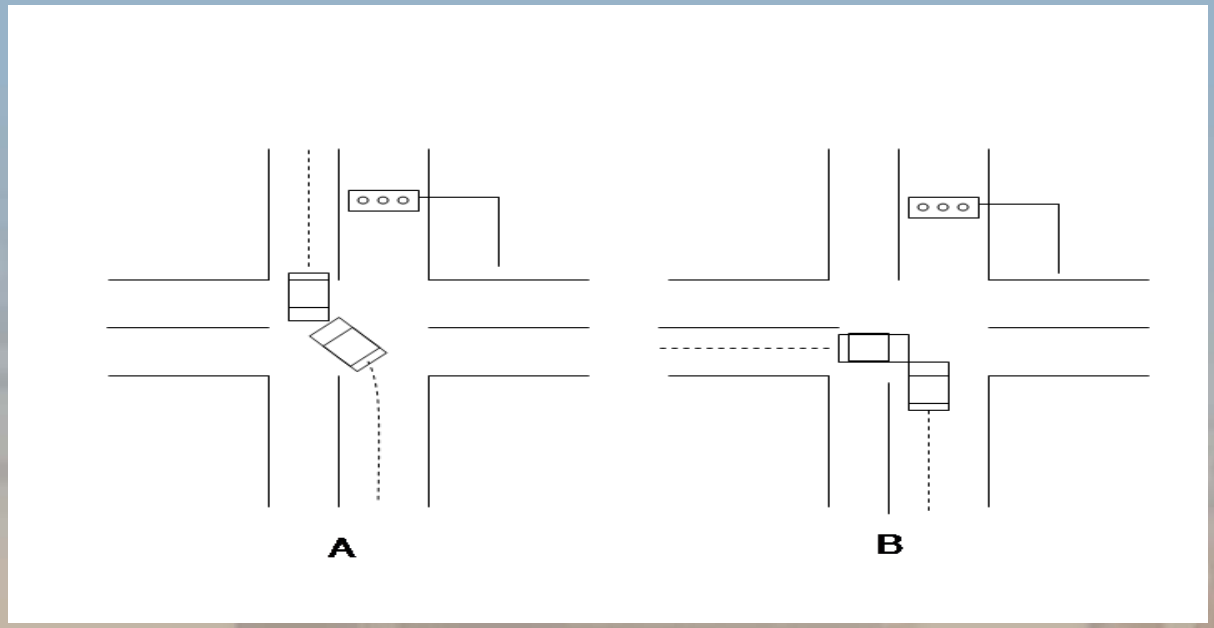
- Inexperienced drivers:
  - Lack critical hazard detection skills
  - Roadway complexity may decrease hazard perception
- Experienced drivers:
  - Previous experience may aid in knowing where to look for hazards
  - Potential to attend to hazards sooner

Driver Experience and Eye Movements

- Eye movements may reveal different strategies in driving behaviour
- Experienced drivers:
  - Recalled more periphery information and look further ahead
  - Perhaps attend to hazardous “areas” knowing “where” to look for potential hazards
  - Greater number of fixations with shorter durations

Complex Driving Task

- Intersections
  - 944,760 crashes occurred at intersections in the U.S. in 2002
  - Of these the most common are Left-turn across path–Opposite Direction (A) and Straight crossing path (B)



Variable Review

- Independent variables
  - Experience (Experienced/Inexperienced)
  - Object type (Traffic Control Devices, Vehicles, Pedestrians)
  - Time to view (3 or 5 seconds)
- Dependent variables
  - Decision accuracy (Correct/Incorrect)
  - Fixation duration
  - Areas of interest

Methodology

- Change Blindness
- Has been used to probe attentional demands
- A failure to detect changes to a scene during a blink, saccade, flicker or movie cut
- Often large changes go unnoticed
- The flicker method requires viewers to engage in a systematic search

Methodology

- The Modified Flicker Method:
- Based on the context that drivers have limited time to make decisions
- Testing drivers attentional capabilities specifically at intersections
- Drivers are tasked with a specific goal in this case to turn or not

Methodology

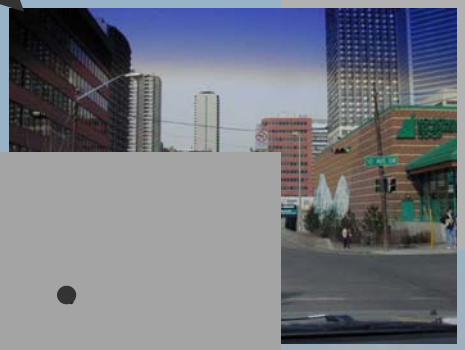
- A total of 36 intersection images were chosen out of 2500

Methodology

Repeats for either
3 or 5 seconds

A‘ (240ms)

Mask (80ms)



A (240ms)

Fixation screen

Turn arrow (Left or
Straight)

ASL 501 Eye movement system

Participants

- Inexperienced (N=12) [18-19 years]
- Experienced (N=12) [35-48 years]

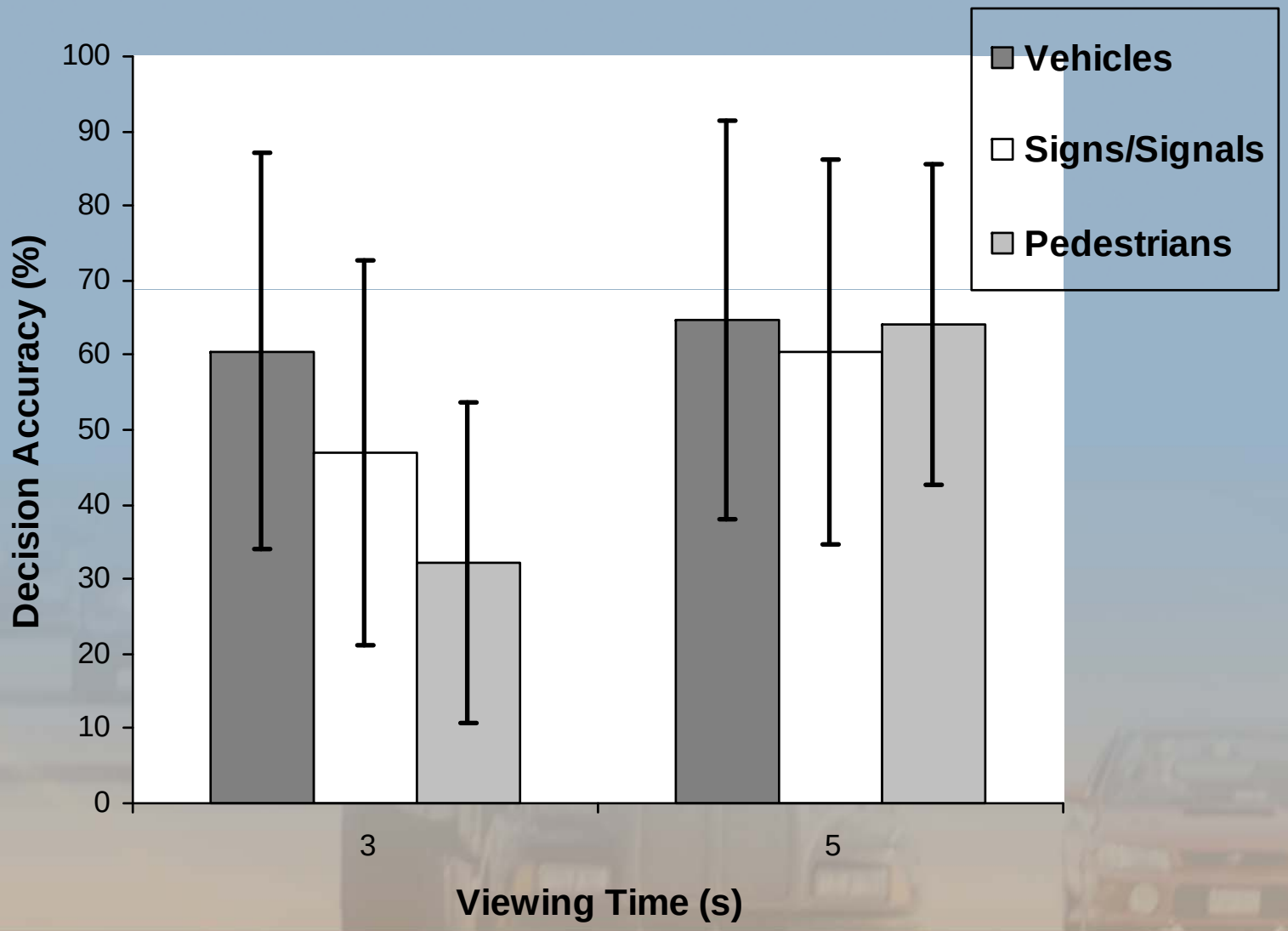
Descriptive Measure	Age Group	
	18 and 19	35 to 48
Mean Age (SD)	18.75 (0.45)	40.38 (4.15)
Driving Experience (SD)	2.27 (0.91)	22.67 (3.11)
Accidents Since Licensure (SD)	0.67 (0.78)	1.67 (1.07)
Mean Kilometers per Year (SD)	15,820 (16,800)	15,000 (5,530)
Median Kilometers per Year	10,000	16,500

Decision Accuracy Results

- Did drivers make the correct decision (to go or not) based on the information presented?
- How did object type and time influence decisions?
- Where decisions influenced by where an object was?

Experience differences

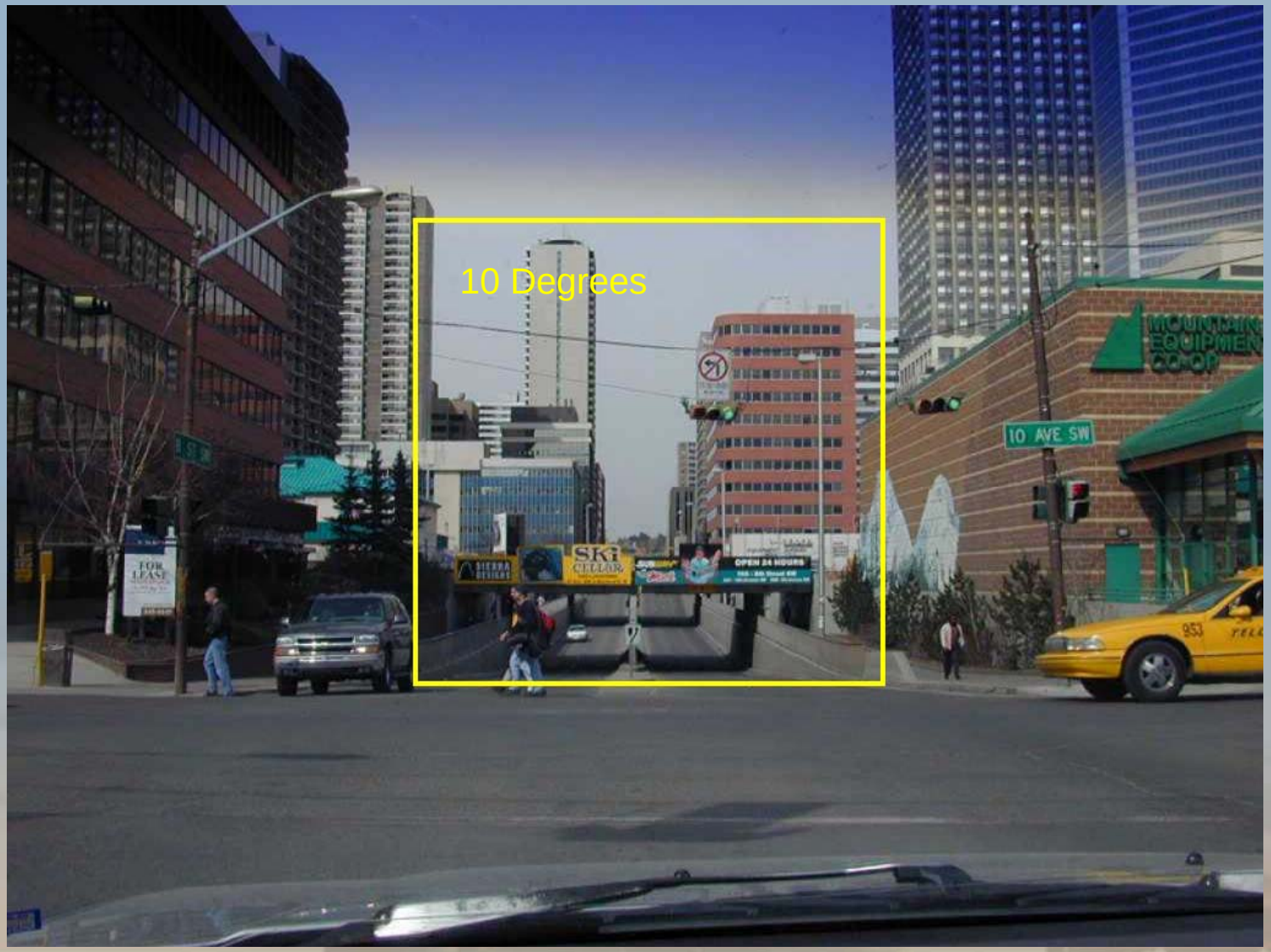
Results: Decision Accuracy



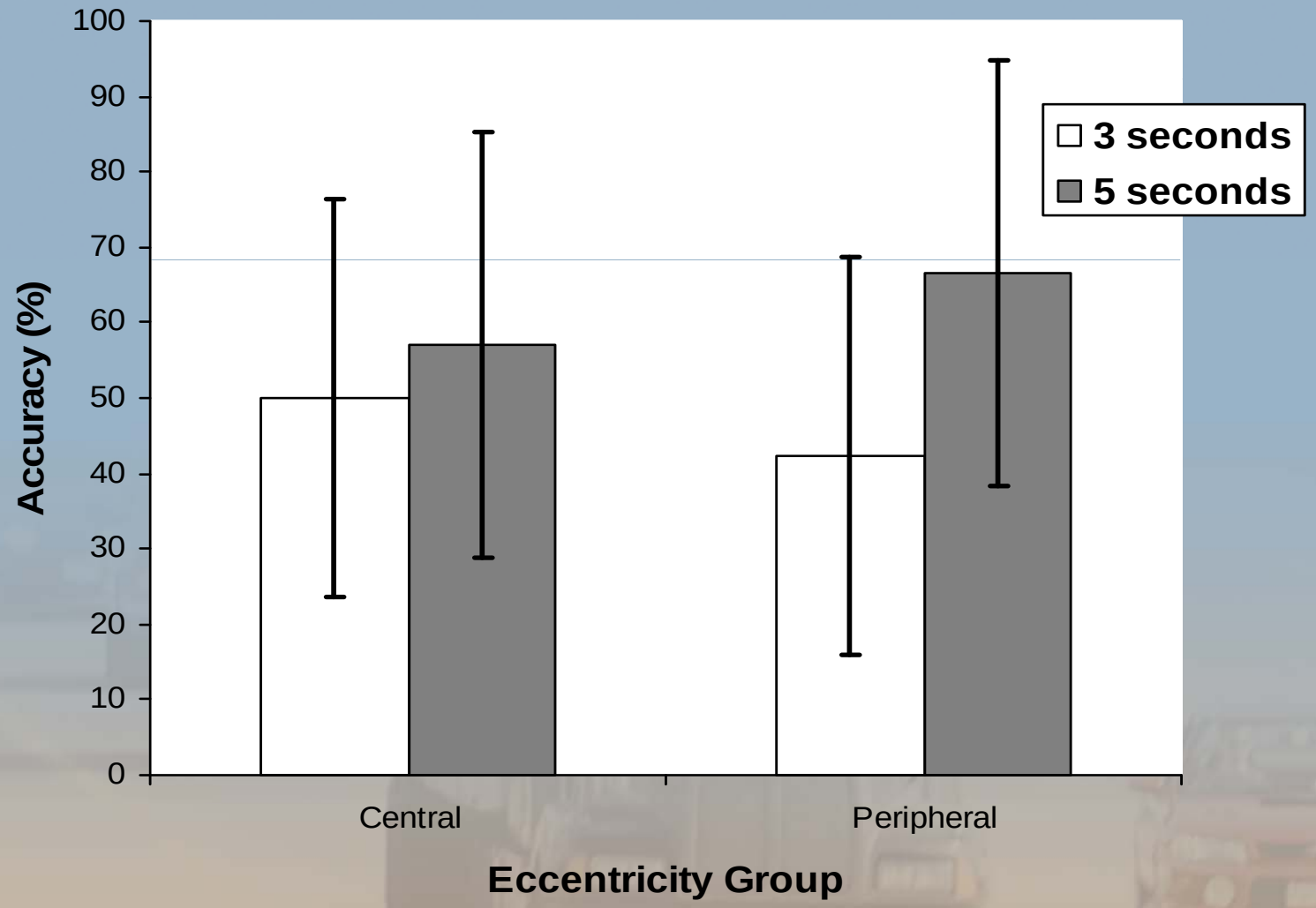
Overall: Time/Object Effects

- Decision accuracy was greater when participants had a longer viewing time (5 seconds)
- Participants had higher detection and made more accurate turn decisions when vehicles were the changing object.
- In 3 seconds, participants made more accurate turn decisions when vehicles and lights/signs were changing compared to pedestrian changes

Results: Central vs. Peripheral



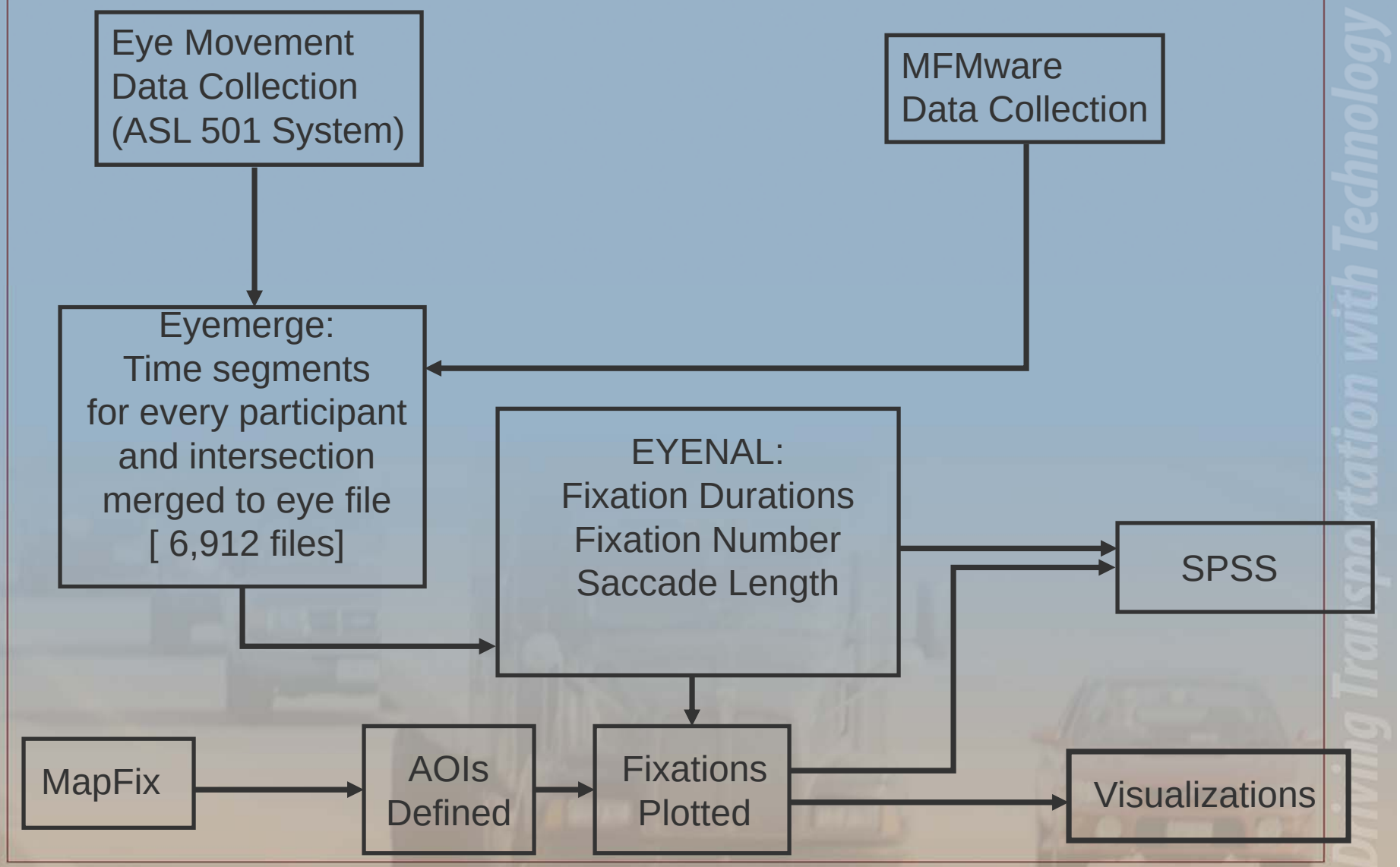
Results: Central vs. Peripheral Decision Accuracy



Eye Movement Results

- What do drivers look at?
- How can this be classified?

Data Reduction



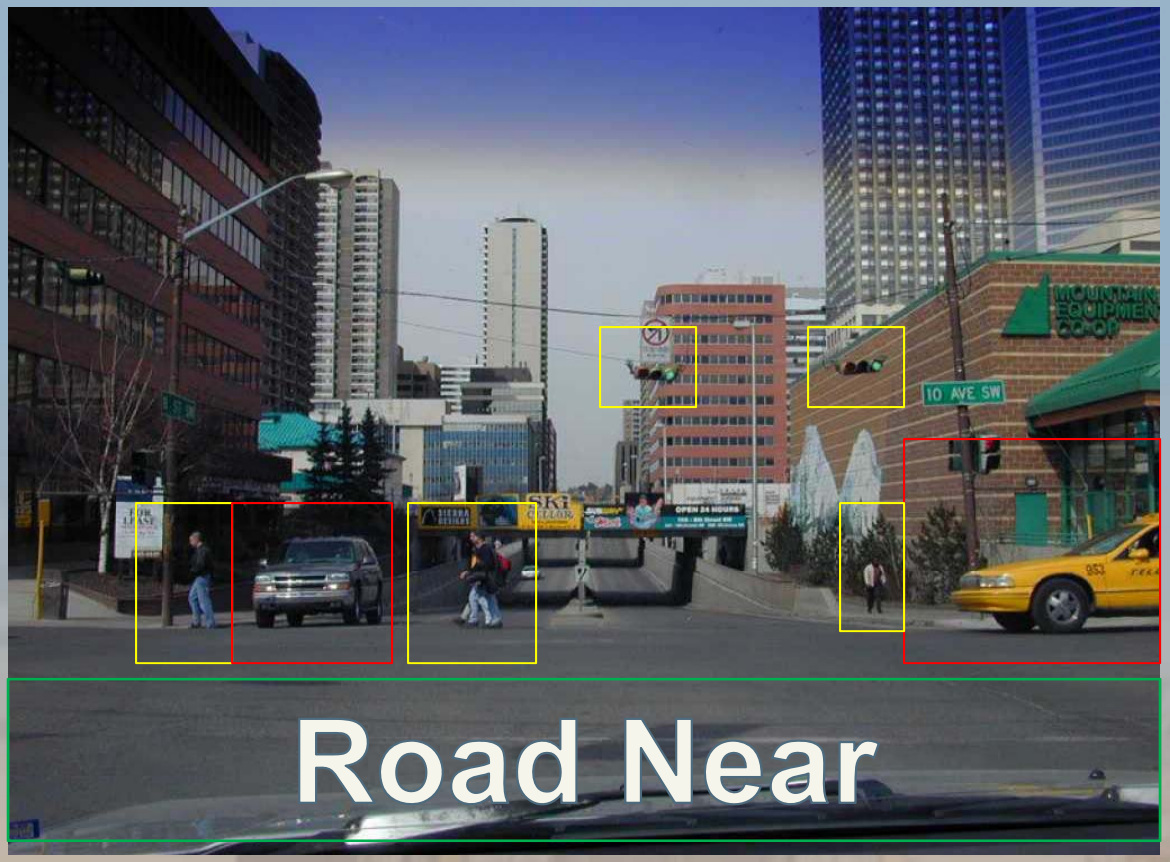
Exploratory: Areas of Interest

Areas of Interest:

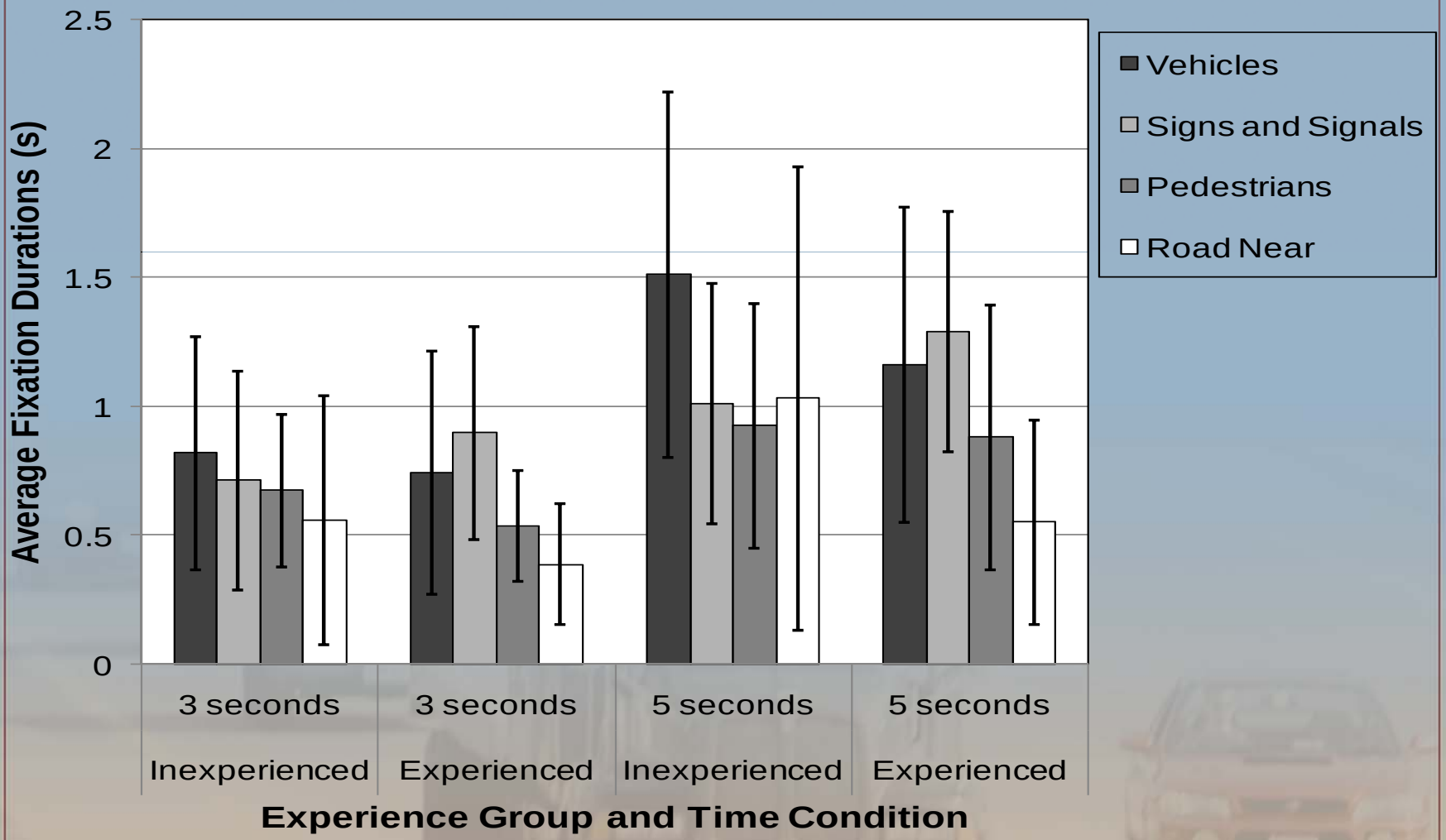
- Objects in scene selected based on relevancy to driver safety (e.g., other vehicles, critical changing objects etc)
- Tightest fitting box around object plus 2 degrees
- AOI differences calculated based on time to view the changing intersections

Areas of interest

- Representation of the AOI layout for each intersection.



Results: AOI and Viewing Time



Decision Accuracy Discussion

- Intersections and Experience
  - Differing driver age ranges
- Decision accuracy
  - Higher accuracy given more time
  - Higher accuracy when vehicles were the changing object
- Object Types
  - Pedestrians in the context of intersections went undetected more often
  - When examining placement of objects, pedestrians appeared more frequently in the periphery

Eye Movement Discussion

- Experience
  - Similar to previous research, inexperienced drivers were found to direct gaze close to vehicle
- Objects
  - Experienced drivers may use traffic control information as part of a strategy and thus fixated/attended these items for longer
- Overall results provide a preliminary insight into intersection complexity, decision making, eye movements, and driver experience

Limitations

- Driver groups were not sufficiently different
- MFM requires participants to focus attention in order to identify changes, however does this reflect drivers real world search?
- Performed using static images with no real consequences for incorrect decisions

Future Directions

1. Novice drivers and intersections

   (How do novice drivers interpret complex intersections)

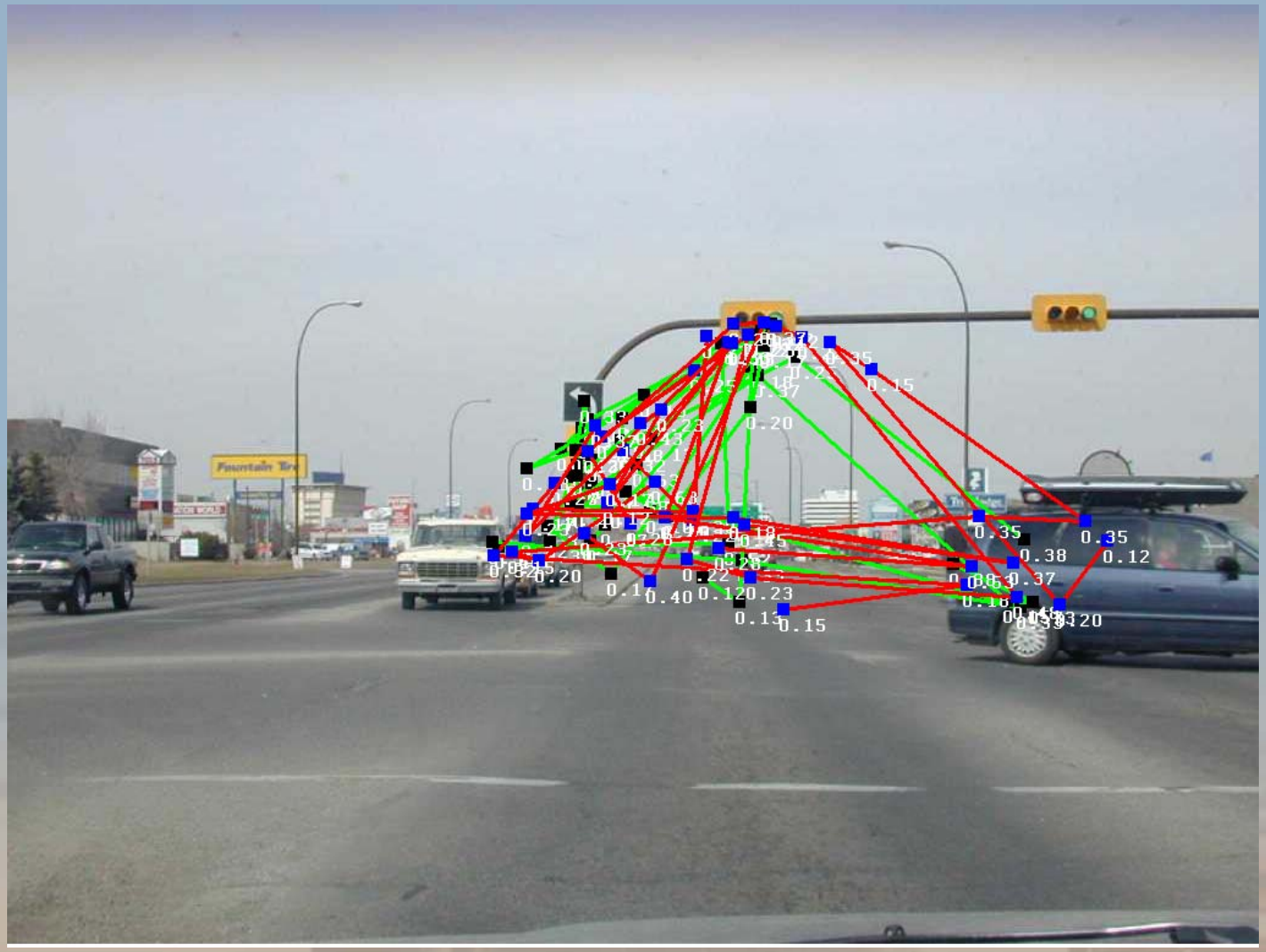
2. Object AOI analyses

   (Using context specific information)

3. Eye movement visualization and dynamic AOIs

   (How to capture and interpret information)

Is this how drivers search a real scene?



Acknowledgements

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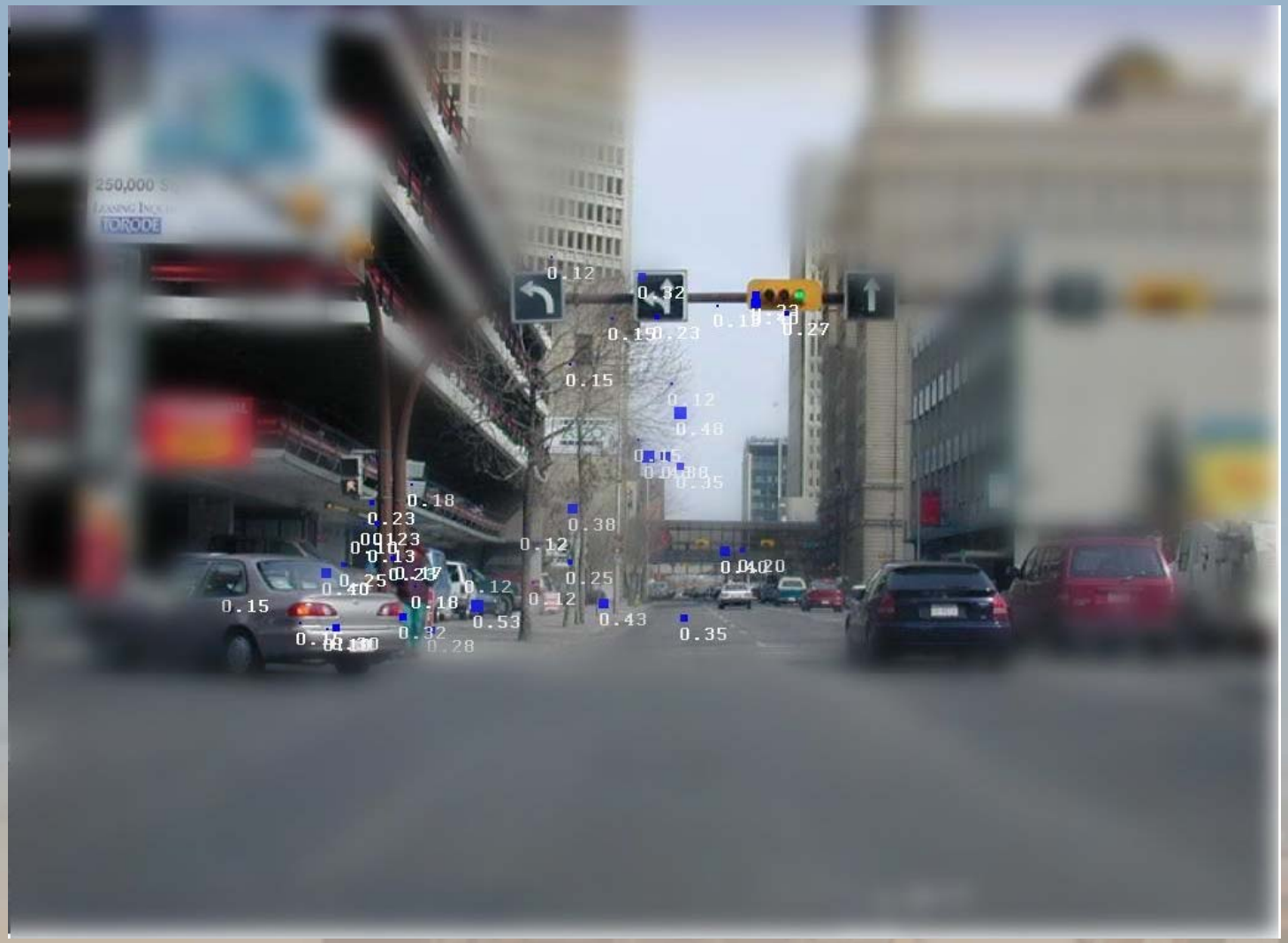
- For more information:
  C.J. Edwards, J.K. Caird, and S.L. Chisholm (2008). The Effect of Driving Experience on Change Blindness at Intersections: Decision Accuracy and Eye Movement Results. *Proceedings of the Human Factors and Ergonomics Society 52nd Annual Meeting,* New York: NY (1243-1247).

Questions?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