# Evaluation of Bicyclist Physiological Response and Visual Attention in Commercial Vehicle Loading Zones

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# Research Background

- With pressure from multiple modes for curb capacity, cities are considering the allocation of curb space
- Rapid growth in urban freight deliveries (e-commerce)
- Safety - drivers killed and injured making deliveries
- Existing road infrastructure does not accommodate needs of a delivery truck - ad hoc solutions prevail so drivers often blocks roadways and paths

# Research Background

- Needs of a delivery trucks are not acknowledged in roadway design and standards guides
- Significant gaps concerning freight in street design prescriptions such as Complete Streets and Smart Growth
- Commercial vehicles using loading zones are often not provided with usable or consistent envelope adjacent to the vehicle for loading and unloading activities.

# Research Goals

- Explore where commercial vehicle activity disrupts bicyclists
- Support better roadway and loading zone design guidelines

## Research Questions

- R1: How is the cyclist's Galvanic Skin Response (GSR) readings influenced by the size of the loading zone, and the presence of the courier or hand cart?
- R2: Is the visual attention of a cyclist influenced by the loading and unloading activities around the commercial vehicle?

# OSU Bicycling Simulator

Right: Eye tracker laptop;
Middle: Bicycle simulator workstation;
Left: iMotions laptop

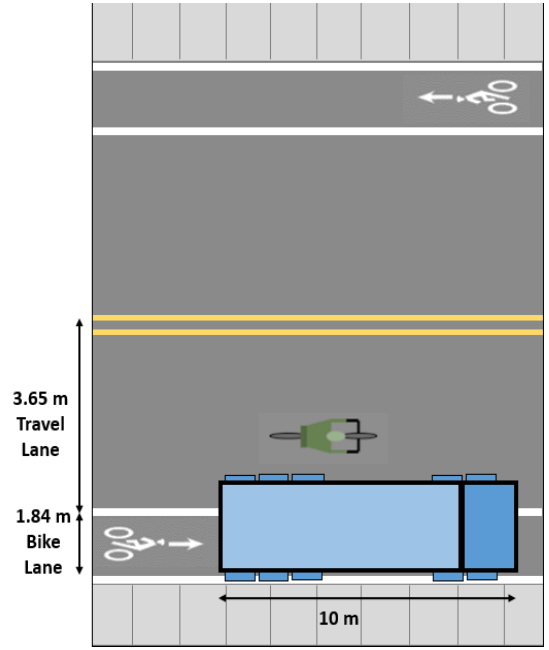
Participant view on a simulator

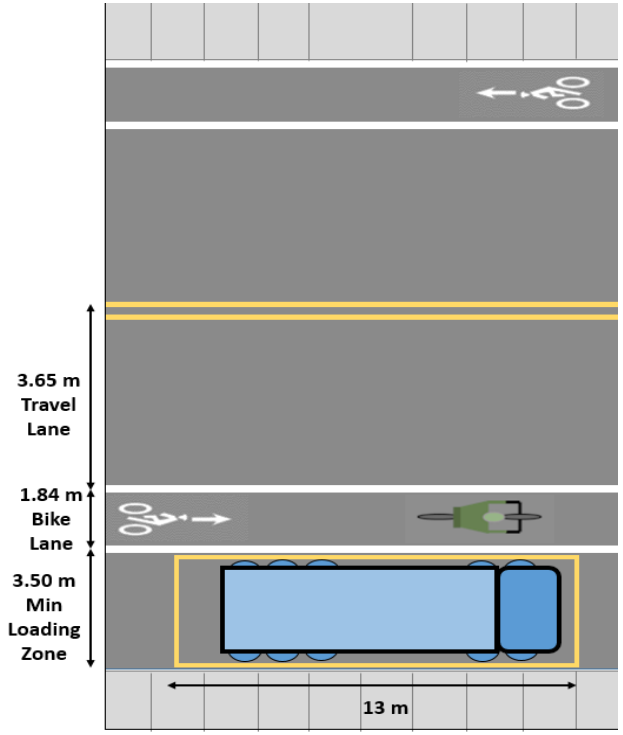
Researcher testing a scenario

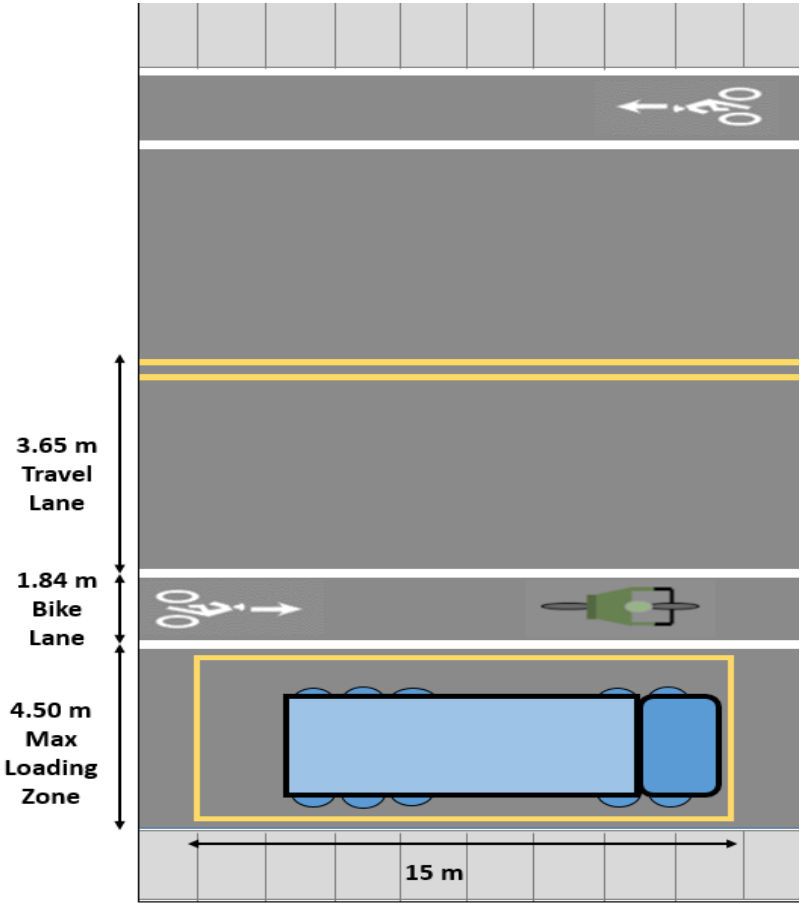
# Independent Variables & Levels

| VARIABLE | Level | LEVEL DESCRIPTION |
|---|---|---|
| Pavement Marking | 0 | No CVLZ – Truck in Bike Lane |
| | 1 | Min CVLZ – Size of the vehicle only |
| | 2 | Max CVLZ – Size of the vehicle plus desired operational footprint (total width = 4.50 m) |
| Courier Position | 0 | No Courier |
| | 1 | Courier Behind Vehicle |
| | 2 | Courier on Driver's Side |
| Accessory | 0 | No Accessory |
| | 1 | Hand Truck |

# Simulated Roadway Geometry



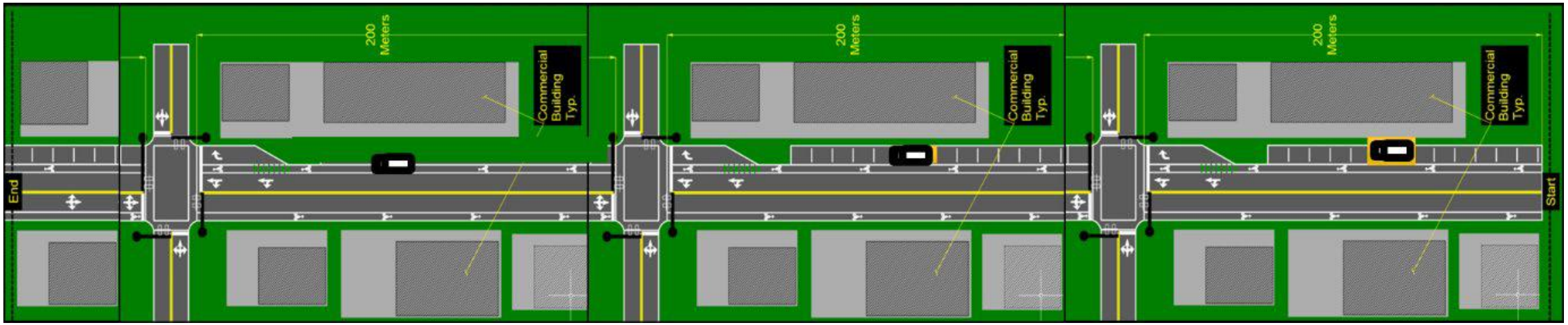




1 meter = 3.28 feet

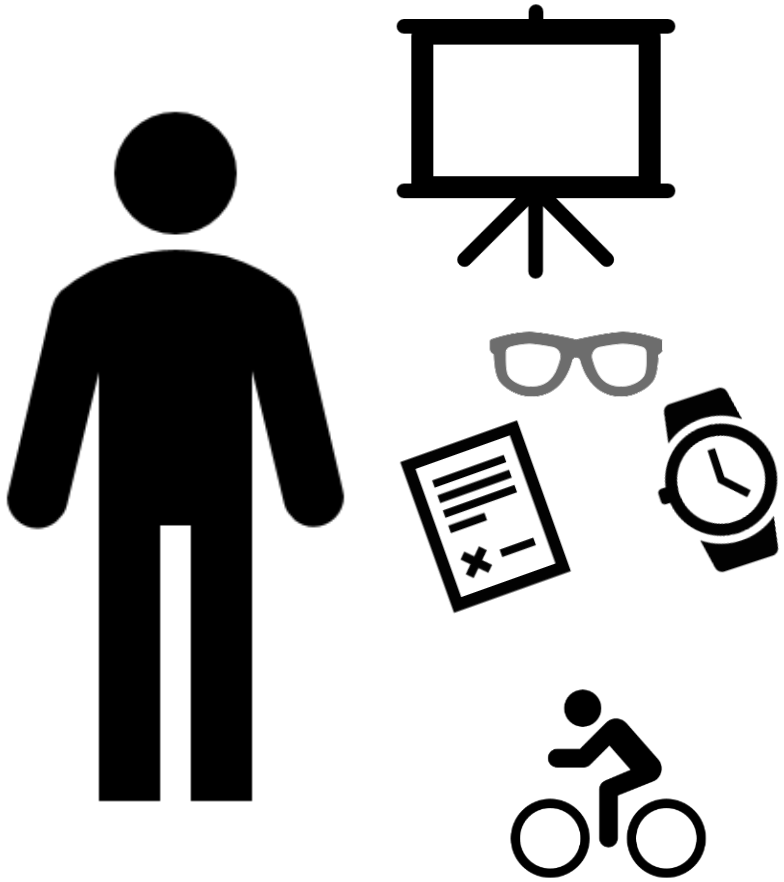
# Example Scenarios

# Example Sequence of Scenarios



# Experiment Protocol

- Recruitment
- Consent
- Pre-Screening
- Calibration
- Eye Tracking
- Experimental Ride
- Survey



# Experiment – Data Acquisition

Participants:

- 50 Participated
- 1 Simulator Sickness
- 1 calibration issue
- 48 Usable
- 864 scenarios
- 25 male, 25 female
- Age range 18-74 years
- Mean age: 32.94 years & SD = 11.52

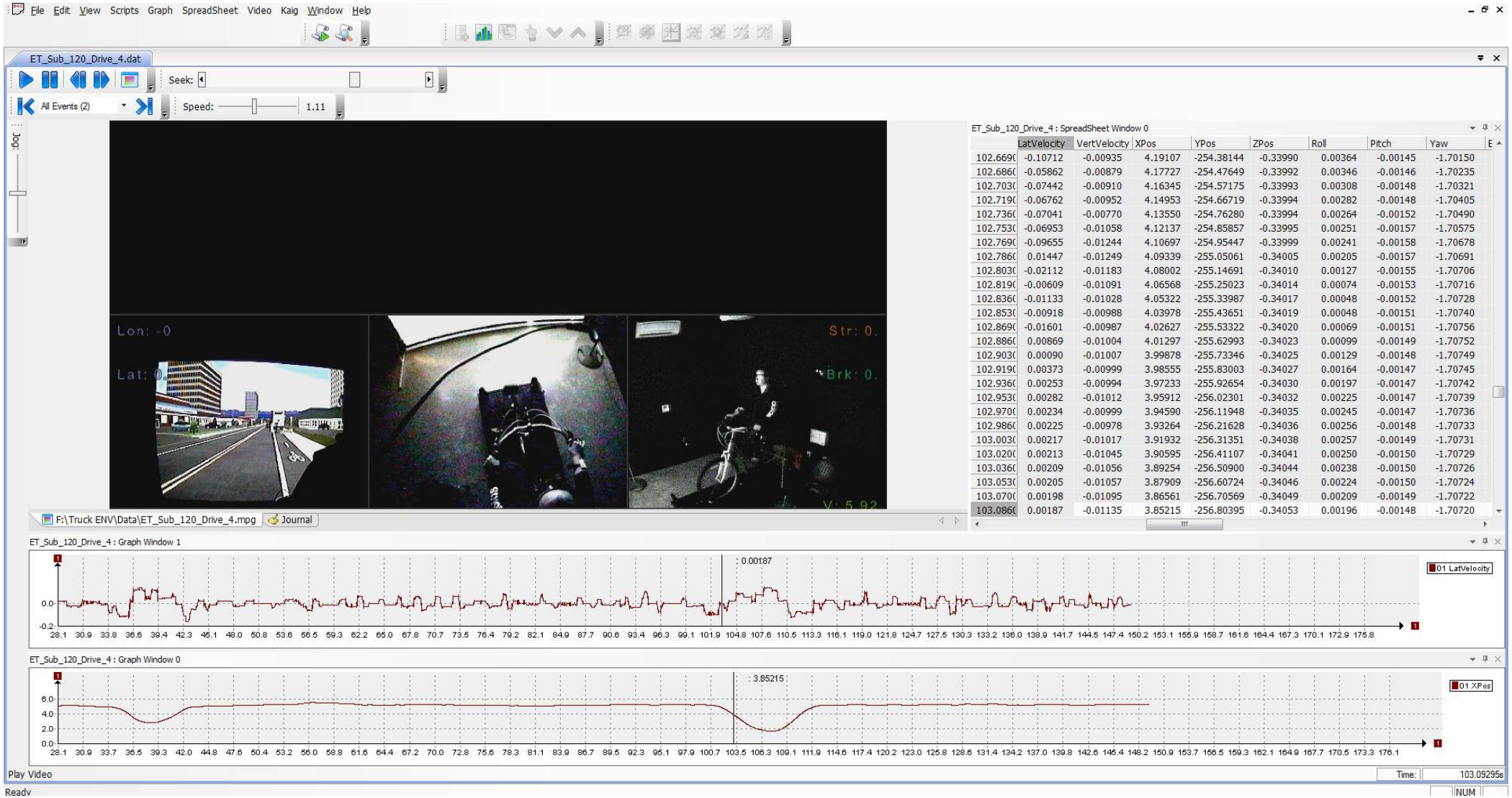
Data:

- GSR
- Visual attention
- Pre-post Survey

# Pre-Survey

| Bicycling Habit | Possible Responses | Number of Participants | Percentage OF Participants |
|---|---|---|---|
| Bicycling Mileage Per Week | Never | 6 | 12.0% |
| | Less than 1 mile | 7 | 14.0% |
| | 1-5 miles | 11 | 22.0% |
| | 5-10 miles | 11 | 22.0% |
| | 10-20 miles | 8 | 16.0% |
| | 20-50 miles | 6 | 12.0% |
| | 50+ miles | 1 | 2.0% |
| Type of Cyclist | Strong and Fearless | 5 | 10.0% |
| | Enthused and Confident | 34 | 68.0% |
| | Interested but Concerned | 11 | 22.0% |
| | No Way No How | 0 | 0.0% |
| Riding Purpose | Commuting to work/school | 30 | 30.6% |
| | Recreation | 34 | 34.7% |
| | Exercise | 33 | 33.7% |
| | None | 1 | 1.0% |

# Data Collection (SimObserver)

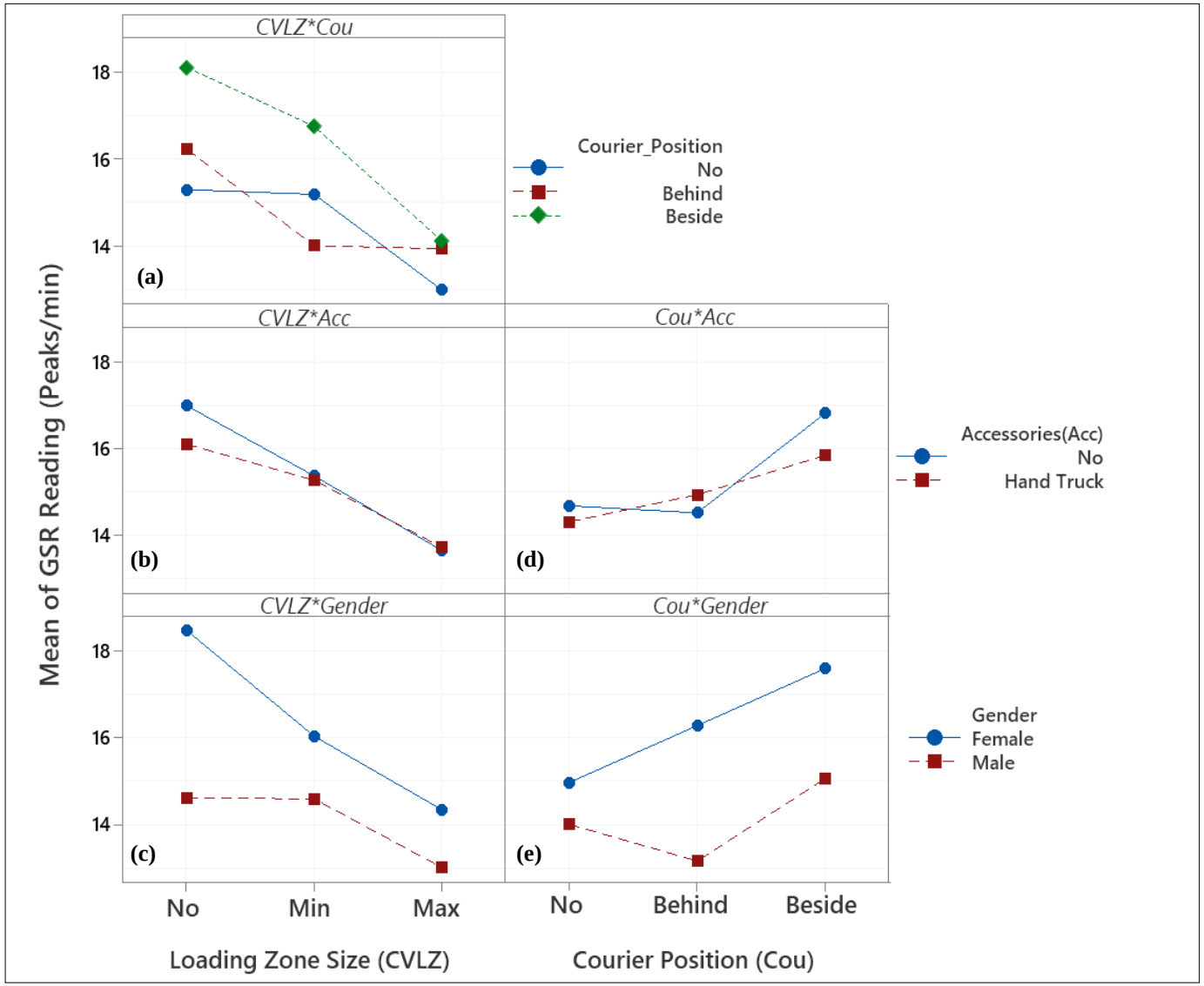


# Data Collection (iMotions)

- GSR (Galvanic Skin Response)
- Shimmer3 GSR + sensor
- Output: peaks/min

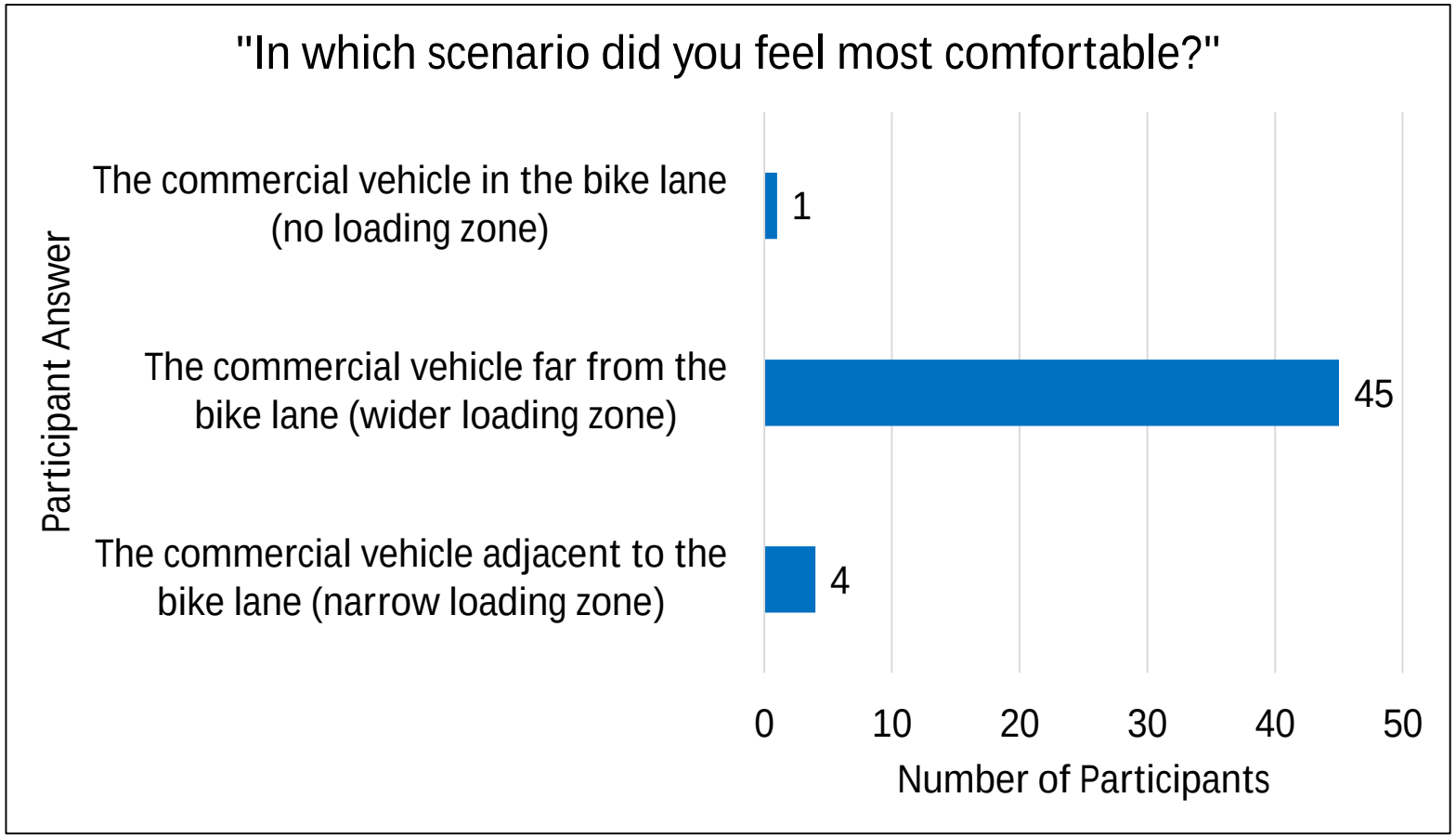

# Results (GSR)

- GSR Reading
- Two-way interactions of all possible variables



# Results (Post Survey VS GSR)

- Validating GSR

# Data Collection (Eye Tracking)


ASL Mobile Eye XG

# Results (TFD)

Oregon State University
College of Engineering


No CVLZ

# Results (TFD)

Oregon State University
College of Engineering

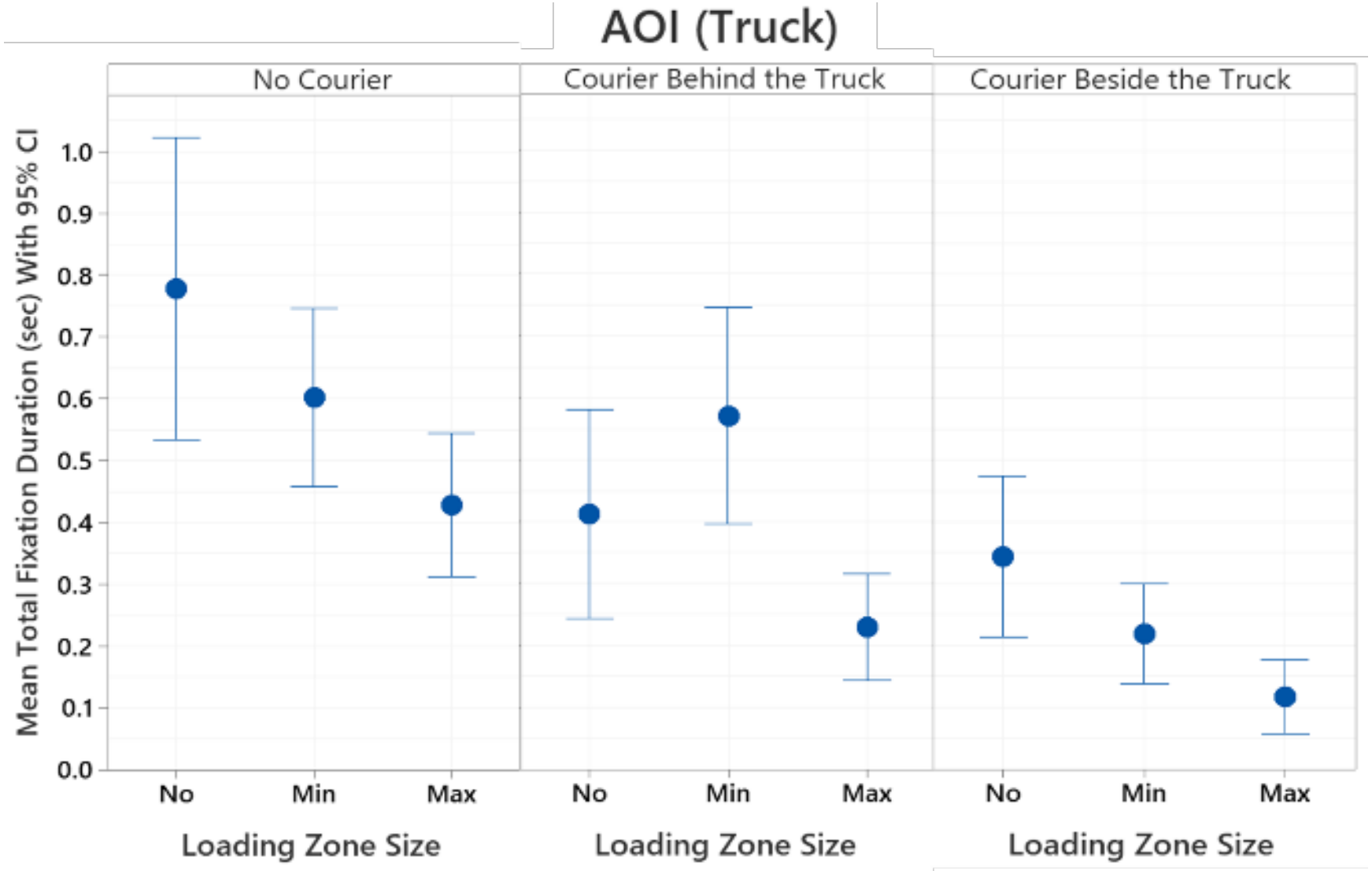

Min CVLZ

# Results (TFD)

Oregon State University
College of Engineering


Max CVLZ

# Results (Total Fixation Duration)



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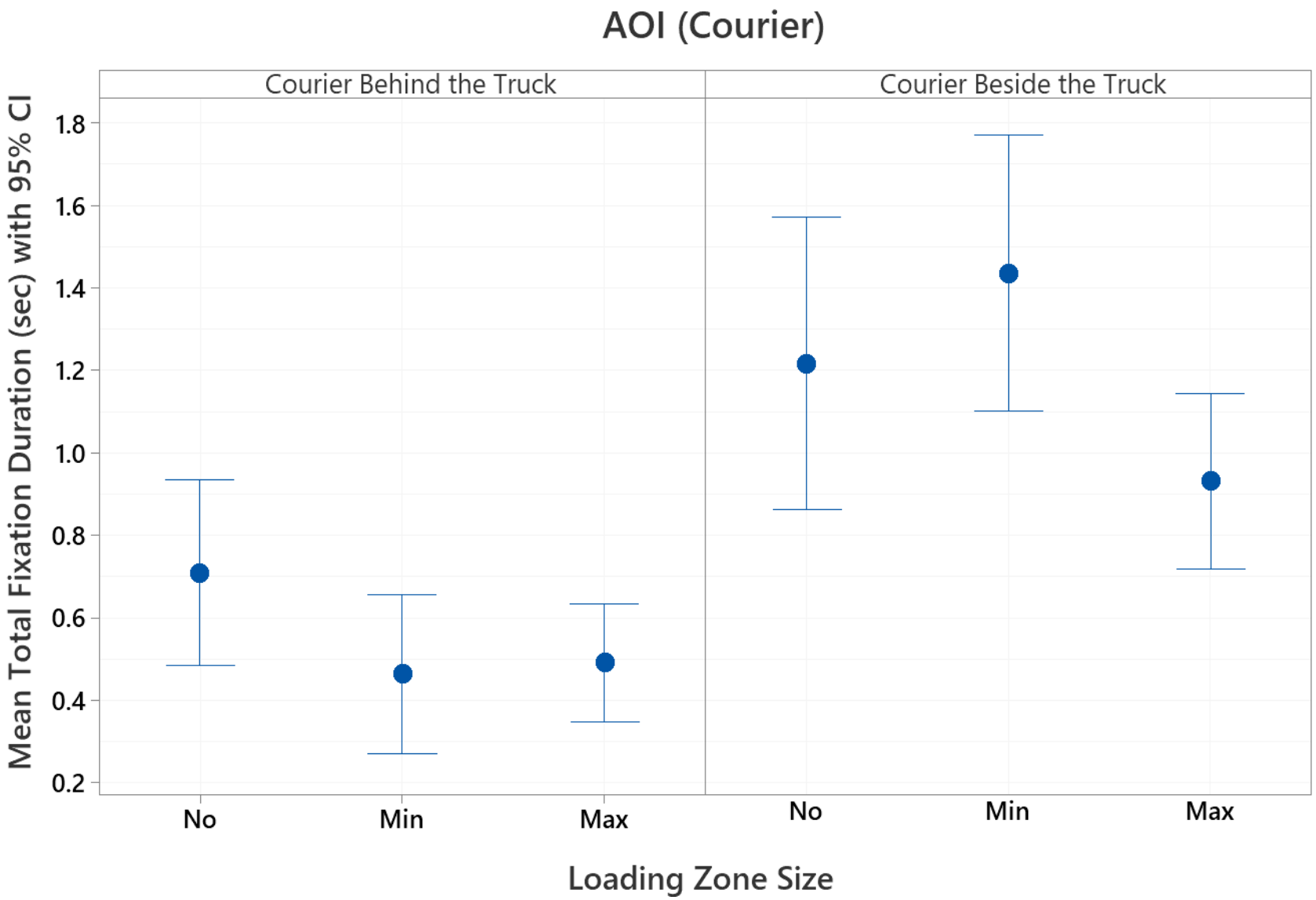
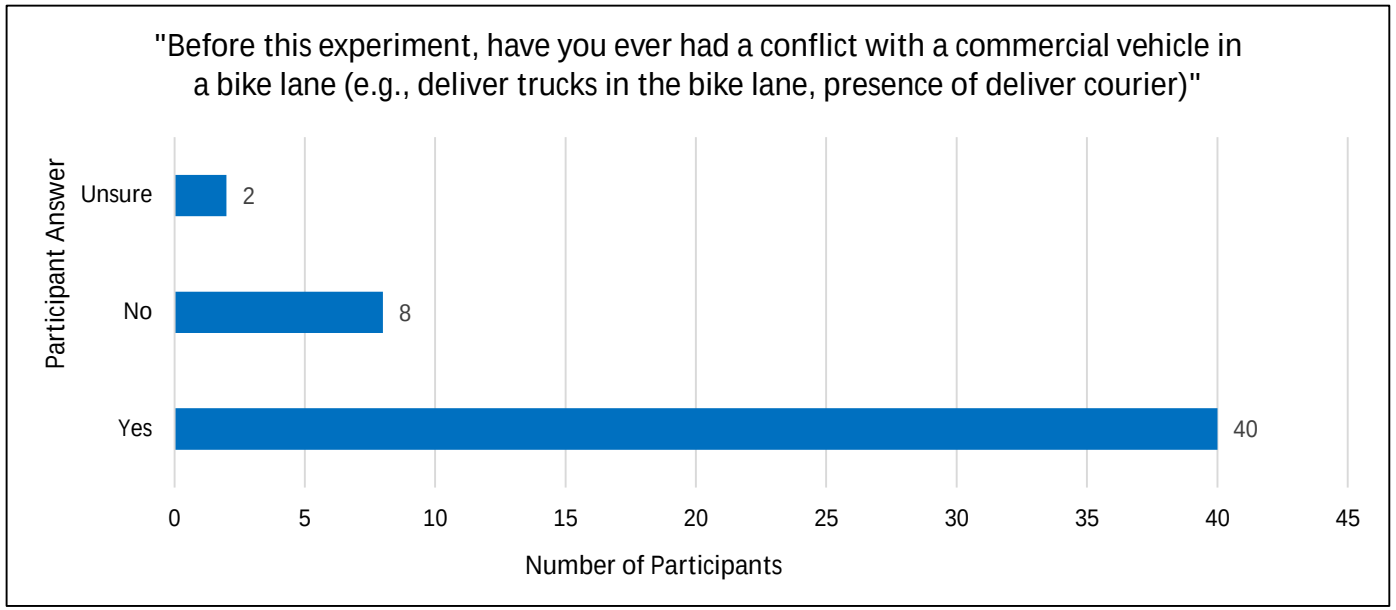
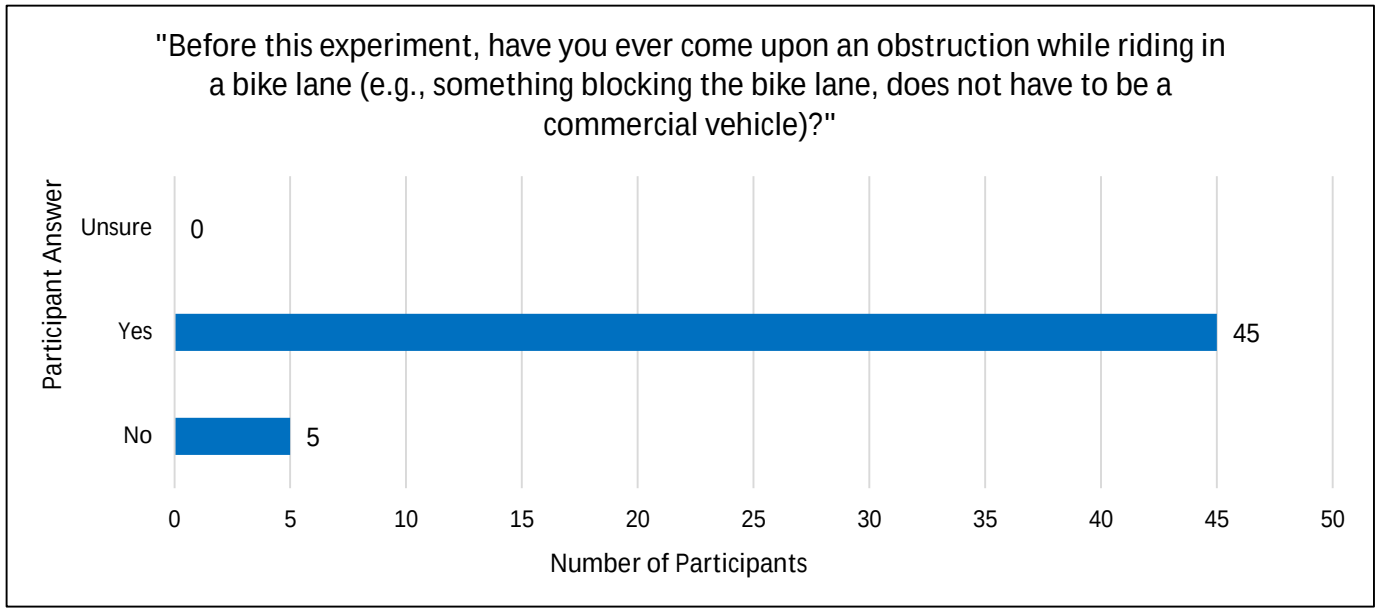


# Results (Post Survey)

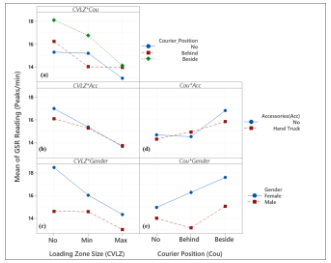
- Similar scenario exposure

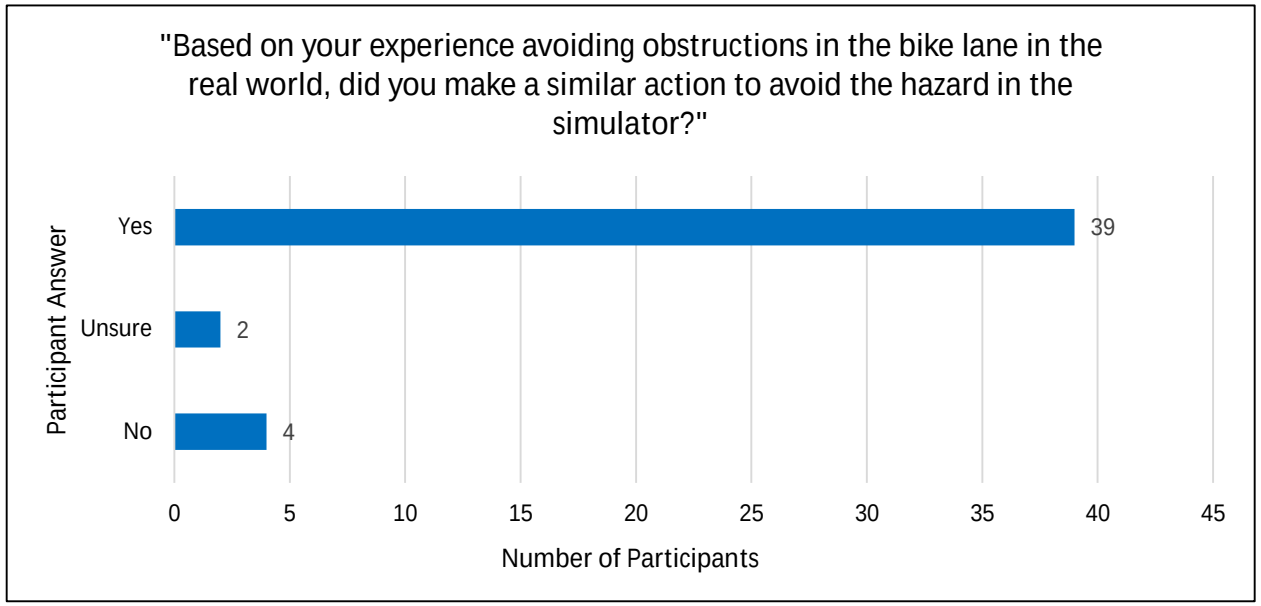


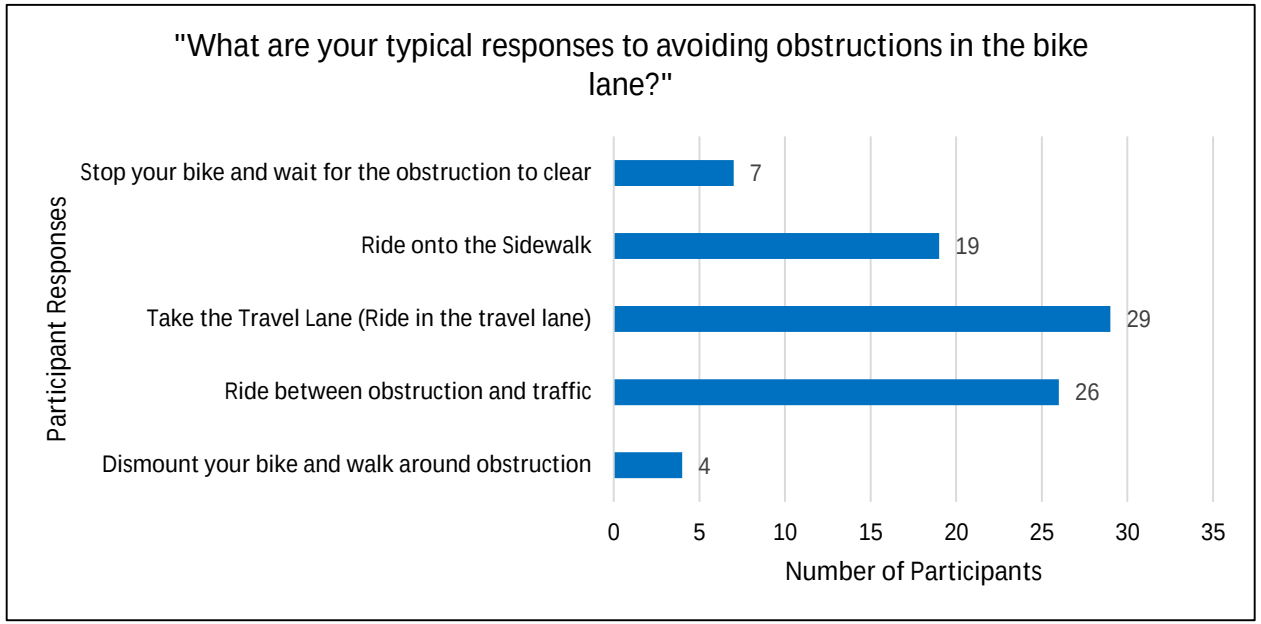



# Results (Post Survey)

- Validating behavioral results





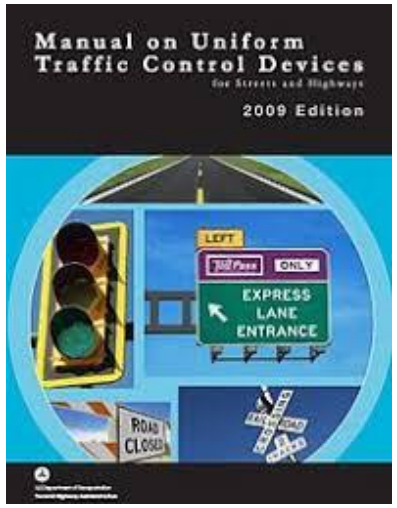



# Conclusion

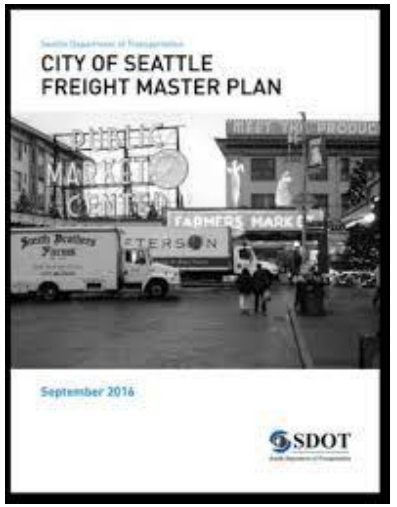
- Loading zone size and courier position had the greatest effect on cyclist's physiological responses.
- Cyclists had approximately 2 peaks per min higher when riding in the condition that included no CVLZ and courier on the side compared to the base conditions (i.e., Max CVLZ and no courier).
- When the courier was beside the truck, cyclist's fixation durations (sec) were 1 second greater than when the courier was located behind the truck, indicating that cyclists were more alert as they passed by the courier.
- The presence of accessories had the lowest influence on both cyclists' physiological response and eye tracking
- About one third of participants decided to use the sidewalk.

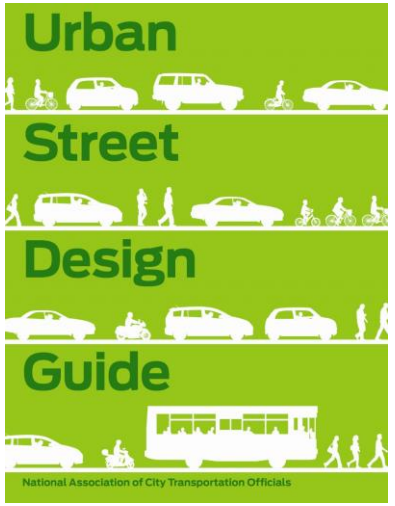
# Recommendations for Practice

- No divergence from bike lane
- Placing barriers on the left side of the bike lane
- Passenger side instead of driver side
- Policy considerations regarding the width of the bicycle lane
- Provision of an additional curb ramp
- Extra buffer in CVLZ for courier improves cyclist's performance measures positively The use of sidewalk




*Can I Ride My Bike On The Sidewalk?*



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# Questions


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