Pilot Demonstration to Enhance Road User Safety in Asbury Park, NJ

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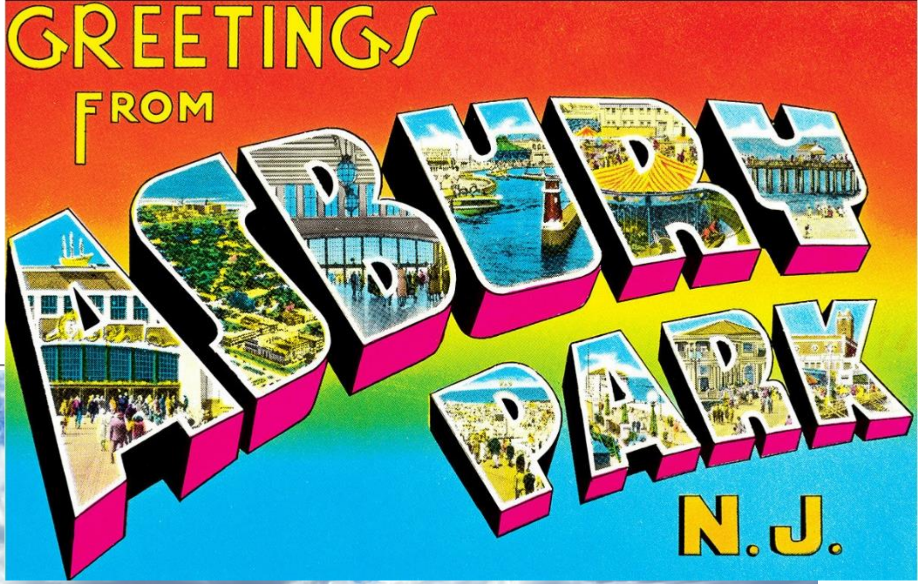
Introduction

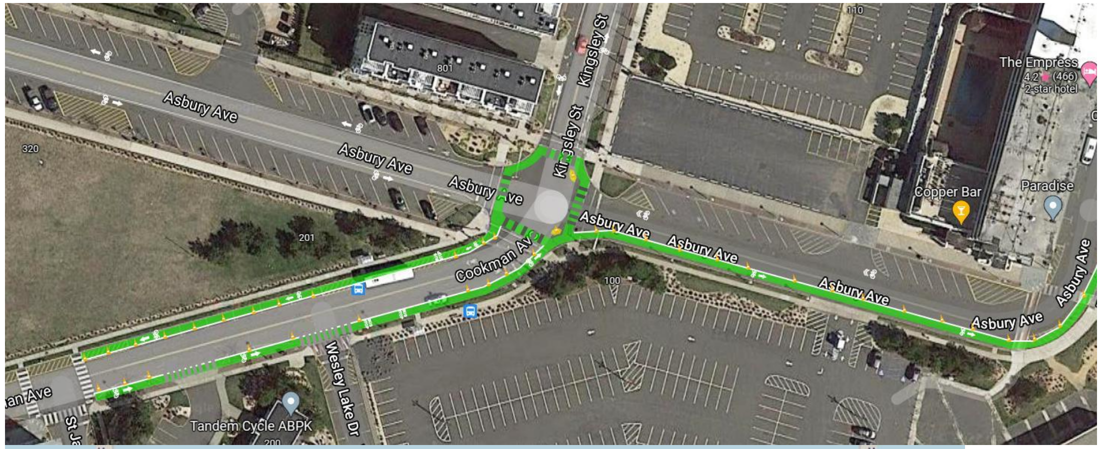
NSF Project: Making Micromobility Smarter and Safer 2020-2024

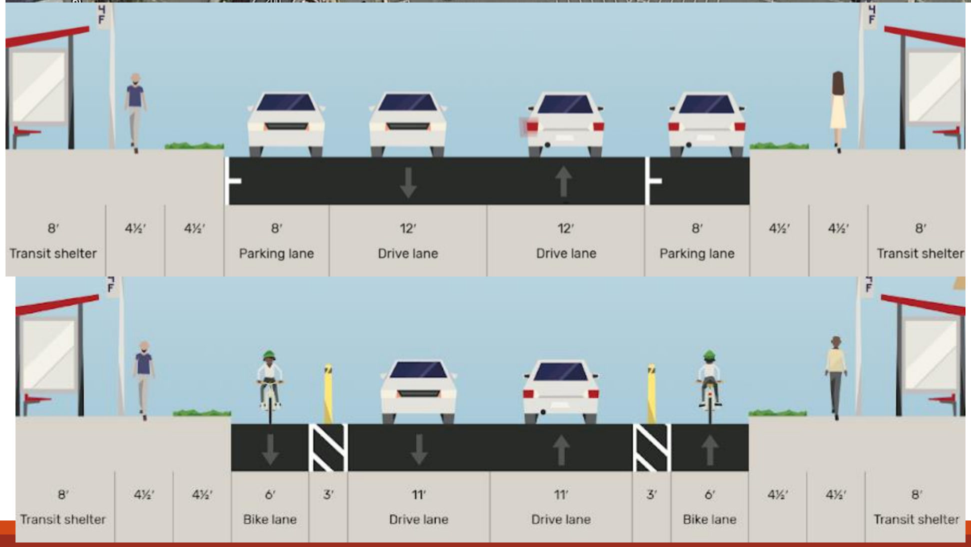
Transportation Planning Studio in the Spring 2022: Smart and Connected: Micromobility Demonstration Project in Asbury Park, NJ.

- Objective: To address safety of non-motorists at a high traffic intersection by adding a bicycle lane.
- Methods for assessing safety: intercept survey (online and in-person), traffic camera footage, and biometric sensors.

Bike lane in Asbury Park







No Bike Lanes

Bike Lanes with Paint

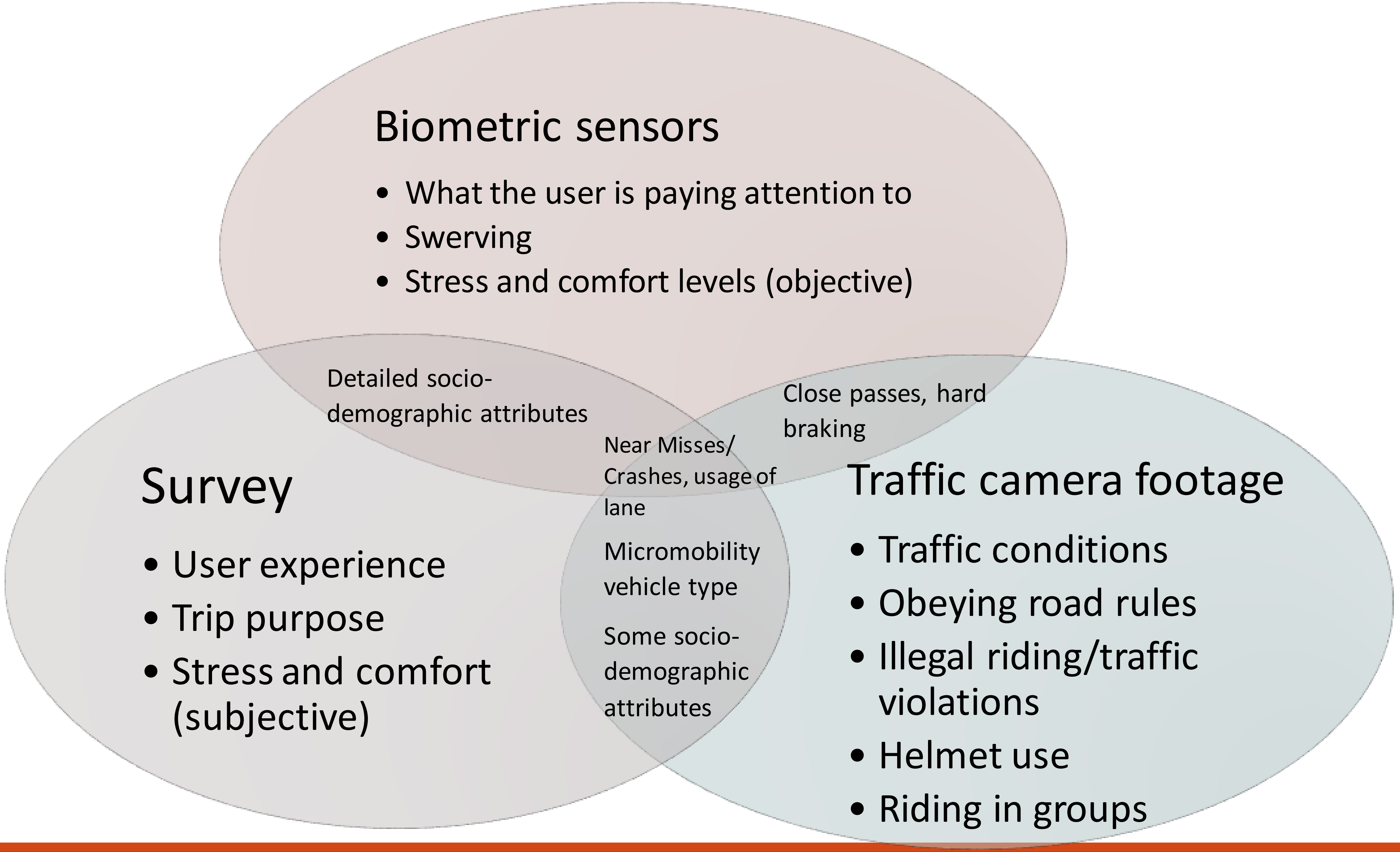
Bike Lanes with Delineators & Cones

Research Questions

1. Is it possible to assemble an integrated view of micromobility safety by triangulating with multiple methods?
2. Is such a construct useful for evaluating a tactical urbanism experiment on micromobility safety?

Methods

1. **Survey**: we developed a 5-minute feedback survey in Qualtrics.
   - We aimed to capture sentiments of the pop-up bike lane among pedestrians and cyclists, as well as socio-demographic attributes.
   - The survey was deployed online, although print outs were handed out in the field as an additional option.
2. **Traffic Camera Footage**: we retrieved 10 days of footage (before, during, and after the removal of the temporary bike lane)
   - We aimed to capture lane usage, helmet use, near-misses, close-calls, and some demographic attributes.
3. **Biometric Sensors:** we used eye-tracking glasses and Galvanic Skin Response (GSR) sensors
   - We aimed to capture cognitive workload, stress levels, and attention span.


Biometric sensors
What the user is paying attention to
Swerving
Stress and comfort levels (objective)
Detailed socio-demographic attributes
Close passes, hard braking
Near Misses/ Crashes, usage of lane
Micromobility vehicle type
Some socio-demographic attributes
Survey
User experience
Trip purpose
Stress and comfort (subjective)
Traffic camera footage
Traffic conditions
Obeying road rules
Illegal riding/traffic violations
Helmet use
Riding in groups

Survey results

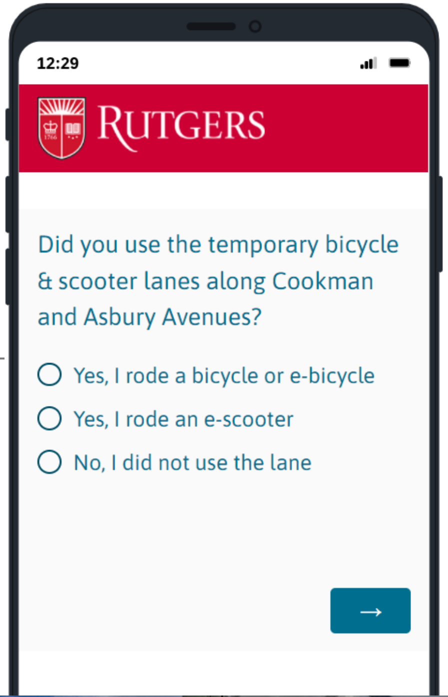
We received 69 responses.

Our survey was skewed towards older individuals; more than half were over 50 years old.

78% were frequent micromobility users: 71% of the respondents are frequent cyclists and 26% are frequent e-scooterists (at least a few times a month).

34% of micromobility users experienced a near-miss or fear for their safety during their last micromobility trip; 77% of those people had no bike-lane available to them.

90% of all respondents wish to see the temporary lane permanent.



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Gender split and safety behavior of cyclists and e-scooter users in Asbury Park, NJ

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Traffic Camera Footage Part 1: Attributes

35 hours of footage were analyzed via manual counts.

Research interests: Prevalence of women riders, of helmet use, riding on bike lane, and riding as a group.

Helmet use was low among cyclists, and non-existent among e-scooterists.

The **gender gap** was narrower among e-scooter users.

Shared e-scooters were more likely to be a **group activity** (80%) than private cycling (36%).

65% of micromobility users used the new **bike lane.**

Traffic Camera Footage Part 1: Helmet use

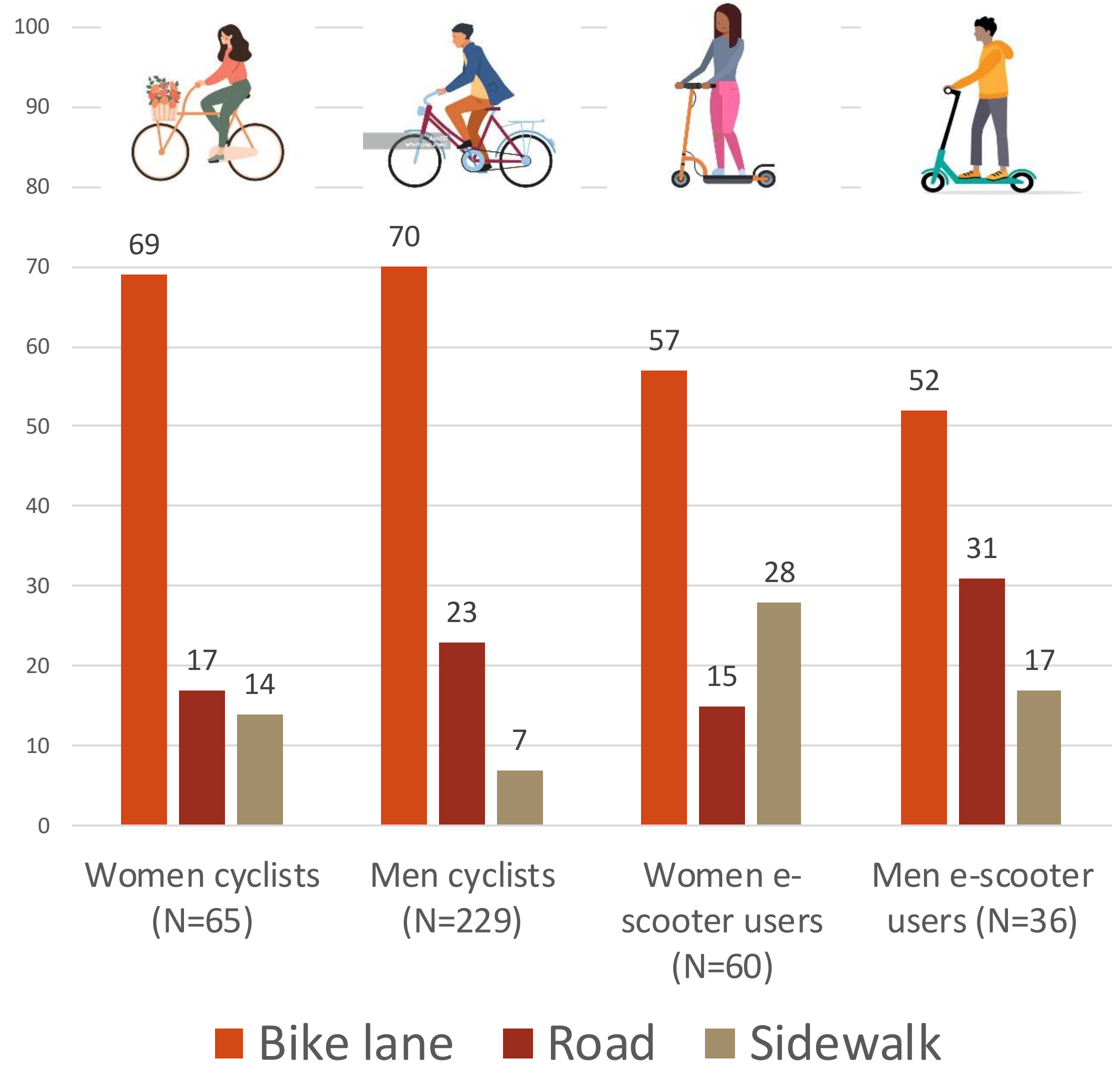
35% of cyclists wore a helmet.

Using a binomial logistic regression (N=493), we found that:

- Cyclists who were **male**, riding in a **group**, riding on the **road**, riding in the morning, and riding on weekends were associated with higher helmet use.

Risk compensation. Protective behavior does not necessarily beget protective behavior. Helmet users were less likely to use the bike lane than non-helmet users.

Morning cyclists were 2.7 times as likely to wear a helmet than afternoon cyclists.



Traffic Camera Footage Part 1: Lane use

Using a multinomial logistic regression (N=437), we found that:

- **Users of the bike lanes** tended to be cyclists, not helmet wearers, traveling alone, and afternoon travelers.
- People turning right were five times as likely to use the bike lane than those making a left turn or going straight. This shows that this configuration may not be easily usable by users going in any direction.

The table here shows the percentage of lane usage by gender and micromobility mode.

- **Women and e-scooter users** are more likely to use the **sidewalk** than men and cyclists, respectively.
- Men are more likely to ride on the road than women.

Traffic Camera Footage Part 2: Trajectory and speed

40 hours of traffic footage were analyzed via computer vision.

Research interest: Does the implementation of the bicycle lane have a traffic calming effect?

SiamMot was used to track pedestrians and vehicles in the intersections. The model was trained using COCO-17 and VOC12 datasets.

2D trajectories are converted into 3D trajectories using LiDAR. 3D trajectories are converted to speed.

Traffic Camera Footage Part 2: Traffic calming

Data: 12,000+ motor-vehicle trajectories and speeds during 40 hours of traffic camera footage

Methods: Computer vision and generalized linear modeling

Findings

- The delineator-protected bike lane was associated with a **22% decrease** in speeds for vehicles turning right on Asbury from Cookman, and a 5% decrease in speeds going straight on Cookman/Kingsley.
- The painted-only bike lane was associated with an **10% decrease** in speeds for right-turns, with no other significant decrease in other directions.

Traffic Camera Footage Part 3: Detection of near-misses

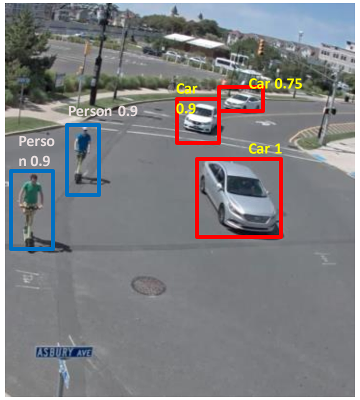
Research interest: Can we develop an algorithm that can detect e-scooters and near-misses between different vehicles? *(Ongoing)*

Current open-source machine learning models (e.g. YOLOv3) do not properly detect e-scooters.

We are currently developing an algorithm that can accurately detect pedestrians, bikes, e-scooters, and vehicles.

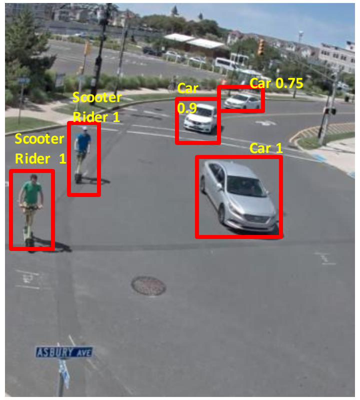
Raw Video

YOLO V3



Video with YOLO pre-train Label

Customized Model

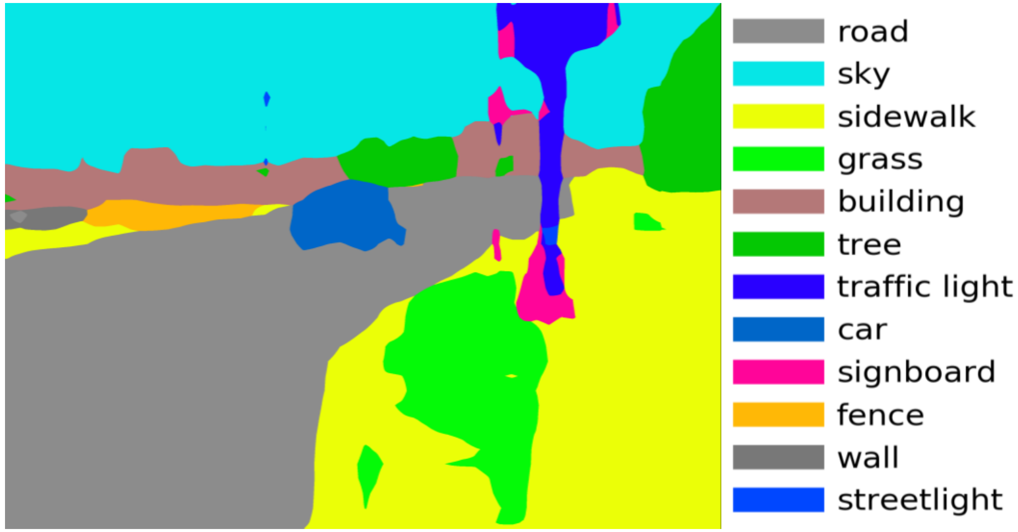


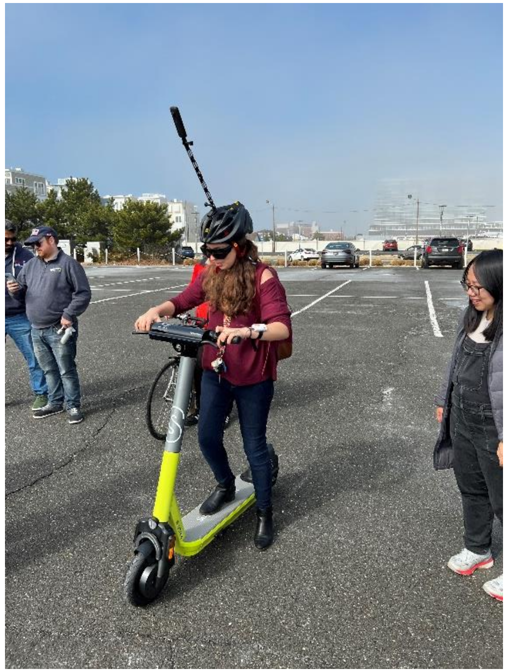
Video with both pre-train Label and Customized Label (biker, Scooter)

Biometric Sensors

By converting the eye-tracking video to image segmentation using PSPNet, we found that the user paid attention to the road 93% of the time.

The user paid attention to the road more often when at an intersection than when riding through a road segment.

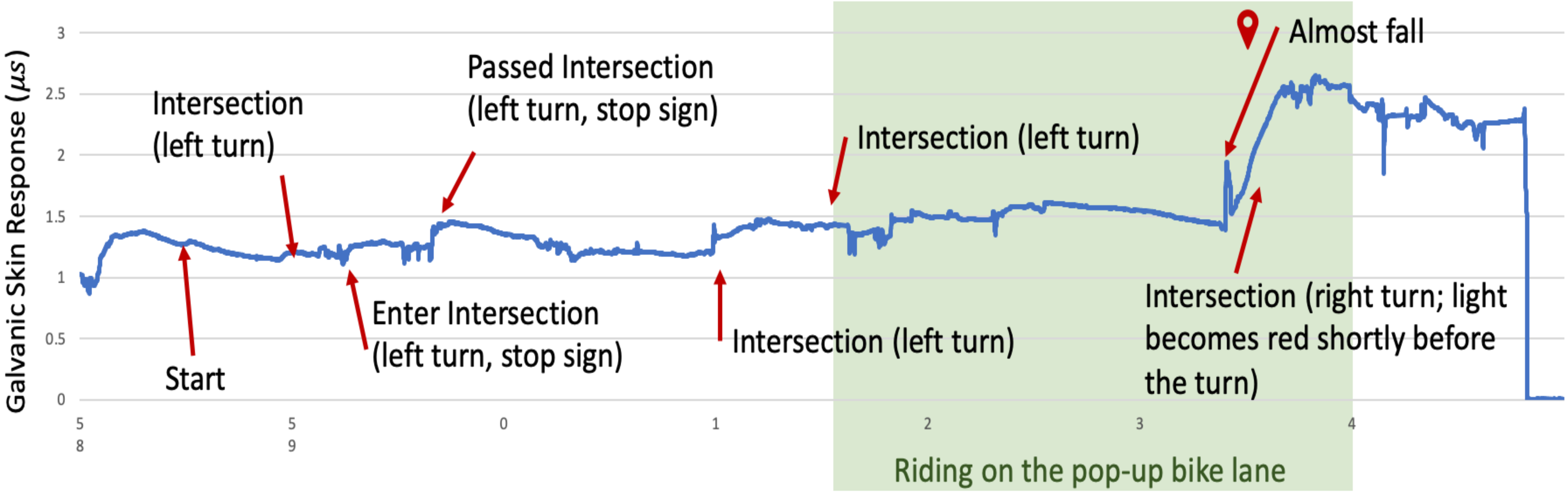




Biometric Sensors

GSR offered insights on when stress levels peaked, including information on possible close-calls or near misses.

This experiment is a proof-of-concept and is currently being deployed as a larger study.



Discussion and conclusion

Most tactical urbanism studies and near-misses studies use only one or two methods to assess safety.

What have we found?

Yes, it is possible to assemble an integrated view of micromobility safety by triangulating with multiple methods. Yes, such a construct is useful for evaluating a tactical urbanism experiment on micromobility safety.

This study realizes a more integrated view of micromobility safety by using more than one method at once.

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https://bloustein.rutgers.edu/micromobility/

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