Distracted Driving Summit 2022

Improving Methods to Measure Attentiveness Through Driver Monitoring

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Distracted driving is a predominant issue in vehicle safety.

Claimed

3,142

lives in 2019*

"Distracted driver texting with mobile cellphone" by T. Vesalainen, 2021, Alamy Stock Photo. Retrieved from https://www.hobbaspilow.com/wp-content/uploads/2021/08/forms-of-distracted-driving.jpg, July 2022.

*National Highway Traffic Safety Administration, *Driver Distraction & Electronic Device Use*, 2020, https://crashstats.nhtsa.dot.gov/#!/PublicationList/41

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- What metrics can be used to determine when a driver is inattentive?
- How often is a driver inattentive during one trip?
- Will inattention increase with more advanced vehicles (L2/L3)?
- What is the most effective way to reduce driver distractions?

*National Highway Traffic Safety Administration, *Driver Distraction & Electronic Device Use*, 2020, https://crashstats.nhtsa.dot.gov/#!/PublicationList/41

Driver Monitoring Systems (DMS) have the potential to detect and reduce driver inattention.

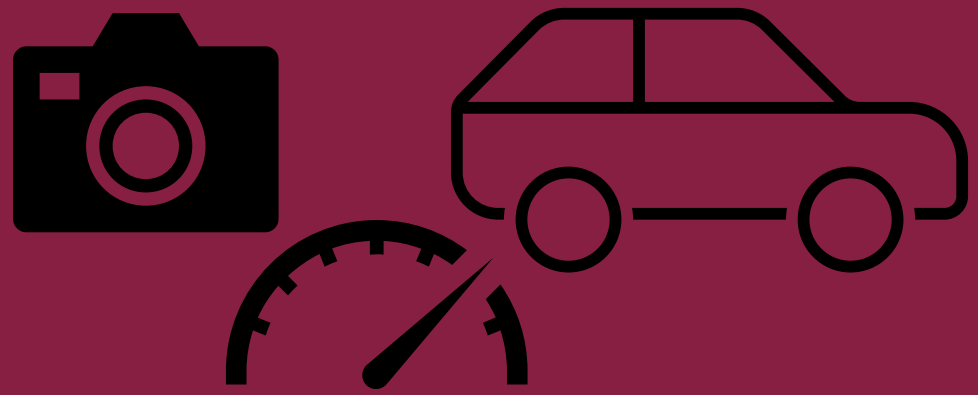
"envisages an incentive for driver monitoring systems that effectively detect impaired and distracted driving and give appropriate warning and take effective action"

Euro NCAP 2025 Roadmap

Euro NCAP 2025 Roadmap: In Pursuit of Vision Zero, 2017, https://cdn.euroncap.com/media/30700/euroncap-roadmap-2025-v4.pdf

A privately funded naturalistic driving database was made available to support this study's research objectives.

- Individuals recruited to use the equipped research vehicles in place of their personal vehicle
- Collection of DMS output and vehicle parameters, including:
  - Glance Location
  - Speed
  - Acceleration
  - Steering Wheel Torque
  - Throttle Pressure
  - Brake Pressure



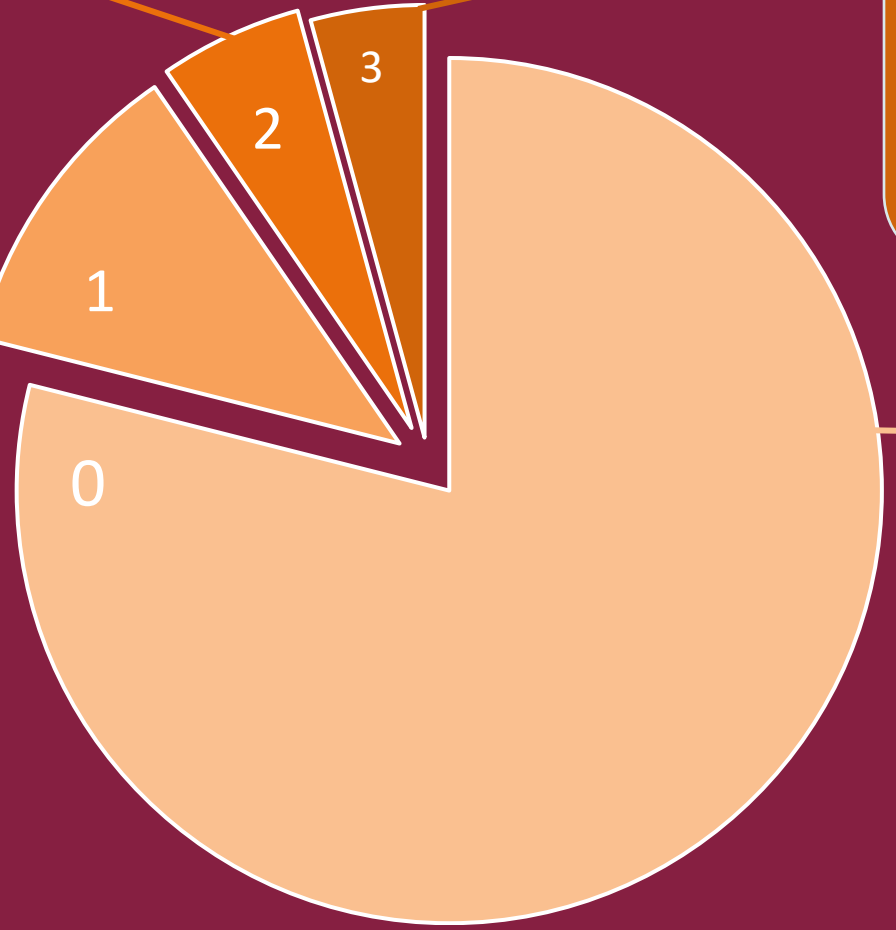
Given context (10 seconds) before the attention rating, we determined the driver's attention level at the end of the event.

Moderately Distracted
73 events

Driver has more extended glances off road, sometimes with phone use or longer uses of the center console

Very Distracted
58 events

Driver has combined sources of distraction with prolonged glances off road to a cell phone and the center console



Slightly Distracted
157 events

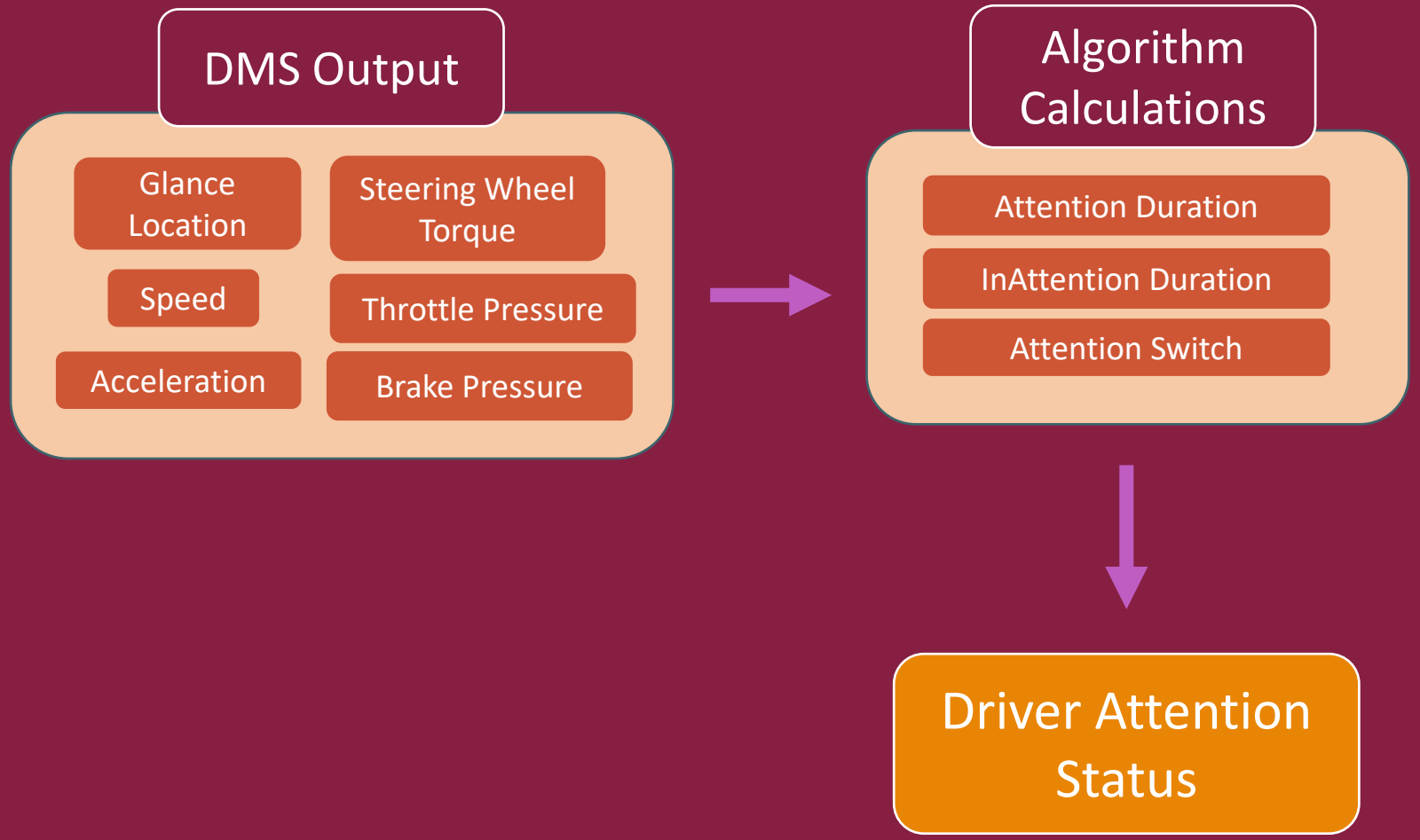
Driver is looking around, often to the center console, for longer periods of time

Not Distracted
1,079 events

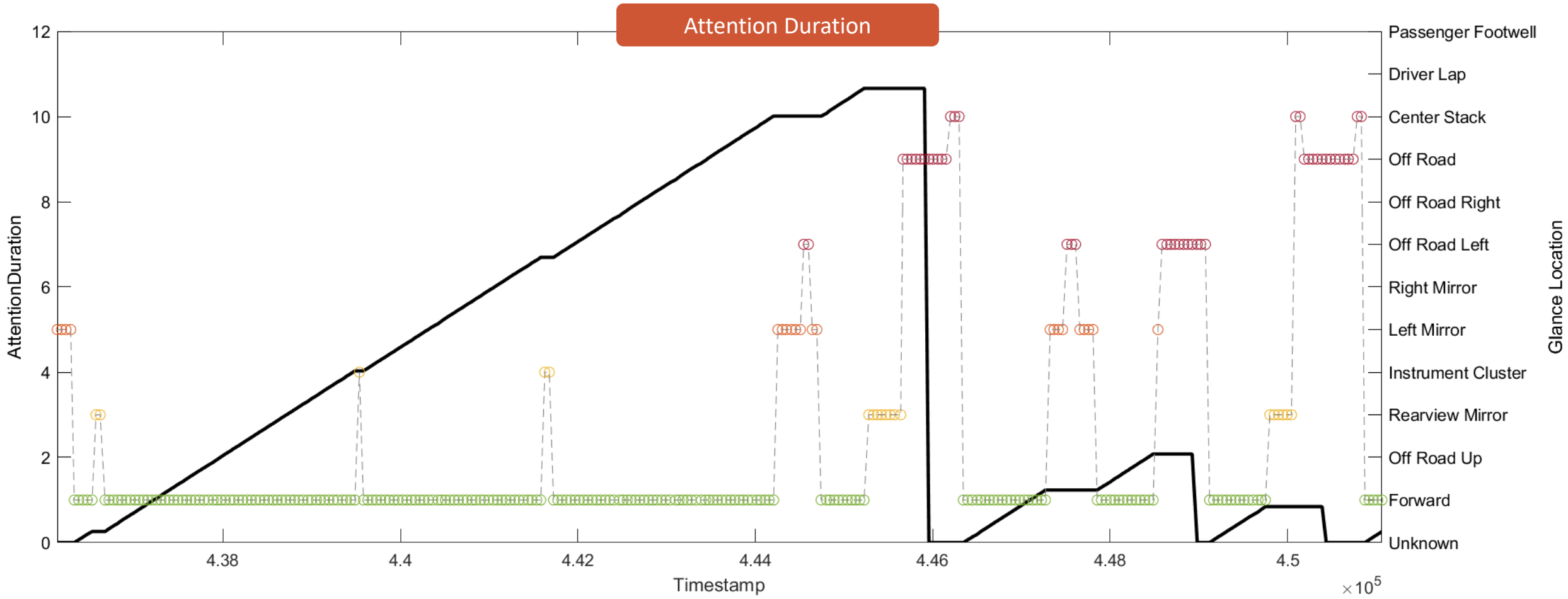
Driver is clearly engaged in the driving task, characterized by glances off road to locations relevant for safe driving

1,367 events

At each timepoint, values were calculated within the algorithm to output the suspected attention level of the driver.



Moderately Distracted



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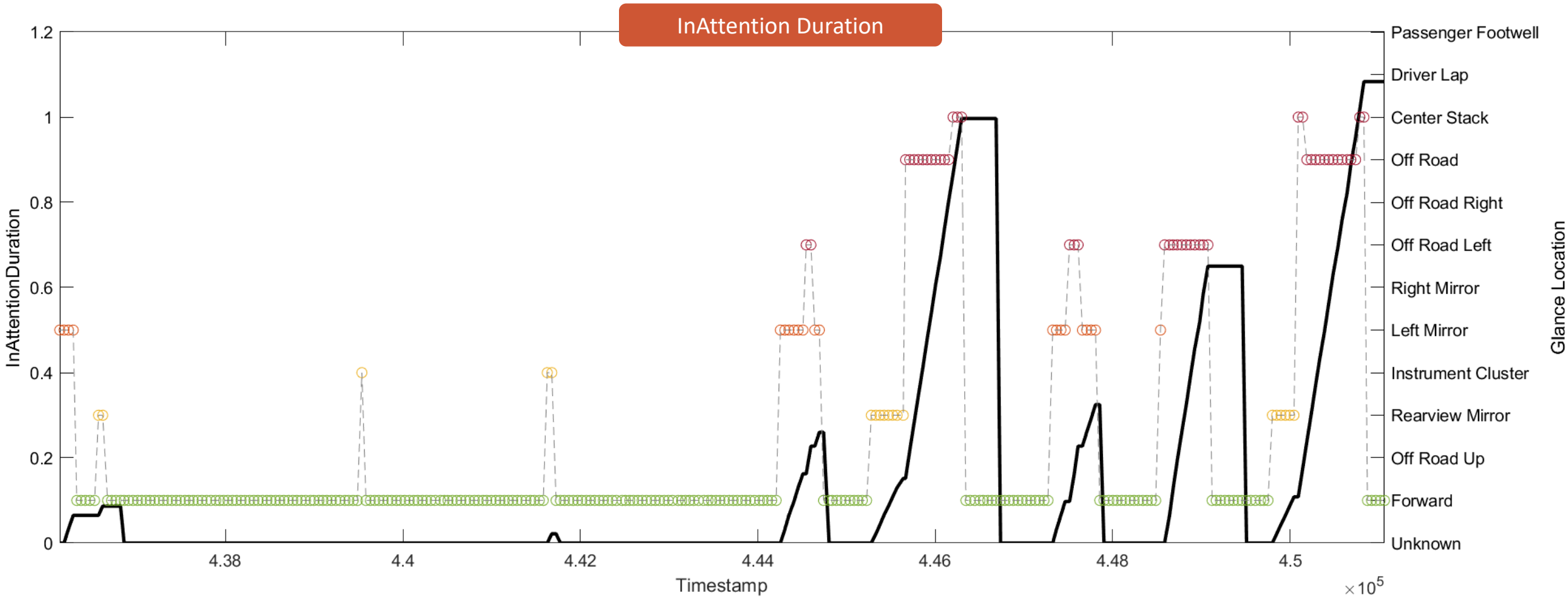

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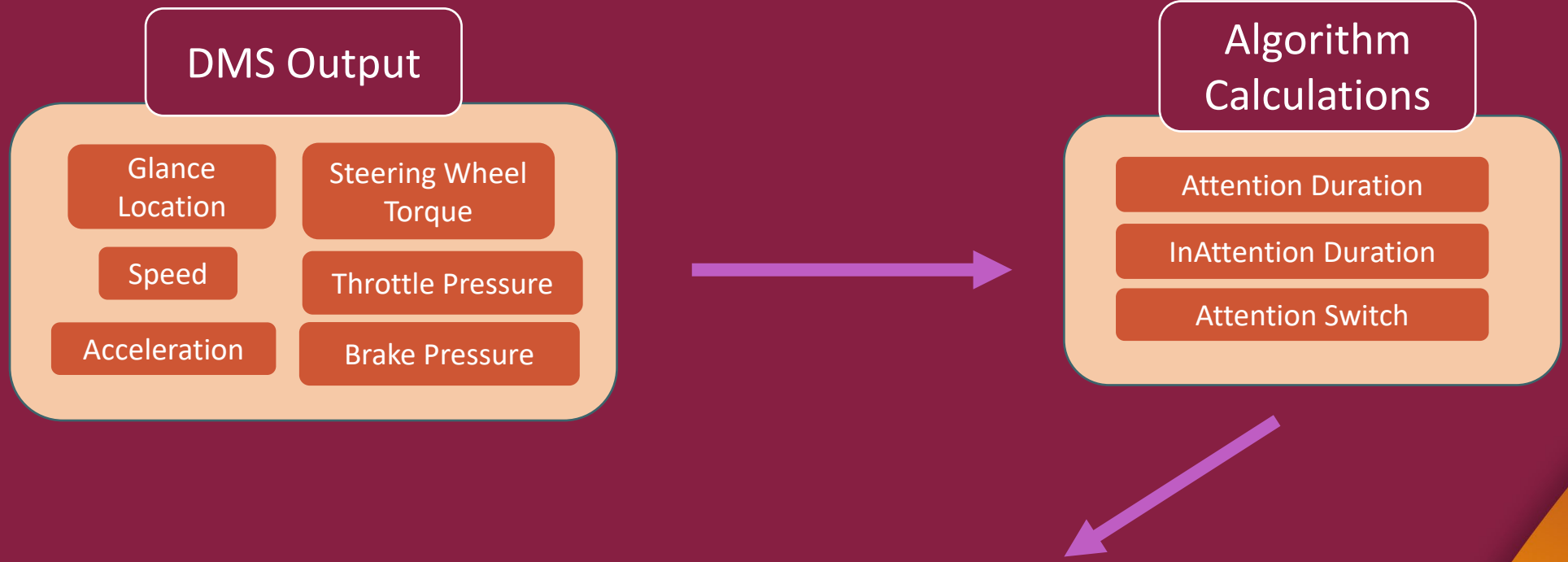

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DMS Output

- Glance Location
- Steering Wheel Torque
- Speed
- Throttle Pressure
- Acceleration
- Brake Pressure

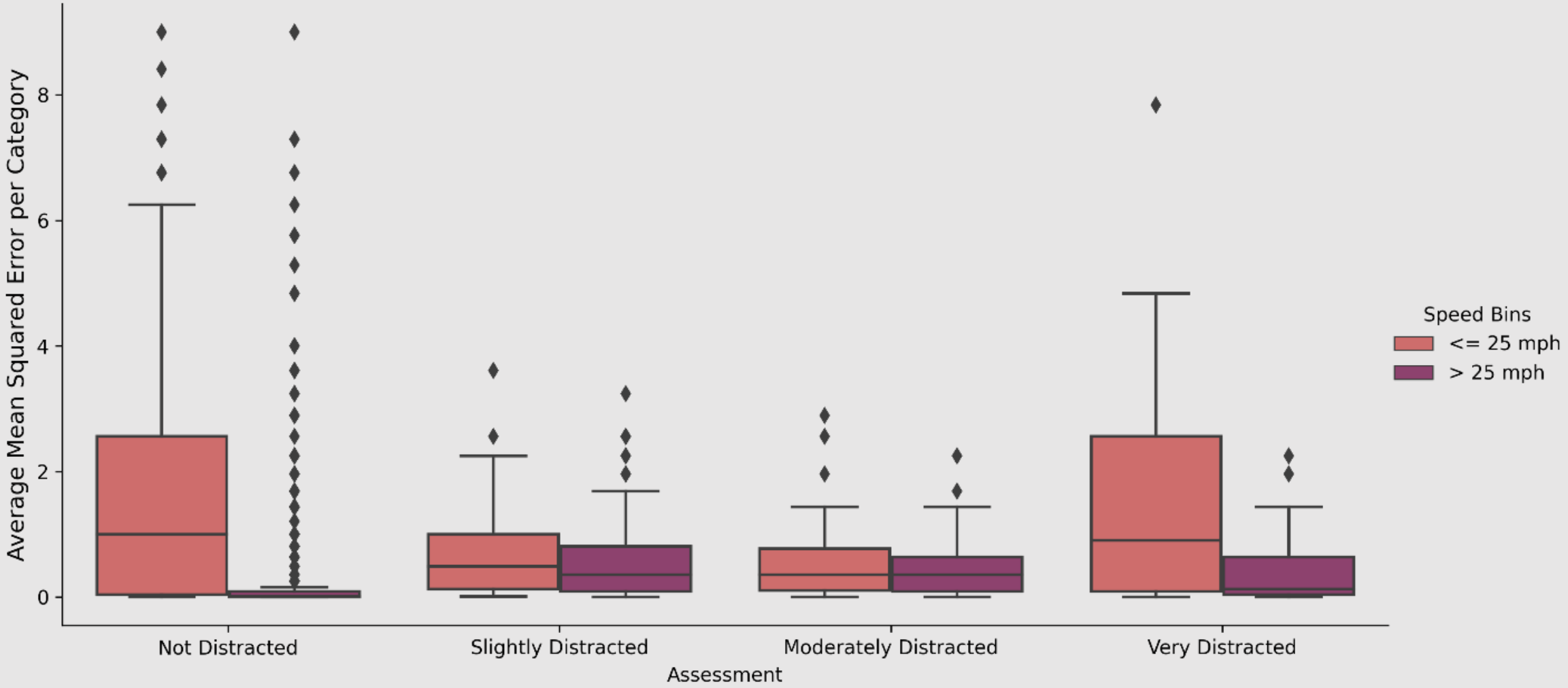
What weights do we use to add to the AttentionDuration and InAttentionDuration?

Algorithm Calculations

- Attention Duration
- InAttention Duration
- Attention Switch

Benchmark Assessment vs **Driver Attention Status**

We can compare different parts of each algorithm to see how different variables affect the algorithm output.



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DMS Output

- Glance Location
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Algorithm Calculations

- Attention Duration
- InAttention Duration
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How do we use these calculations to assign the driver's attention status?

Benchmark Assessment **vs** Driver Attention Status

At each timepoint, values were calculated within the algorithm to output the suspected attention level of the driver.

DMS Output

- Glance Location
- Steering Wheel Torque
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- Throttle Pressure
- Acceleration
- Brake Pressure

Algorithm Calculations

- Attention Duration
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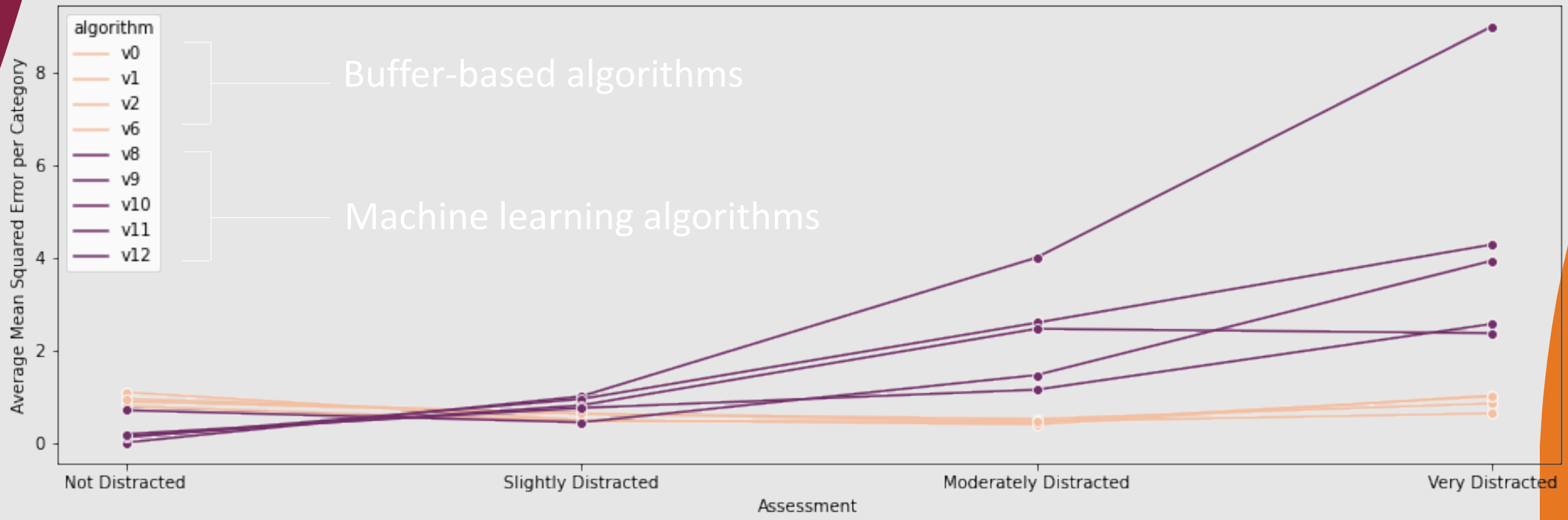
- Attention Switch

How do compare the algorithm output to the benchmark?

Benchmark Assessment vs **Driver Attention Status**

We can compare algorithms against one another to determine the correct algorithm for each application.



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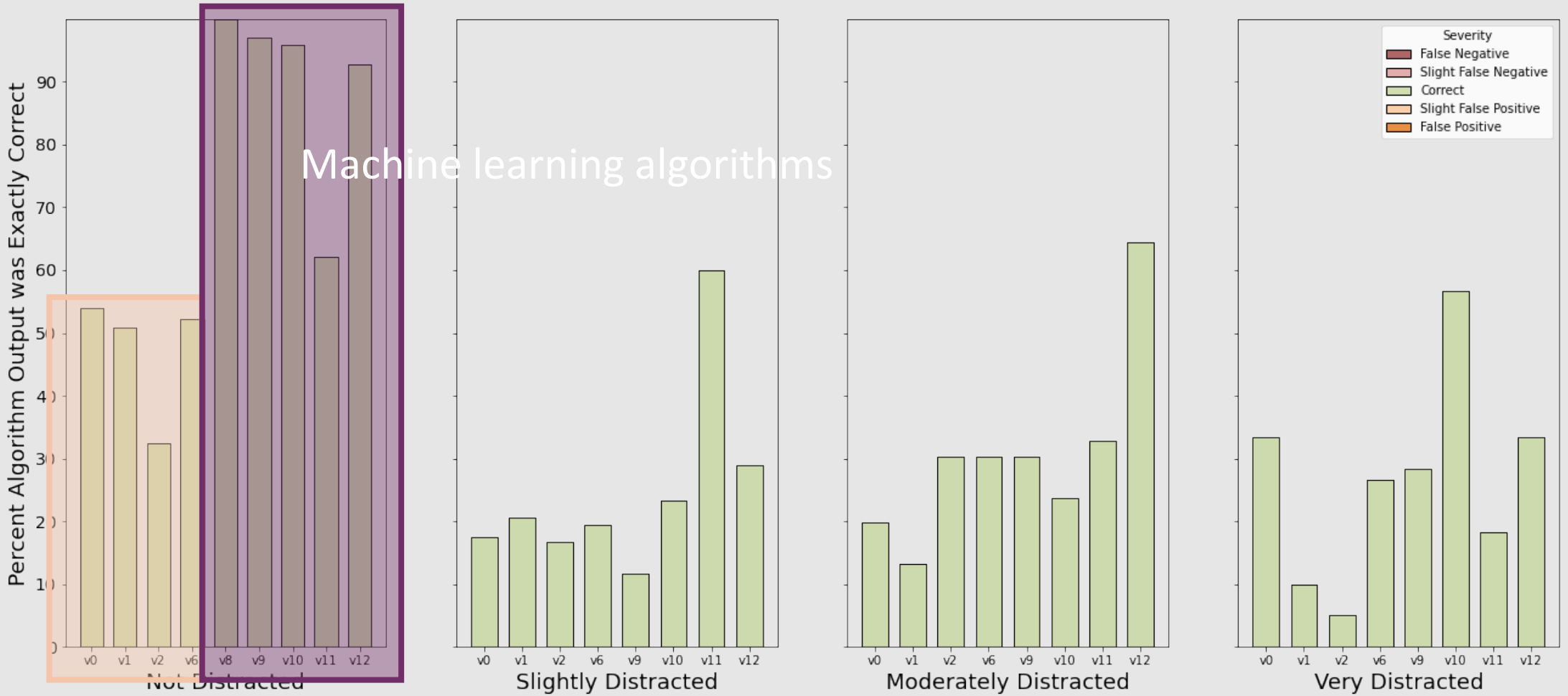

Machine learning algorithms

Buffer-based algorithms

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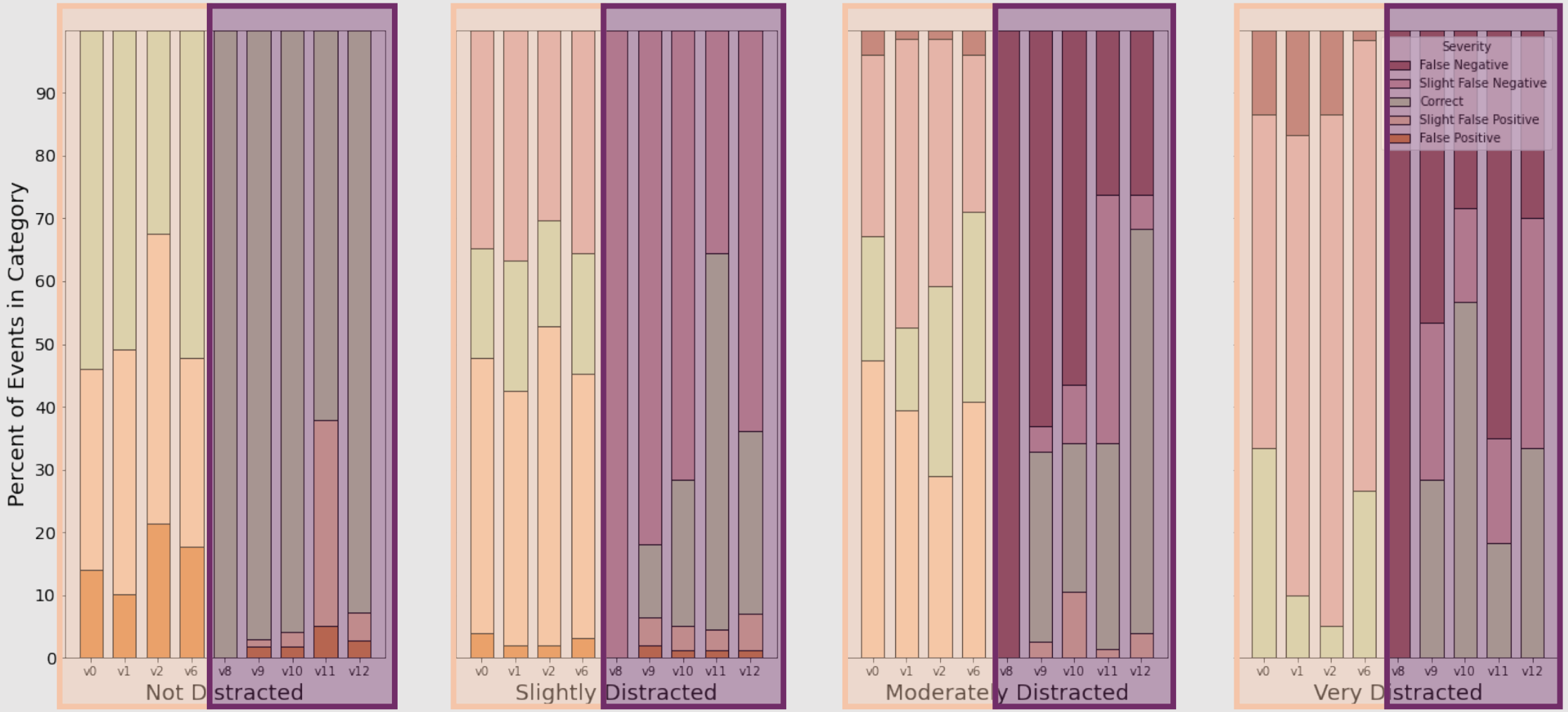

In Summary:

- Tools available now make it possible to determine when a driver is inattentive
- Algorithms used to determine driver attention should be designed with an understanding of their limitations and could be used as a guideline for further development
- At a minimum, both glance location and speed should be used to assess driver attention
- Driver monitoring is an important component in detecting and reducing distractions

Thank you!

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