Mitigating Drowsiness during Short Drives: Implications of Staged and Discrete Alerts

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Getting Drowsy

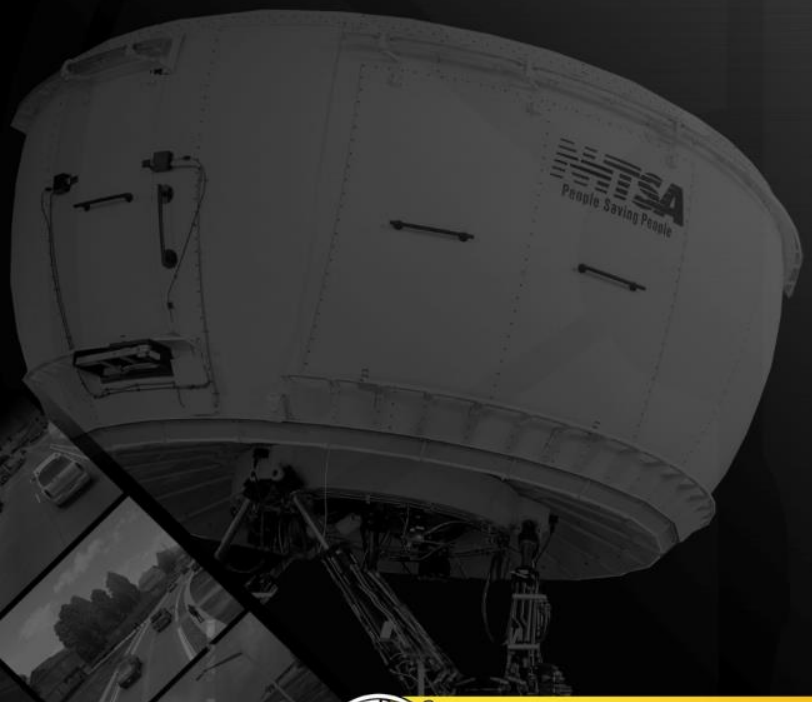
- Long trips
- Late at night
- Afternoon Circadian dip
- Sleep deprivation

How do you effectively alert drowsy drivers?

- Will the same mitigation strategy work for every type of drowsiness?
  - Long day 20 minutes from home
  - 90 minutes from home late at night
  - Driving 10 hours on the interstate
  - Coming off a night shift

This research focused on short duration drives

- End of a long trip
- On the way home while drowsy



Drowsiness mitigation is intended to restore alertness and motivate a break

There are several drowsiness mitigation systems on the market

- Discrete warnings

Volvo Driver Alert Control

Mercedes Attention Assist

Bosch driver drowsiness detection

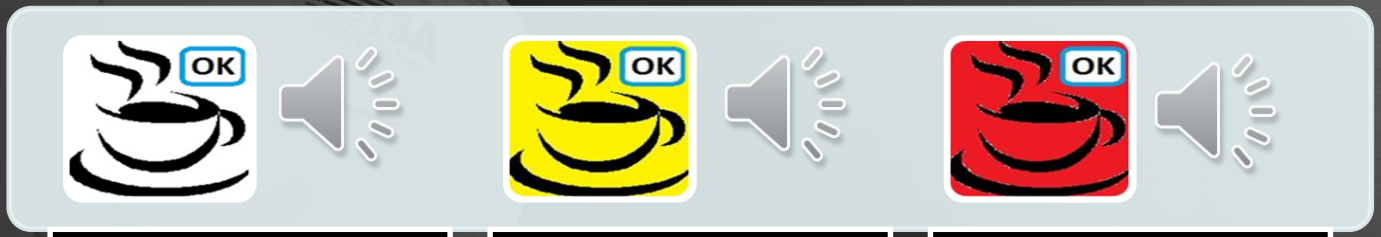
- Staged or continuous warnings

Ford Driver Alert

Nissan Driver Attention Alert

Mitigation: goal to study combinations of warning modality and alert type

Alert Type	Modality
• Discrete • Staged	• Audio-Visual • Haptic seat • Combined



Stage 1	Stage 2	Stage 3
Single pulse	Double pulse	Mult. pulse

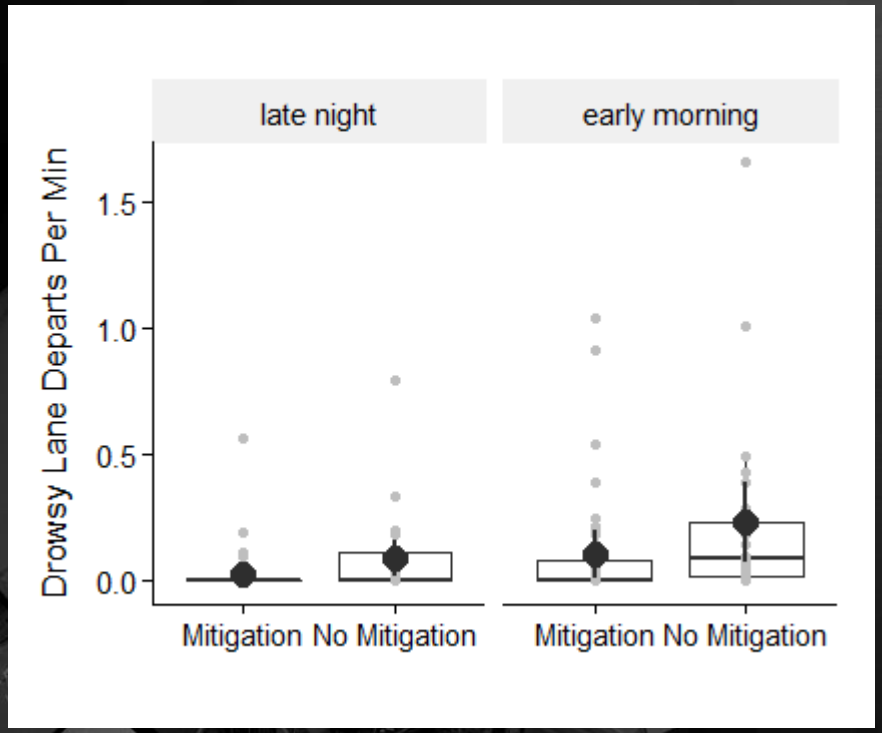
National Advanced Driving Simulator
NADS-1

General Method

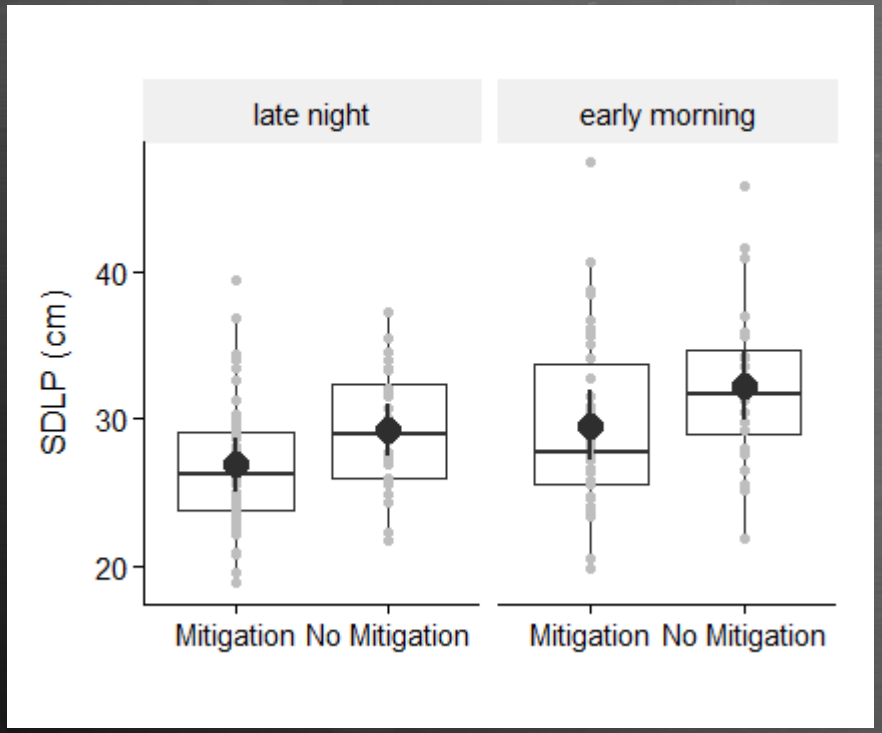
- Awake by 7 am
- No caffeine or naps
- Drive times (10 pm – 2 am and 2 am – 6 am)
  - Mitigated on separated nights
  - Baseline same night
- Participants (21-34 years of age)
  - 48 for the mitigation conditions
  - 24 for baseline

Mitigation reduced drowsy lane departures and SDLP

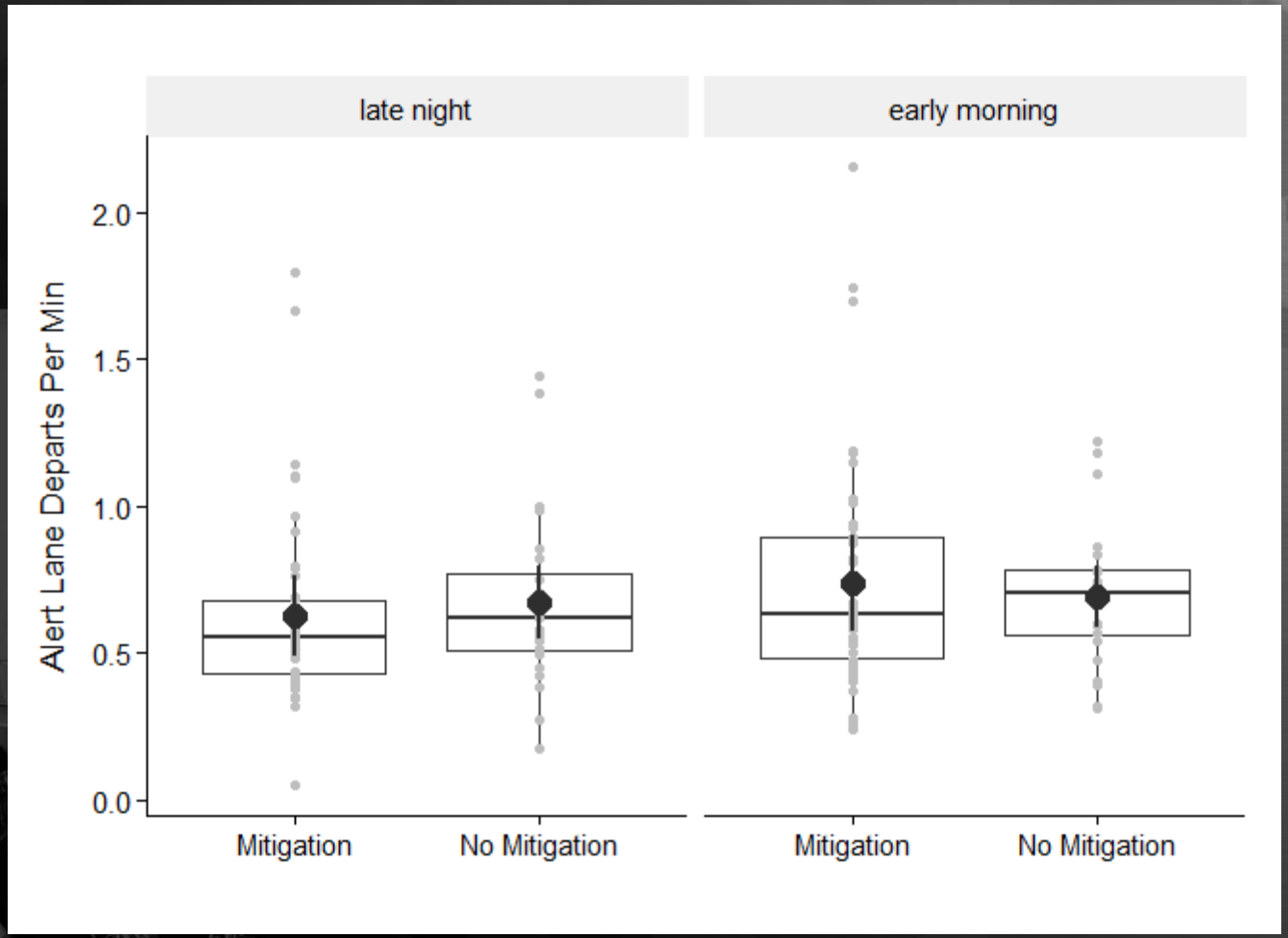
Drowsy Lane Departures



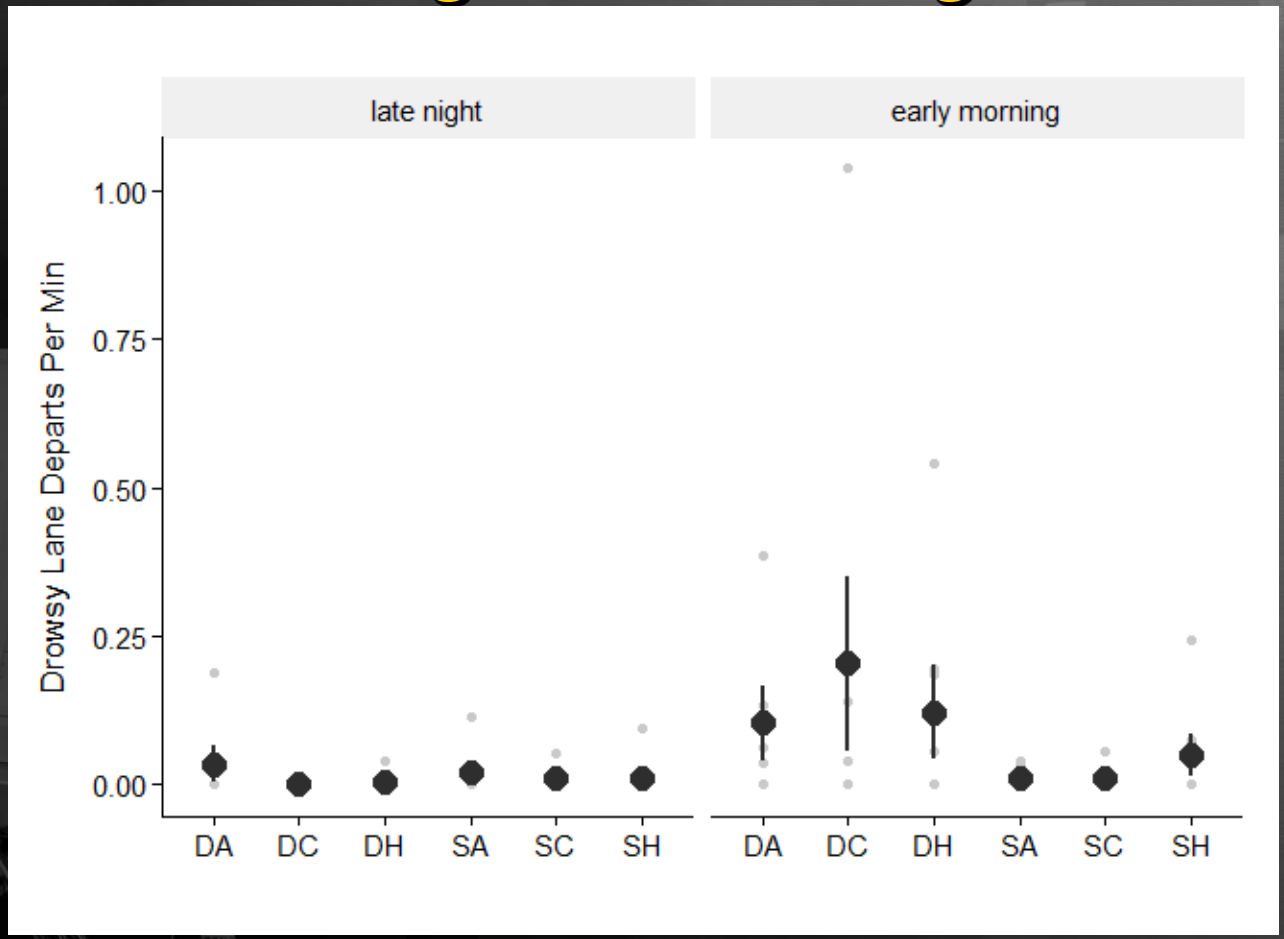
SDLP



Mitigation did not affect **alert** lane departures



Staged mitigation was more effective than discrete mitigation during late drives



- No difference between warning modalities

Mitigation did not alter subjective drowsiness

- Stanford Sleepiness Scale (SSS)

7 = asleep

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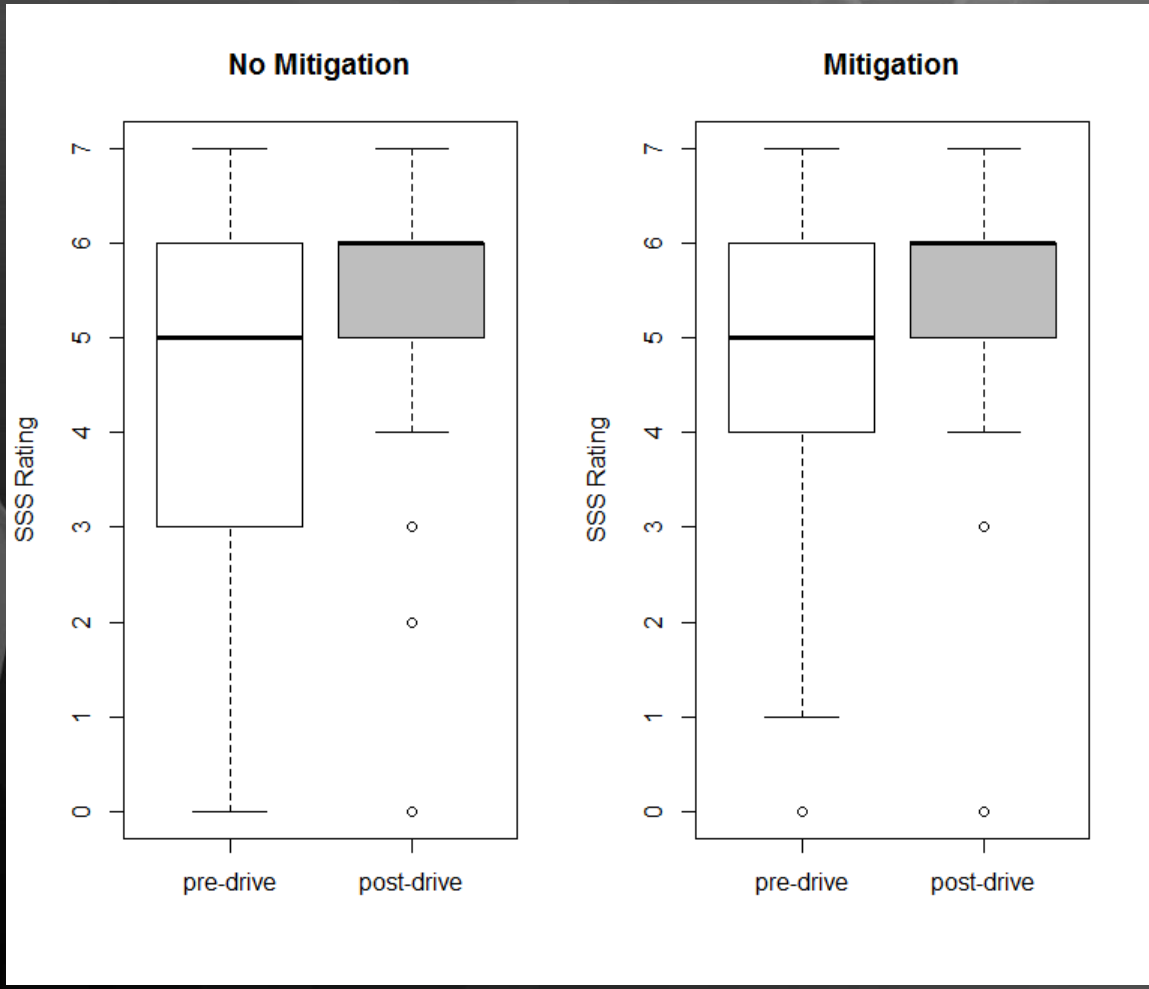
0 = awake



Conclusions

- Real-time drowsiness mitigation can reduce risk of drowsiness-related lane departures

- Staged mitigations are more effective than discrete mitigations
  - Irrespective of modality

Future work

- How to evaluate mitigations geared toward longer drives where simple alerting may not be effective