

CARSP Conference
Toronto, ON
18-21 June 2017



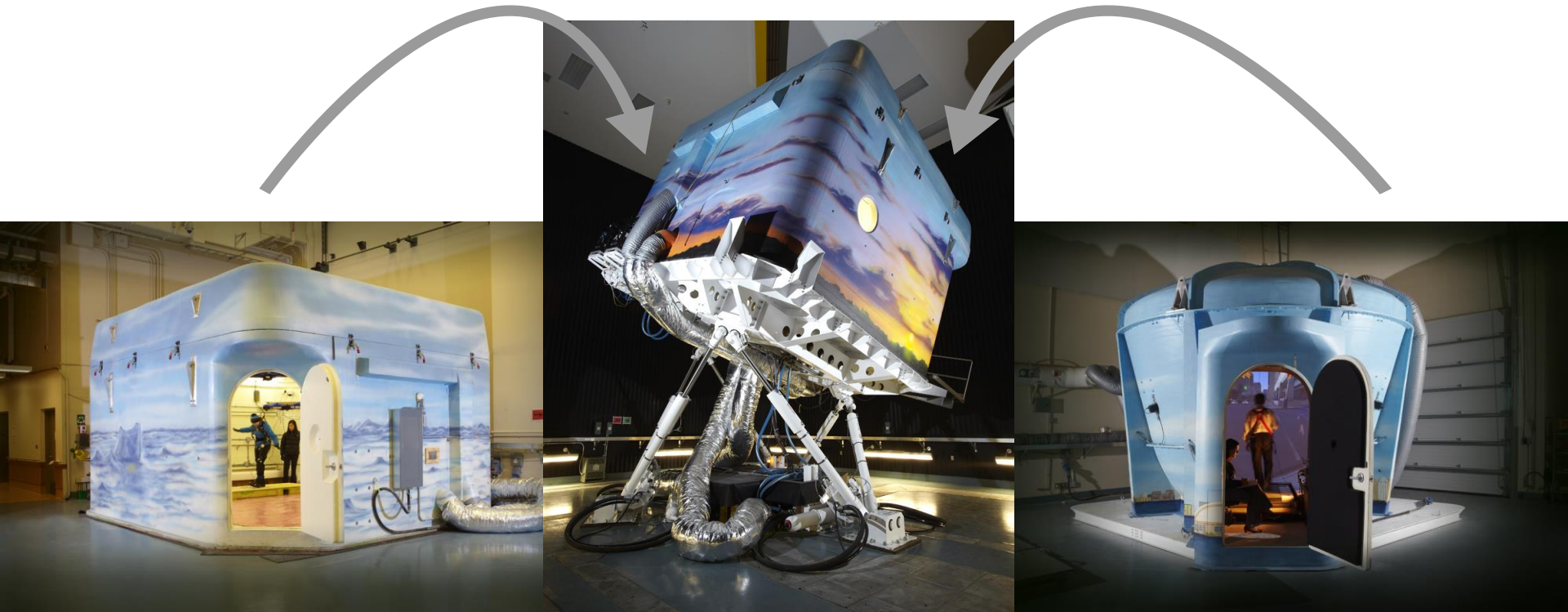
Lane Departure Warning Systems: Influence of Auditory Cue Type, Adaptation Effects, and Age

Haycock B, Bartolini A, Furlan A, Campos J

LDWS: Influence of Auditory Cue Type, Adaptation Effects, and Age

- Introduction
 - Challenging Environment Assessment Laboratory
 - Background and Aims
- Methods
- Results
- Conclusions

Challenging Environment Assessment Laboratory



WinterLab

StairLab

StreetLab

Introduction - DriverLab



Introduction - Background

- Lane Departure Warning Systems (LDWS) are a common type of Advanced Driver Assistance System (ADAS)
- Conflicting results concerning the effectiveness of LDWS on driving safety
 - Warning cue inconsistencies?
 - Properties of warning cues?
 - Differences among user populations?
 - Adaptation?

Introduction - Aims

1. Are there differences in lane keeping performance between natural/intuitive cues (rumble) vs. neutral cues (beep)?
2. Will short-term adaptation effects be observed when the LDWS is intermittently and unexpectedly deactivated?
3. Are there age-related differences in the use of different audio cue types and/or adaptation effects?

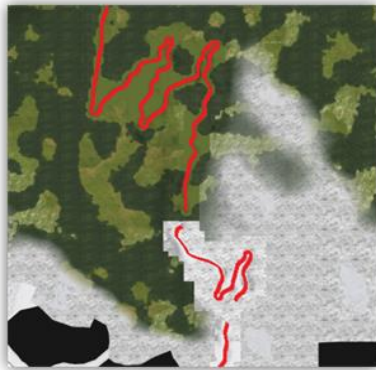
Methods

- Immersive driving simulator - StreetLab



Methods

- Immersive driving simulator - StreetLab
- Rural driving course

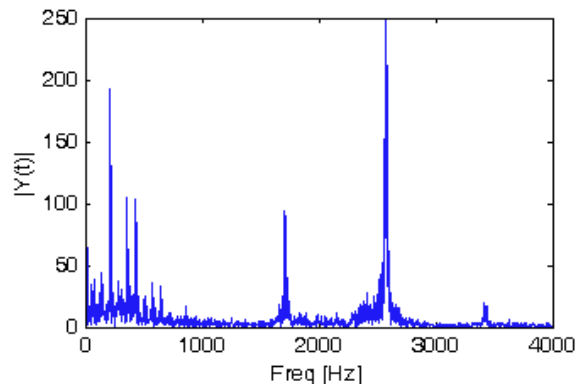


Methods

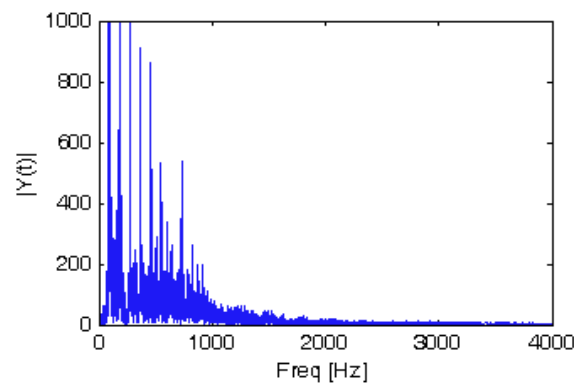
- Immersive driving simulator - StreetLab
- Rural driving course
 1. Acclimatization
 2. Baseline
 3. LDWS Active
 4. LDWS Intermittently Active

Methods

- Immersive driving simulator - StreetLab
- Rural driving course
- Two audio cue groups



Beep



Rumble

Methods

- Immersive driving simulator - StreetLab
- Rural driving course
- Two audio cue groups
- Healthy, active drivers
 - Screened for sensory, motor, cognitive impairments
 - 14 younger (M=27.1 years, SD=4.9),
11 older (M=72.3 years, SD=6.4)

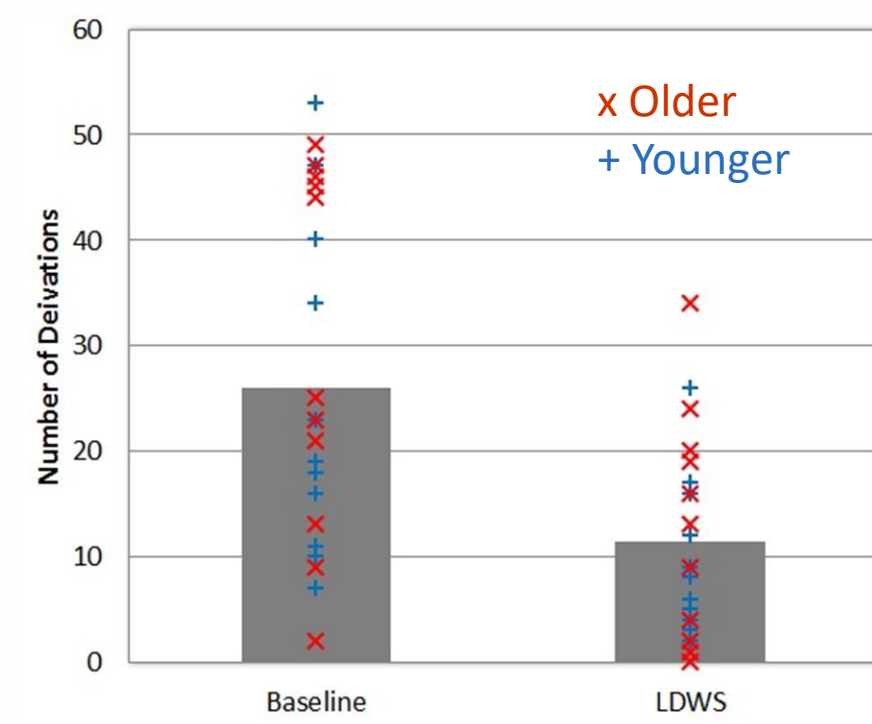
Independent Measures

- Age: older, younger
- Auditory cue: beep, rumble
- Condition: Baseline, LDWS On, LDWS Off (briefly)

Dependent Measures

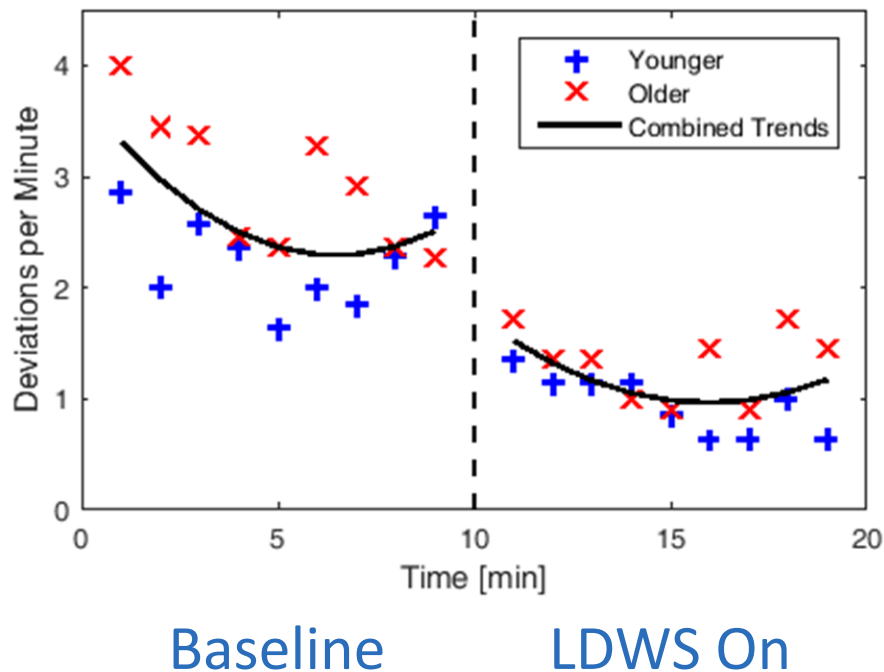
- Number of deviations
- Time of deviations (seconds)
- Magnitude of deviations (metres)

Results – Baseline vs. LDWS On



- Both LDWS auditory cues reduced *number*, *time*, and *magnitude* of deviations compared to Baseline
- No effect of cue type
- No effect of age

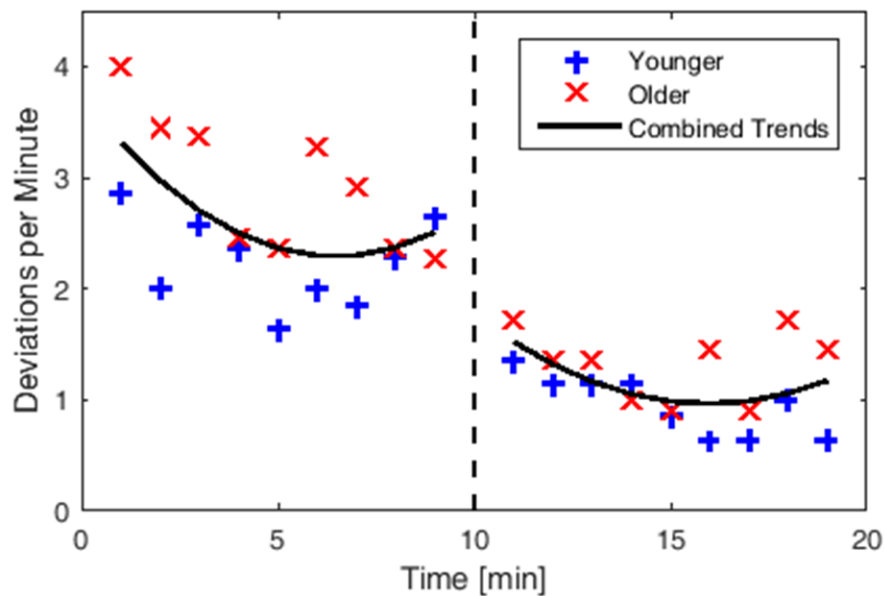
Results – Baseline vs. LDWS On Practice Effects



- Looking just at the end of Baseline vs. start of LDWS, both cues still reduced *number*, *time*, and *magnitude* of deviations
- No effect of cue type
- No effect of age

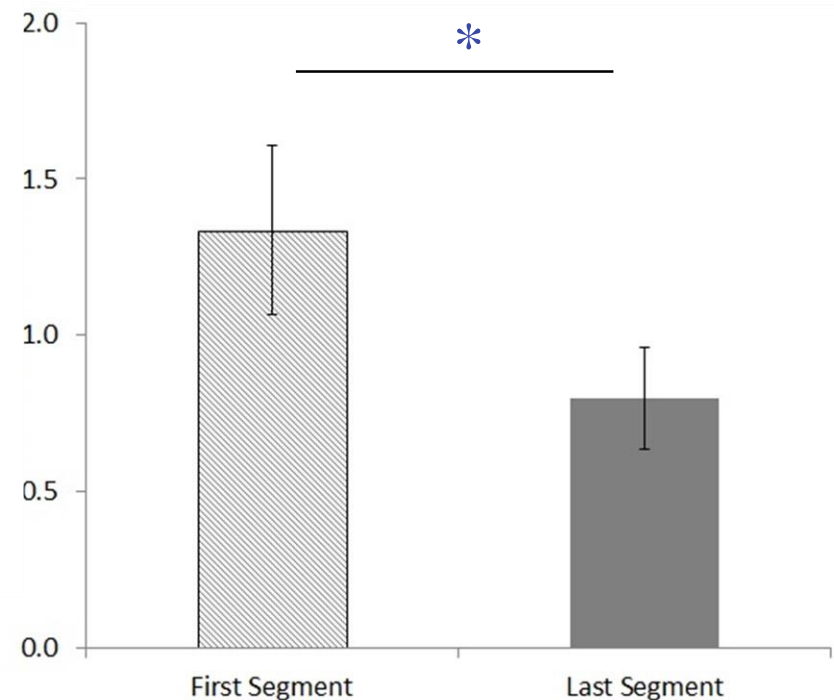
Results – LDWS On

- Fewer deviations with time overall



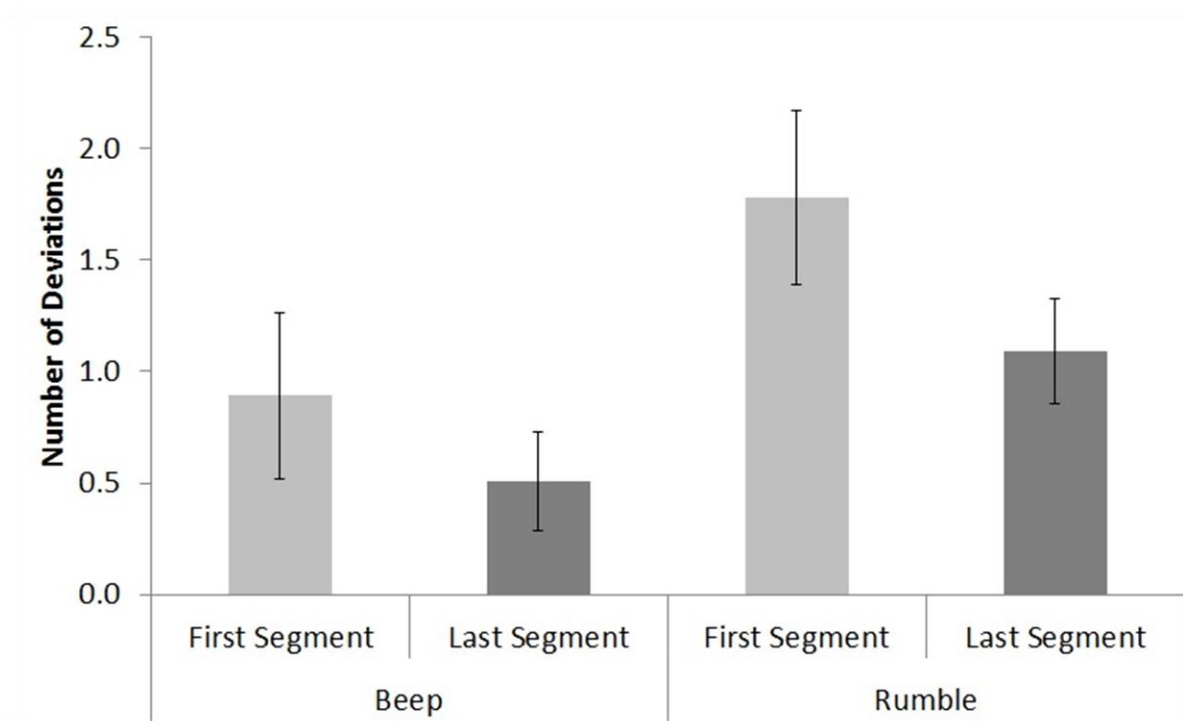
Baseline

LDWS On



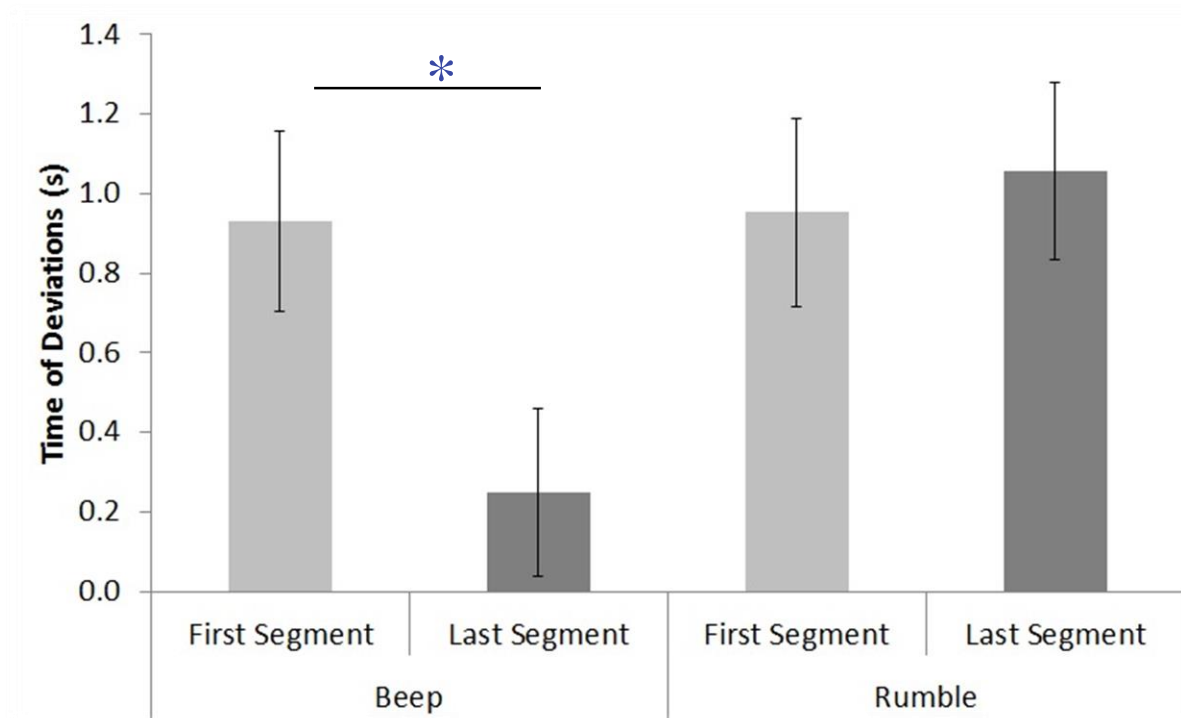
Results – LDWS On

- Fewer deviations with time overall
- More deviations with rumble than beep



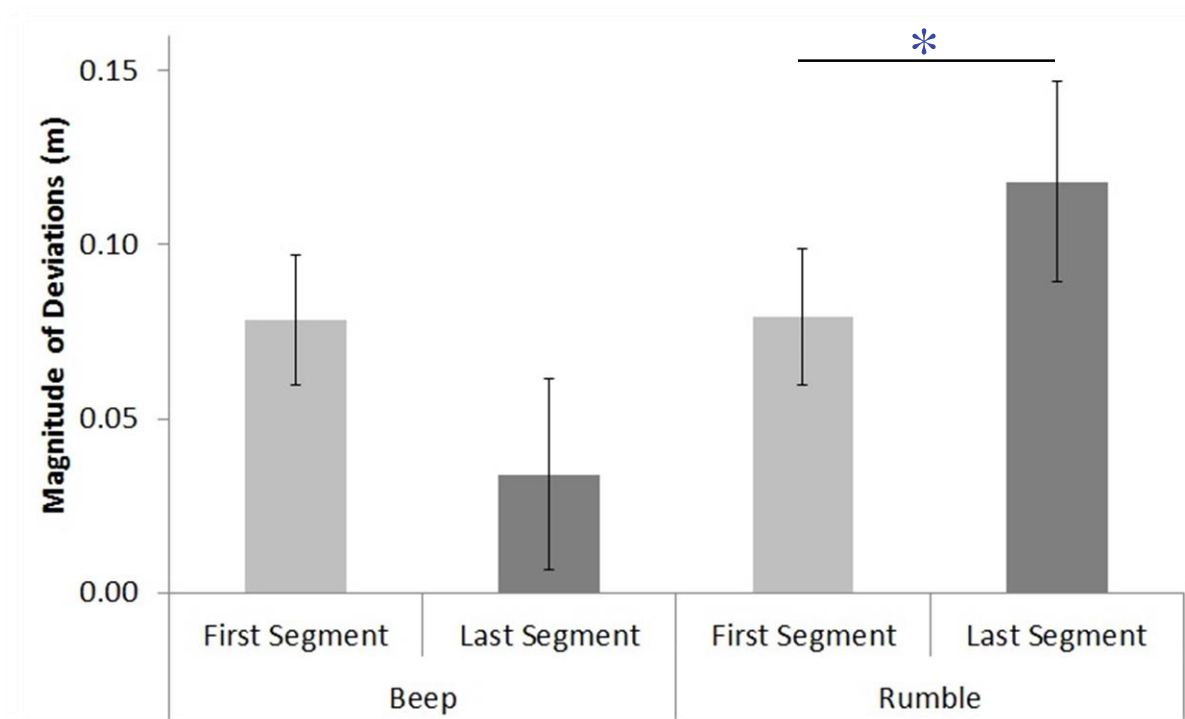
Results – LDWS On – Time

- Only improved over time with beep cue



Results – LDWS On – Magnitude

- Larger deviations over time with rumble cue

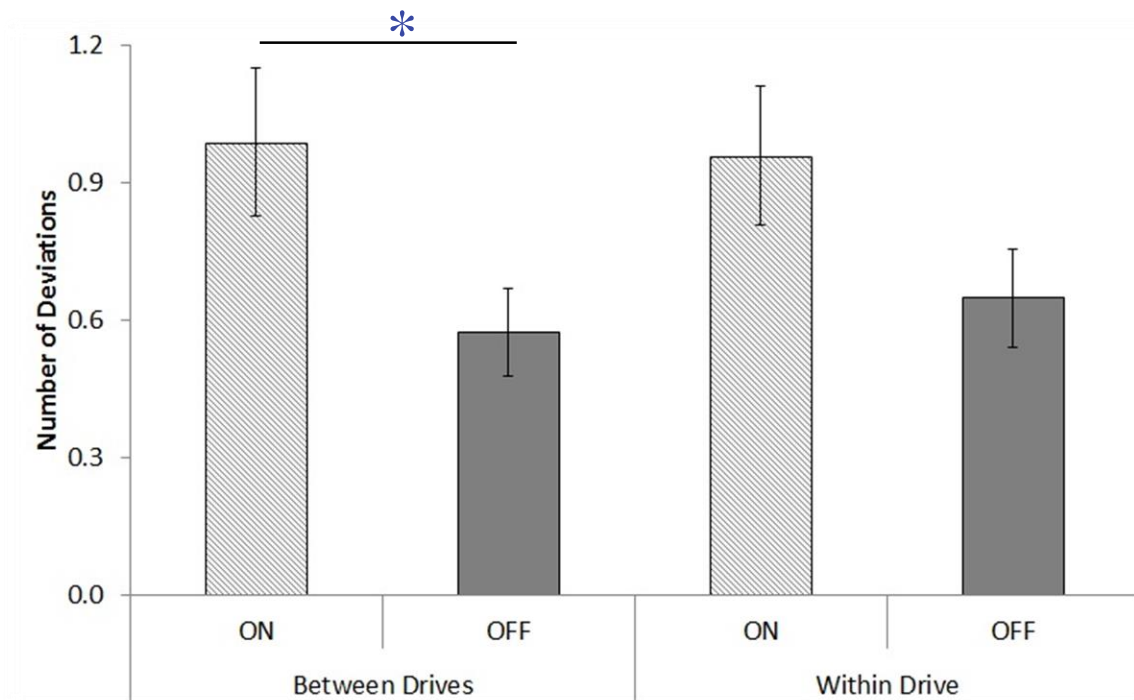


Results – Intermittent LDWS

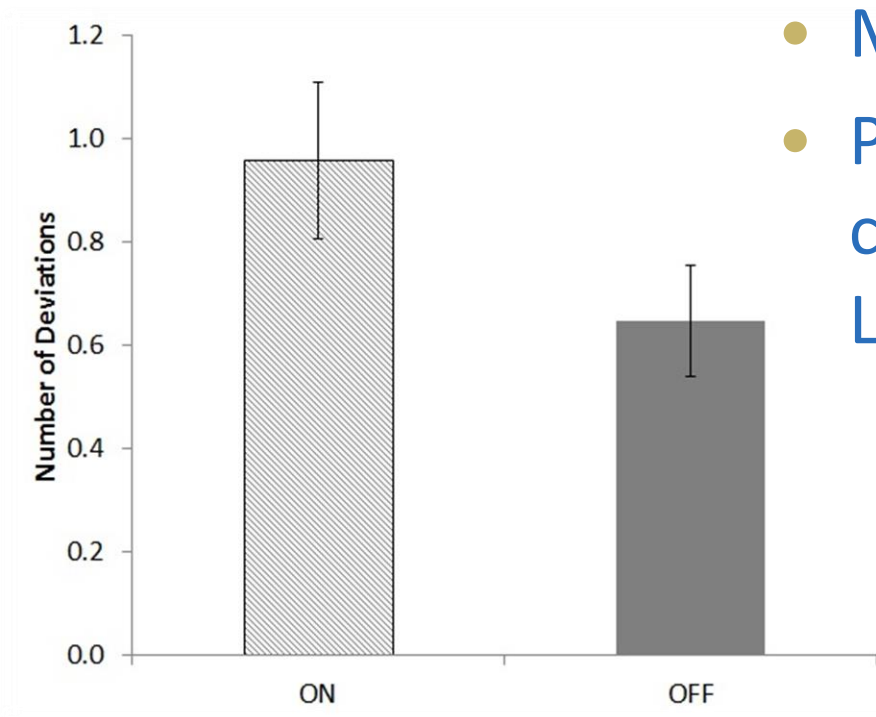
- Compare sections of road where the LDWS was Off during the Intermittent drive with the identical section from the LDWS On drive
 - This leaves potential for order/practice effects
- Also compared On/Off sections just within the Intermittent drive itself

Results – Intermittent LDWS

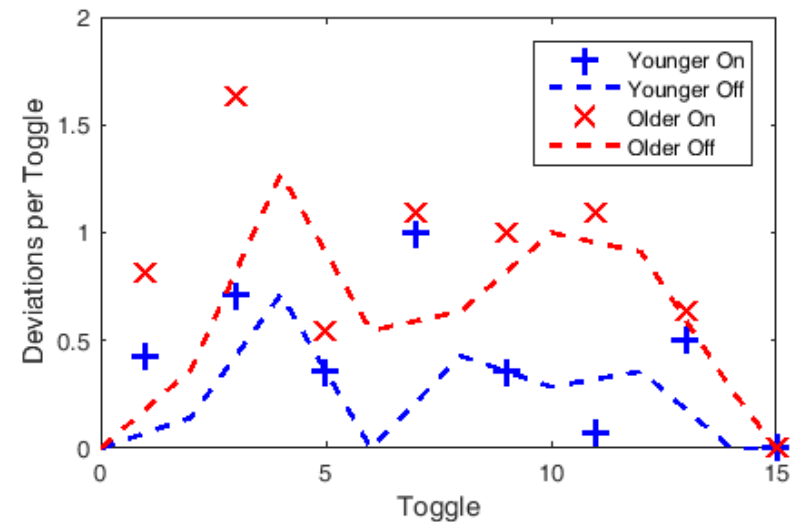
- More deviations when the LDWS was ON between and within drives



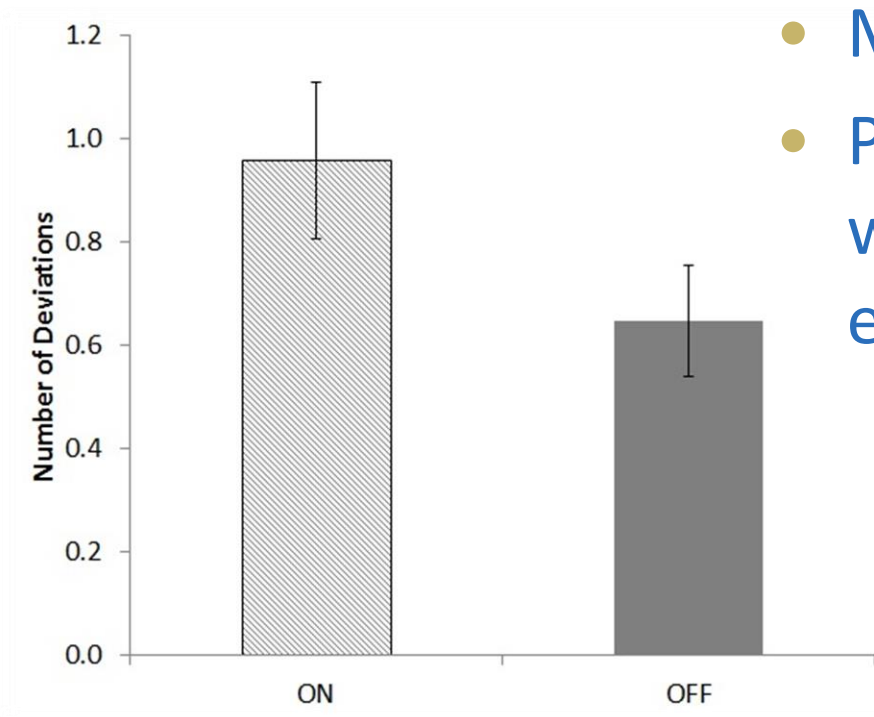
Results – Intermittent LDWS



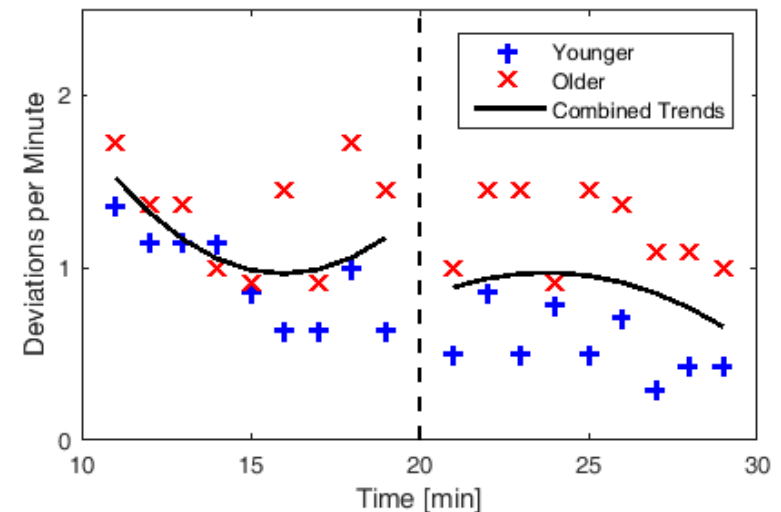
- More deviations with LDWS On
- Performance reasonably consistent over final drive, but LDWS On = more deviations



Results – Intermittent LDWS

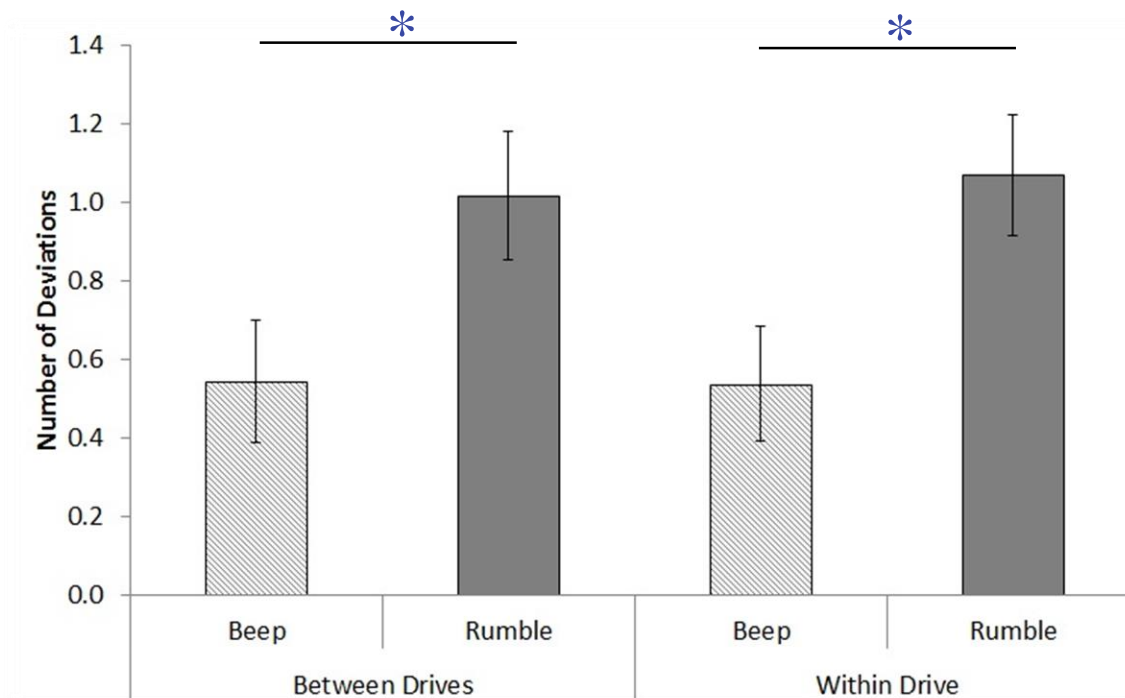


- More deviations with LDWS On
- Performance initially improved with LDWS, but degraded with exposure



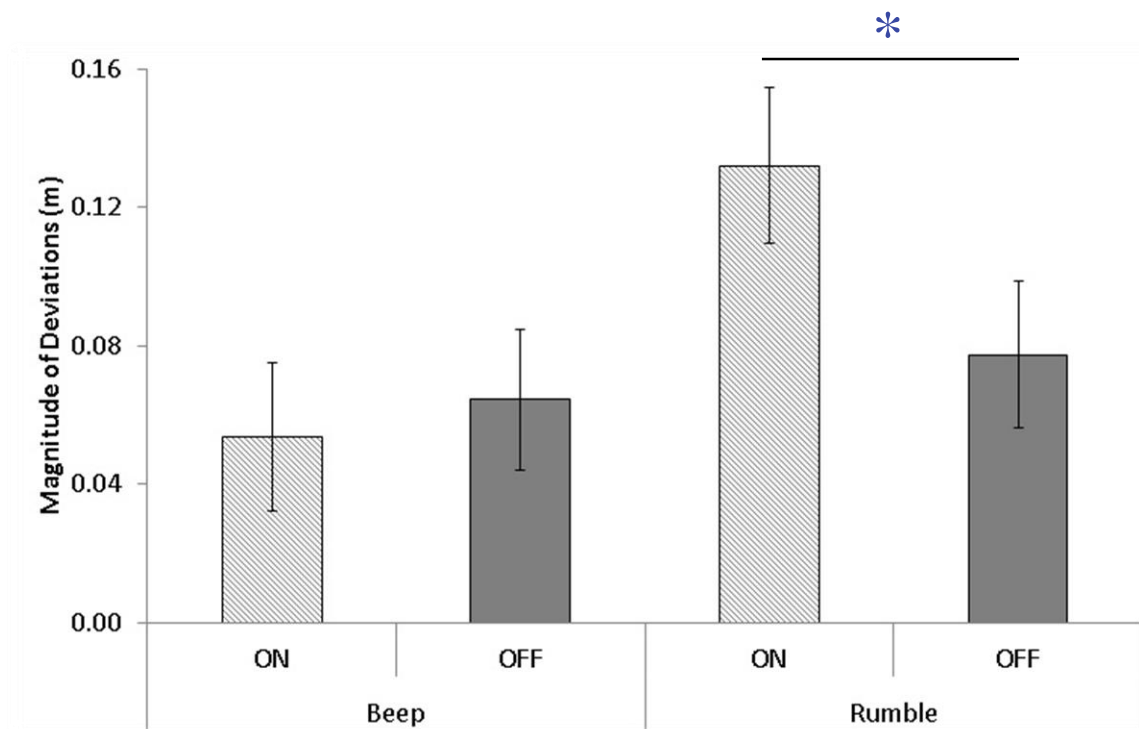
Results – Intermittent LDWS

- More deviations when using the rumble cue
- Longer deviations when using the rumble cue



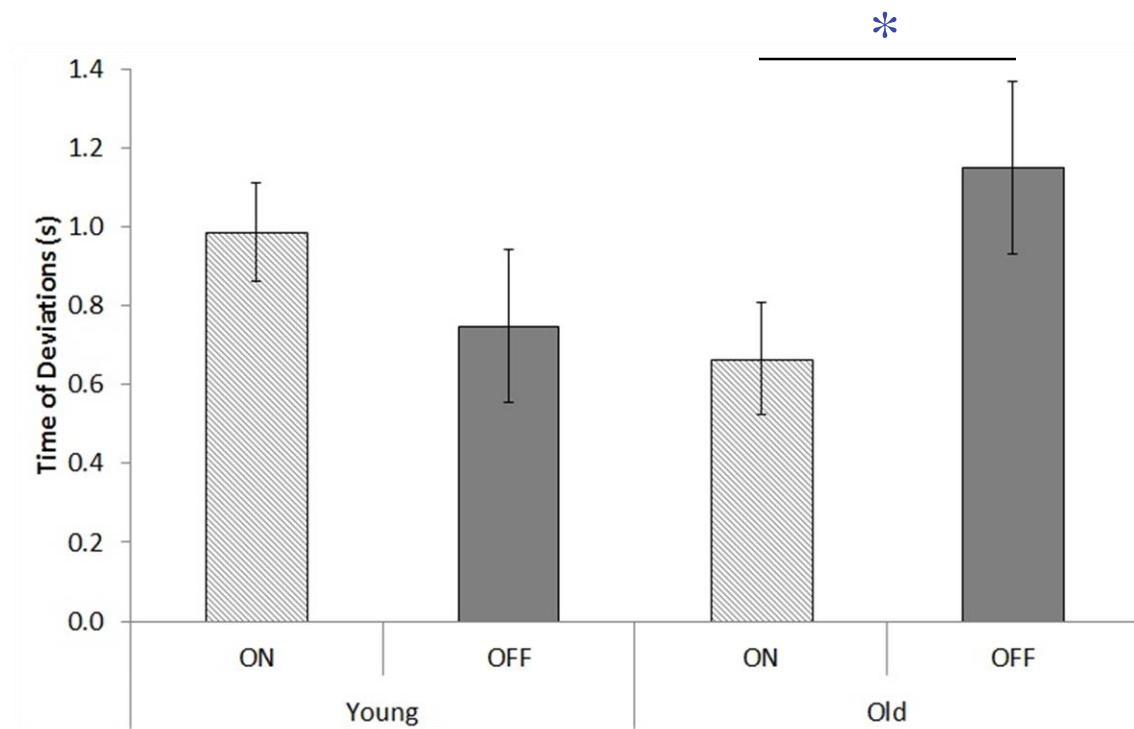
Results – Intermittent LDWS

- Larger deviations during times when LDWS was ON using the rumble cue



Results – Intermittent LDWS

- Older drivers had shorter deviations overall when LDWS was On



Conclusion

- Lane keeping initially improved with LDWS
- Neutral beep cue was more effective than the more intuitive rumble
- More deviations over time with continued exposure to the LDWS
- May increase risk of driver error under some conditions

Questions?

Bruce Haycock
Bruce.Haycock@uhn.ca

Jennifer Campos
Jennifer.Campos@uhn.ca

