COMPARING WHOLE BODY VIBRATION EXPOSURES ACROSS FOUR TRUCK SEATS

HW DAVIES; F WANG; B DU; P JOHNSON

BACKGROUND

- Exposure to vehicle induced whole body vibration (WBV) is associated with several adverse health outcomes
  - Low-back pain
  - Driver fatigue
  - Digestive, urinary, circulatory problems
  - Balance?
- Back injuries are … insert WorkSafeBC stats.
- Epidemiological studies have consistently linked WBV to low back pain/injury
- Dose response relationship established (~5 years of exposure)

Seat Suspension Technology Evolution

1950's

1960's

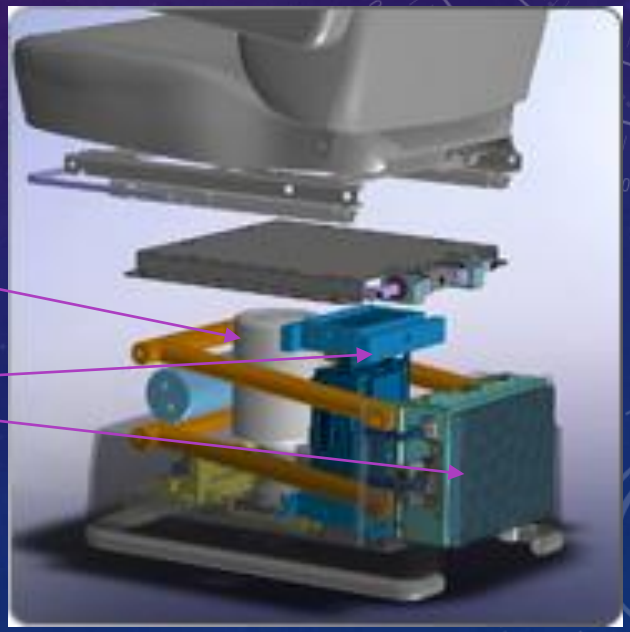
1980's

2010

	Static	Mechanical Suspension	Air-Ride	ElectroMech Active
Uses	On-Road	On/Off Road	Many	Trucking
Cost	Low	+ Moderate	++ Moderate	+High
Pros	?	?	?	WBV?
Cons	?	?	?	Currently On-Road

EAVC TECHNOLOGY

- **To combat challenges with air-ride seats, new “active suspension” truck driver seats have recently been developed and introduced**
  - **Air suspension system like a conventional truck seat**
  - **Sensor in seat base, microprocessor processes seat sensor data in order to cancel forces in real time**
  - **Linear electromagnetic actuator counteracts forces**



OBJECTIVES

- Evaluate the WBV attenuating performance of an active suspension seat and three less expensive air-suspension truck seats
- Determine whether there were differences in WBV attenuation performance between seats
- Effect of environmental conditions on performance?

Seat 1
National Premium

Seat 2
Sears Elite 80

Seat 3
Isringhausen 6860

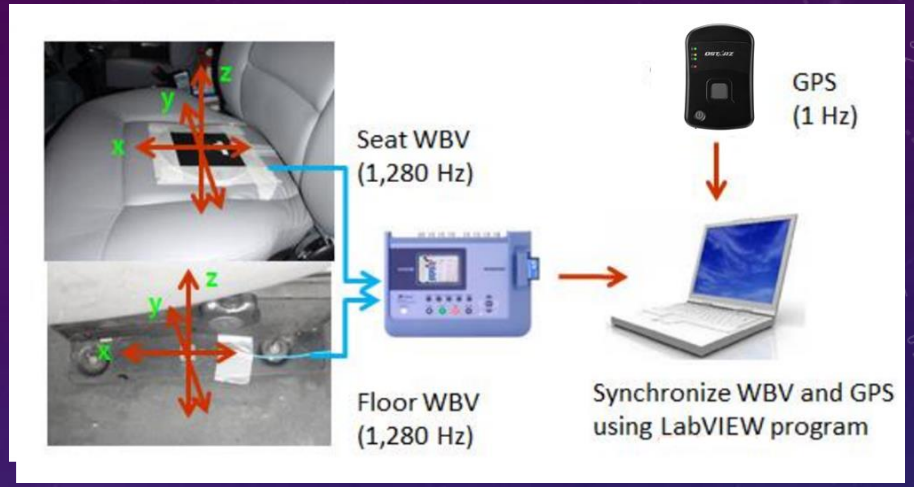
Passive Suspension Seats

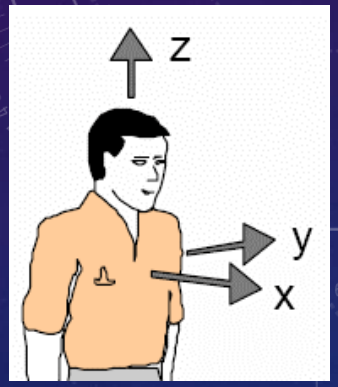
Seat 4
Bose Ride

Active Suspension Seat

METHODS - EXPOSURE

- 10 hour full-shift WBV exposure
- ISO 2631-1 standards
- Tri-axial seat and floor vibration at 1280 Hz
- GPS recording speed and location





METHODS - ANALYSIS

- Whole route and two road types (on and off road)
- WBV data were processed in Labview
- Parameters
  - A(8)
  - VDV(8)
- Seat Effective Amplitude Transmissibility (SEAT)
  - Seat vibration/Floor vibration
- Repeated measures statistical methods

RESULTS

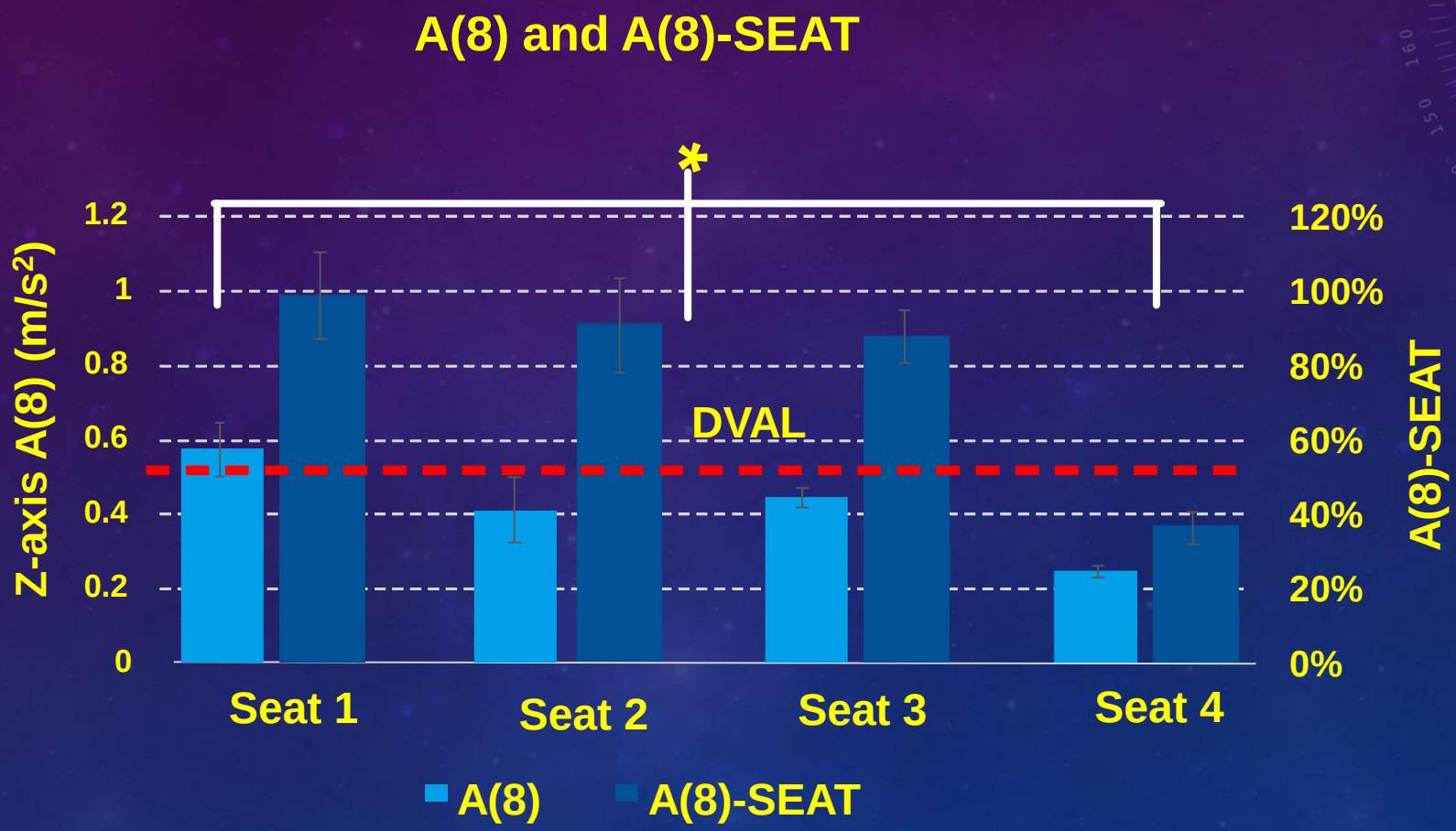


Figure 2. Median (±IQR) z-axis seat-measured A(8) WBV exposures of whole routes

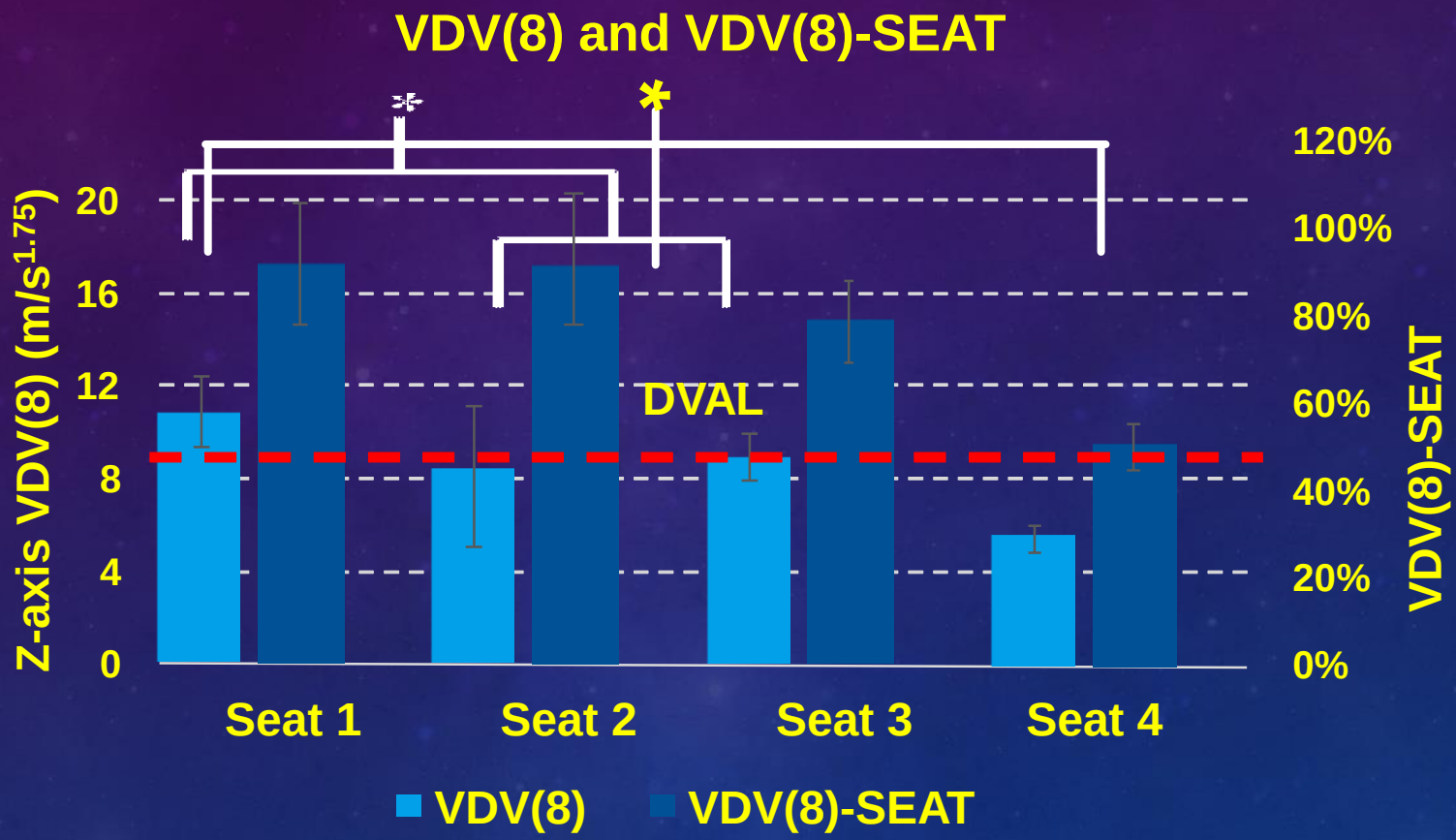
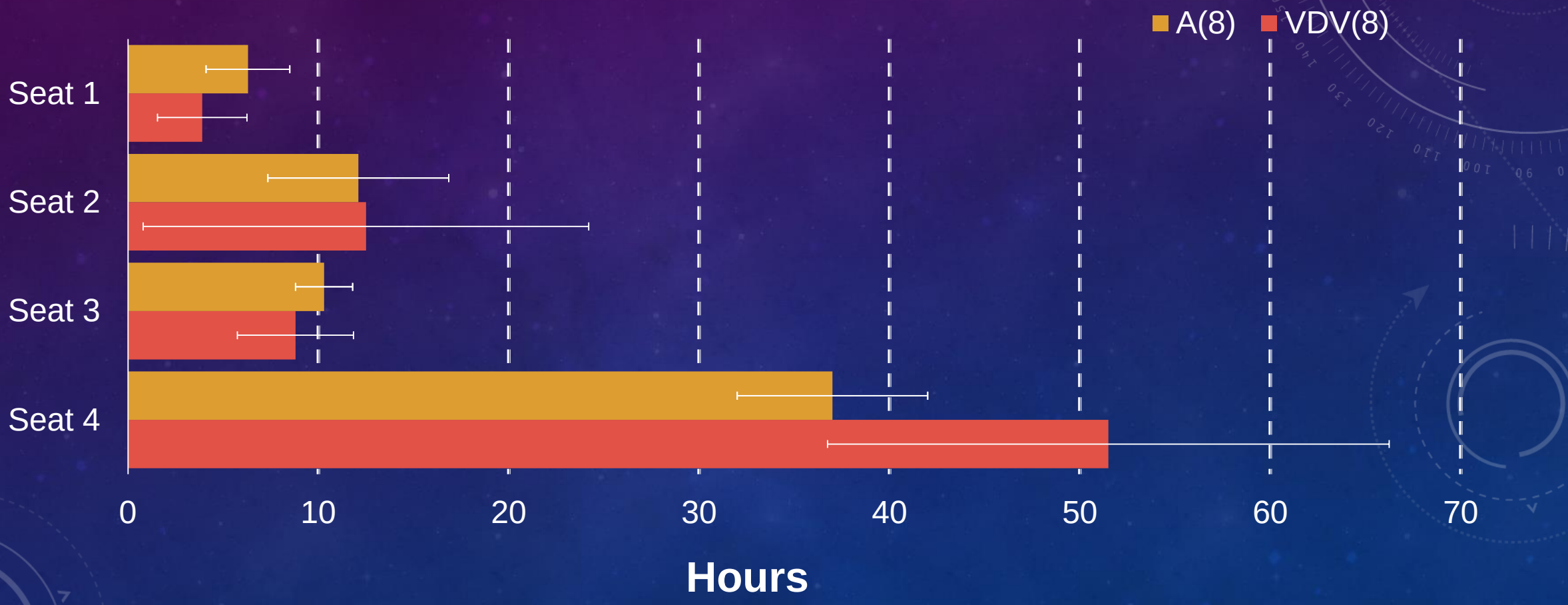


Figure 3. Median (±IQR) z-axis seat-measured VDV(8) WBV exposures of whole routes

Vehicle Operation Hours to Daily Vibration Action Limits



CONCLUSIONS

- The active suspension seat, Seat 4, had substantially lower WBV exposures compared to the other three passive, air-suspension seats.
- In the passive, air-suspension seats, there were performance differences on-road at higher speeds but not off road at slower speeds.
- Relative to Seat 1, the two higher performing passive, air-suspension seats substantially increased the duration of time to reach the ISO daily vibration action limits.
- Future work:
  - Compare Power Spectral Densities of different seats
  - Explore the effects of WBV on vigilance performance

ACKNOWLEDGEMENTS

- Washington State medical Aid and Accident Fund
- Worksafe BC Fund
- Arrow Transportation Systems, Inc.