

# Motivation to Continue Driving while Sleepy: The effects on Sleepiness and Performance Levels

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& Road Safety - Queensland (CARRS-Q)

CARRS-Q is a joint venture initiative of the  
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[www.carrsq.qut.edu.au](http://www.carrsq.qut.edu.au)

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# Driver Sleepiness

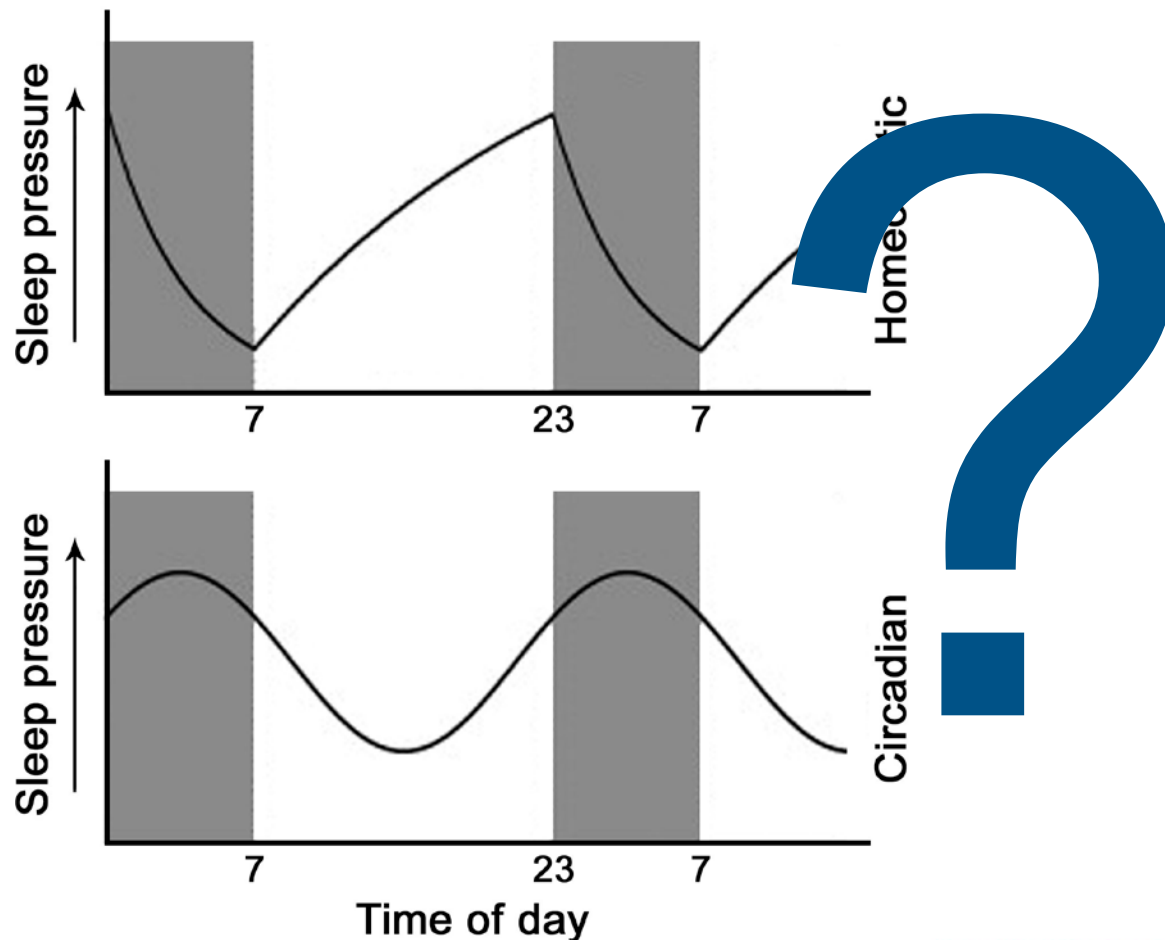
- Strongest evidence (case-control data) suggests that 19% of all fatal and severe crash are due to sleepiness
- Crashes often have multifactorial causes
  - Sleepiness and alcohol
  - Sleepiness and distraction
- Sleepy driving is not viewed as a critical issue for road safety by most drivers
  - Between 59-77% of drivers will drive when sleepy
  - 73% of drivers will continue to drive once aware of their increasing sleepiness

# Younger Persons

- Younger drivers (< 25 years) are over represented in sleep-related crashes
  - Accounting for one third of sleep-related crashes
- Younger persons are more critically affected by sleepiness
  - Greater levels of physiological and subjective sleepiness as well as performance impairment
  - Drive frequently during times of high sleepiness
- Different influences for younger drivers
  - $\uparrow$  motivations +  $\downarrow$  risk perceptions =  $\uparrow$  continue drive sleepy

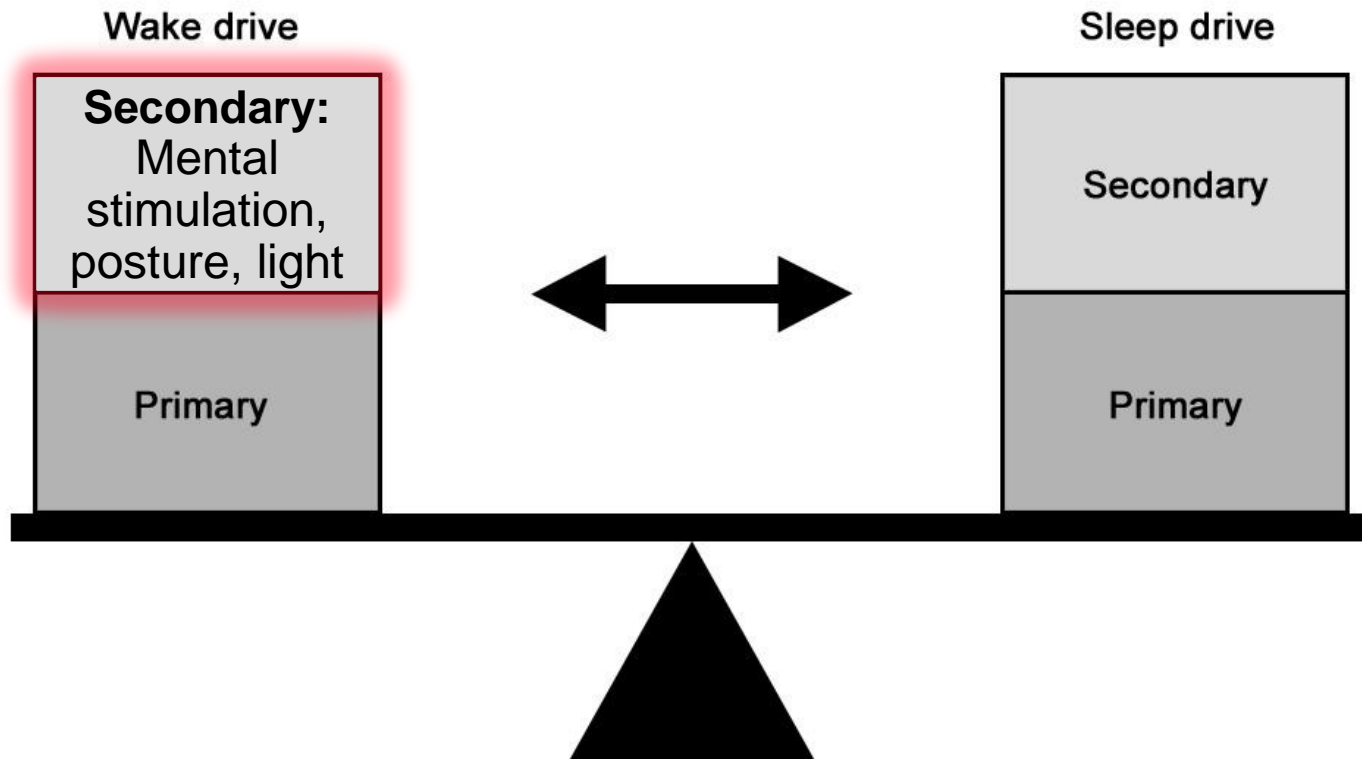
# Sleep-Wake Regulation

- Two-process model (Borbély, 1982)



# Sleep-Wake Regulation<sup>(2)</sup>

- Four-process model (Johns, 1993)
  - Sleep or wake is dependant upon the comparative strengths of the sleep and wake drive systems



# Motivation

- Motivation can reduce the duration to fall asleep but also can effect our ability to remain awake
- Motivation negates performance impairment from sleep deprivation on low-order tasks
- Smaller effects of motivation (no sleep deprivation) are found with performance of high-order tasks
  - Increases of speed or accuracy of responses
- Increases of physiological arousal levels

# Study Aim

- What are the effects of motivation on sleepiness and performance?



# Method

- Participants

- In total, 18 young adults, 20-25 ( $M = 22.29$ ) yrs
- Extensive exclusion criteria
  - Habitual bedtime later than 12 midnight
  - Excessive daytime sleepiness and/or sleeping difficulties
  - Drank more than three cups of coffee per day and/or more than two standard drinks of alcohol per day

- Measures:

- Physiological (EEG: F5, C3, O1 electrode sites)
- Subjective (Karolinska Sleepiness Scale)
- Performance (PVT & HPT: reaction time latencies)
- Intrinsic task experiences

# Performance Measures



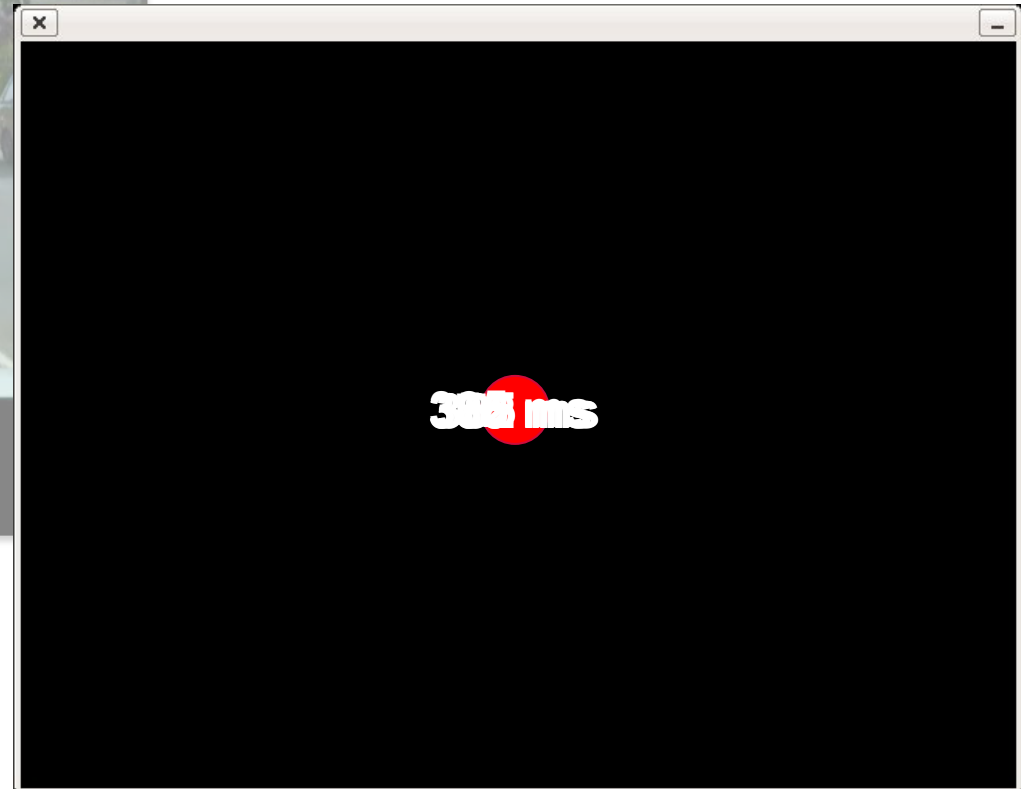
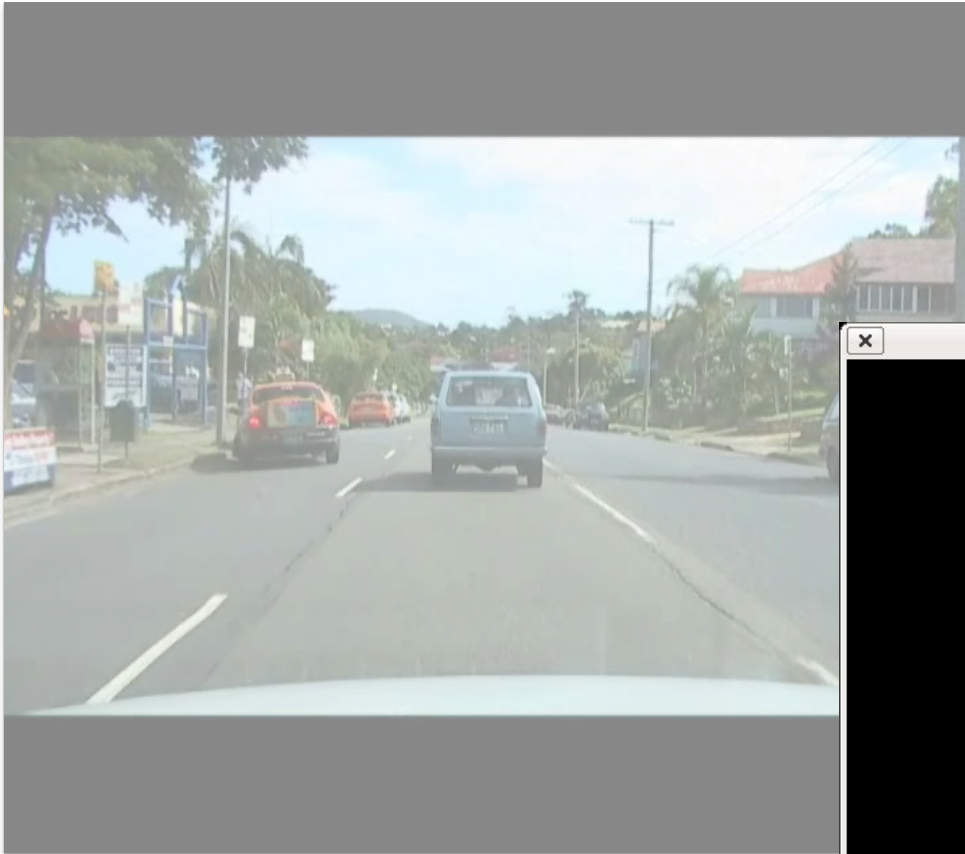
## Hazard Perception Test (HPT)

- Hazard perception is the skill to notice that a traffic situation may result in a dangerous situation, requiring an action from the driver to avoid an incident
- **High-order cognitive task**
- Validity data with actual on-road crashes
- Sensitive to sleepiness

# Performance Measures

## Psychomotor Vigilance Test

- Neurocognitive attentional network
- Low-order cognitive task
- Sensitive to sleepiness



# Method<sub>(2)</sub>

- A series of 2 x 2 x 2 (PVT) and 2 x 2 x 3 (HPT) repeated measures ANOVAs
  - Three within-subjects factors
    - Sleepiness level (alert: 7.9 hrs, sleepy: 6 hrs)
    - Motivation level (motivated, non-motivated: via instructions)
    - Time period (**PVT**: 0-5, 5-10 mins; **HPT**: 0-20, 20-40, 40-60 mins)

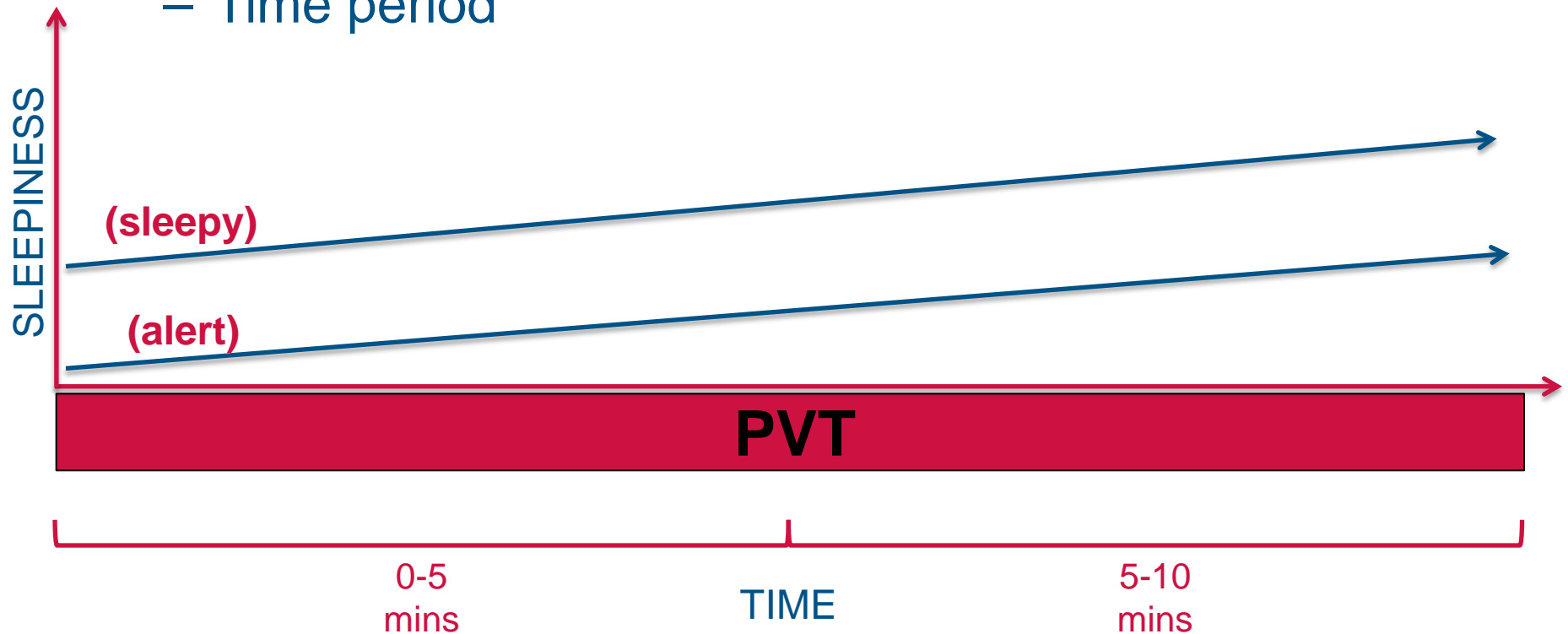
**PVT**

0-5  
mins

5-10  
mins

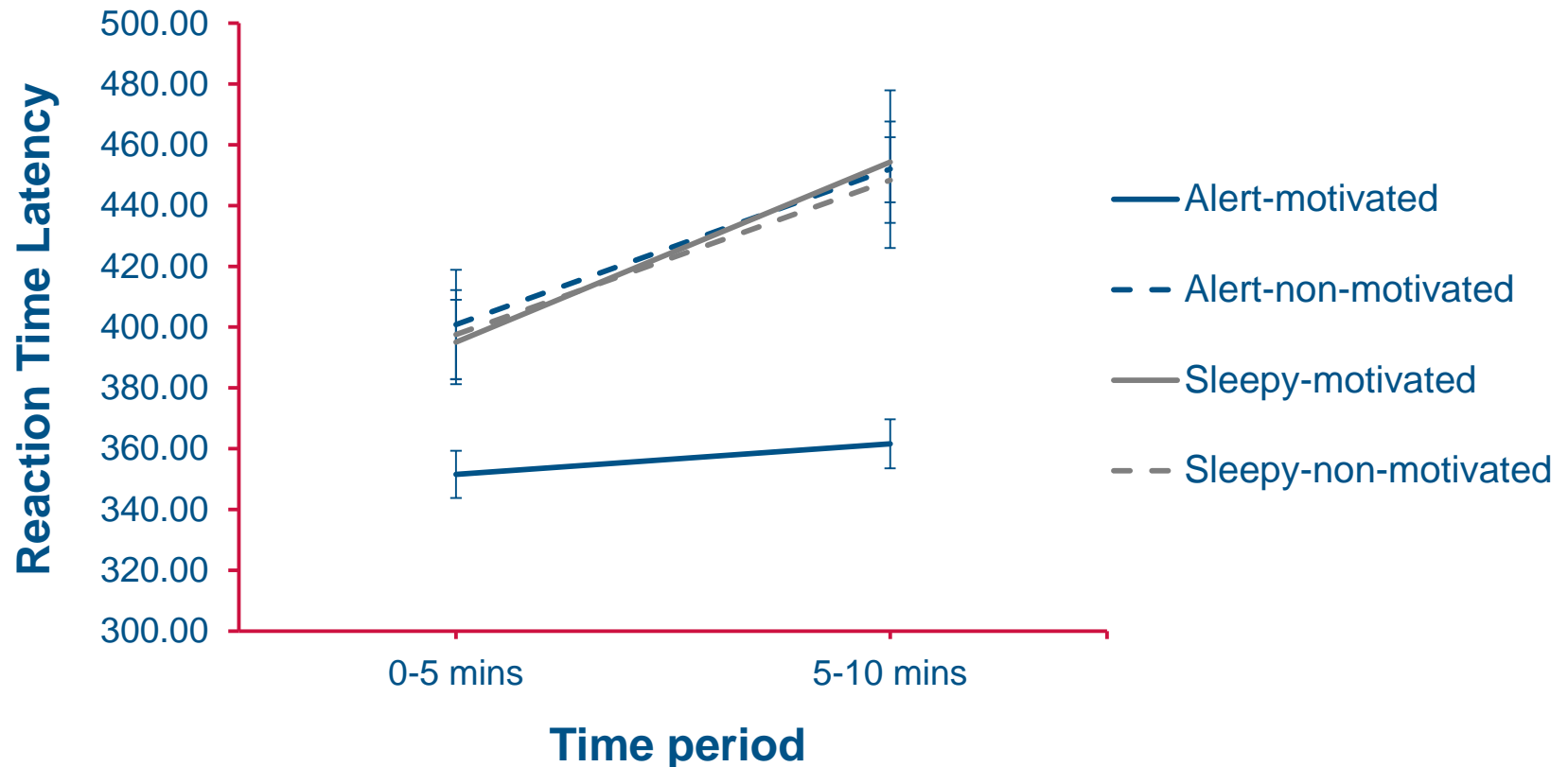
# Results: PVT

- EEG and KSS data, Main effects for
  - Sleepiness level
  - Motivation level
  - Time period



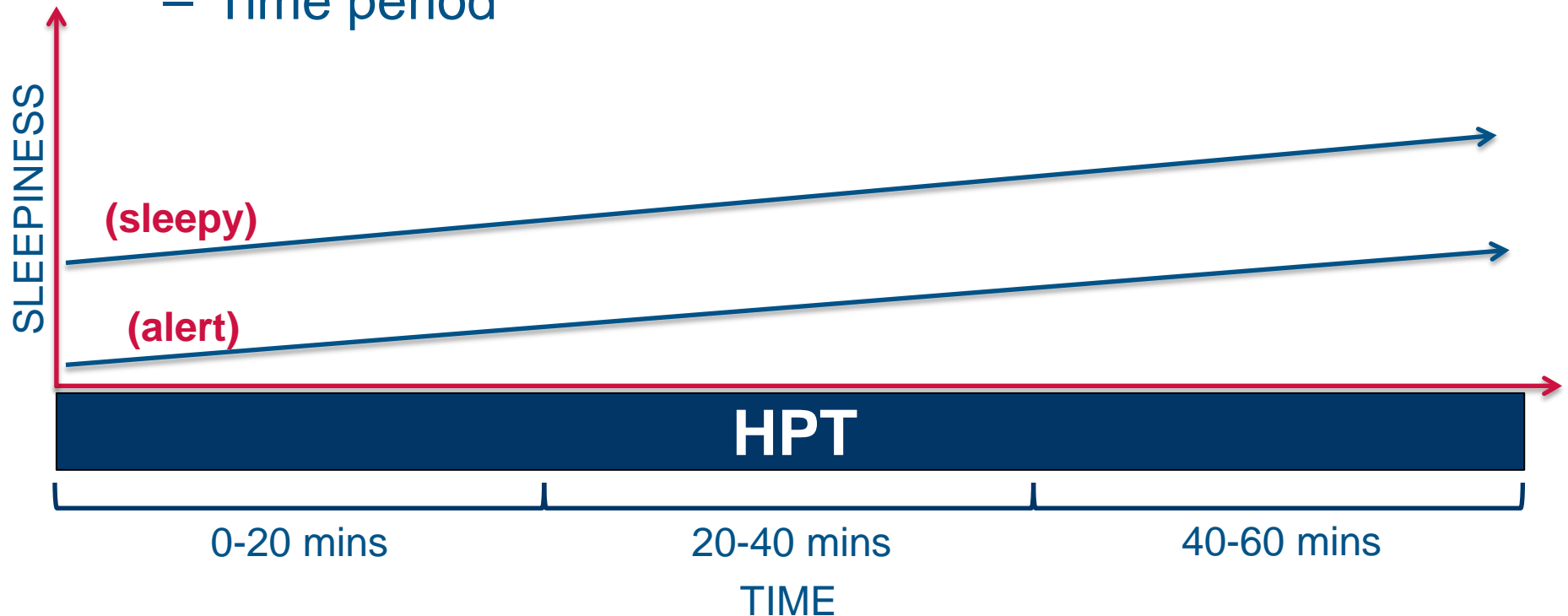
# Results: PVT<sub>(2)</sub>

- PVT performance data
  - Three-way interaction

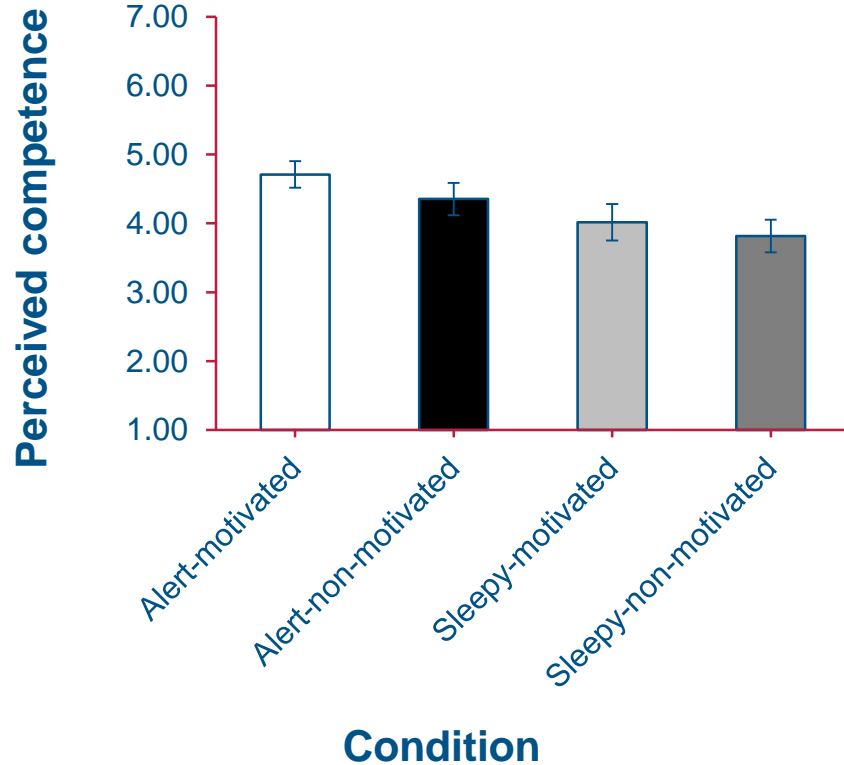


# Results: HPT

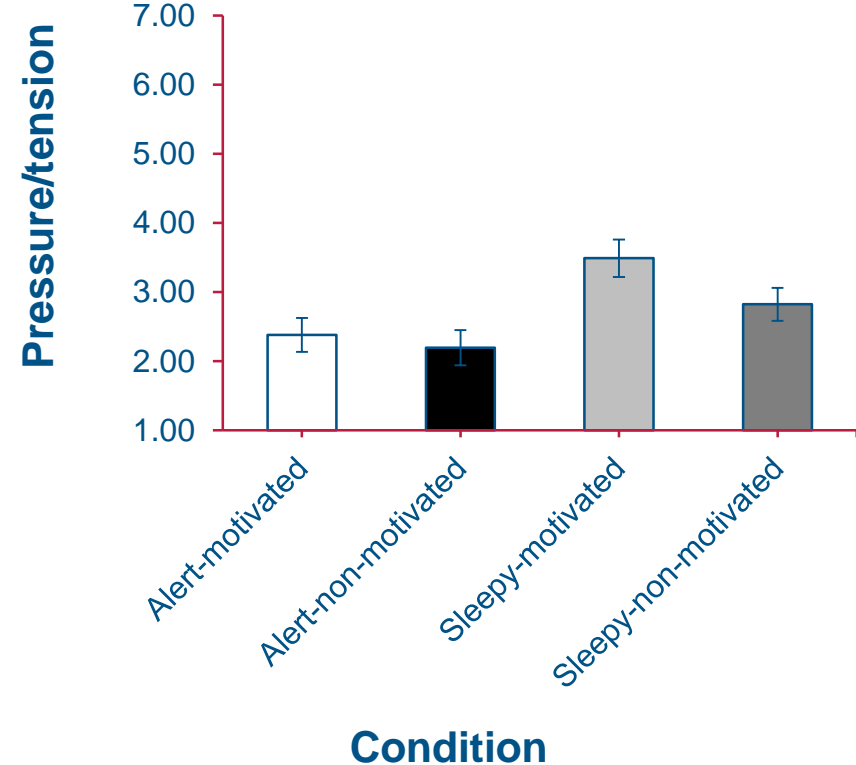
- EEG, KSS, and HPT data, Main effects for
  - Sleepiness level
  - Motivation level
  - Time period



# Results: Task Experiences



- Sleepiness level
- Motivation level



- Sleepiness level
- Motivation level
- SLP\*MOT interaction



# Discussion

- Overall, limited effect of motivation
  - BUT, on a low-order task there was some capacity to maintain performance
    - Room for improvement
    - Performance feedback
- Motivation did not reduce physiological or subjective sleepiness
  - Sleep drive is King!
- Differences between conditions for intrinsic task experiences
  - ↑ pressure/tension during the sleepy-motivated condition

# Discussion<sub>(2)</sub>

- Motivation could have a major effect on road safety
  - Negative/unsafe aspects
    - No effects for reducing sleepiness or improving HPT performance
  - Positive/safe aspects
    - Absence of motivation to continue driving
- Reinforces safe driving practices
  - Good sleep health practices
    - Especially before a long drive
  - Awareness of signs of sleepiness
  - Recognition of the dangerousness of driving while sleepy

# Discussion<sup>(3)</sup>

- Limitations
  - Small-ish sample size
  - Laboratory environment
- Strength
  - Use of a number of convergent measures

# Conclusion

- To date, this is the first study to examine psychophysiological and performance changes with motivations and driving while sleepy
- Overall, motivation had no effect on physiological and subjective sleepiness
- Differential effects of motivation on performance
  - Low-order vs. high-order cognitive tasks
- The obtained results reaffirm the dangerousness of continuing to drive while sleepy

Thank you for listening!

**Comments  
or  
Questions?**

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