Effects of sleep deprivation and sleep fragmentation on hippocampal neurogenesis in mice

PRESENTER:
Robert Gibson

BACKGROUND

- Disruptions of sleep patterns and circadian rhythms leads to cognitive impairments
- Shift-workers and Alzheimer's Disease (AD) patients are especially at risk for sleep-related impairments in cognition
  - Shiftwork -> being awake at inappropriate times of day
  - AD -> commonly exhibit fragmentation (Waking several times throughout night)

METHODS

1. Modelled sleep disturbances in C57bl/6 mice. 12hr/day for 7 consecutive days
   a) Shiftwork -> sleep deprivation (SD)
   b) AD -> sleep fragmentation (SF)
2. Injected BrdU 2hr pre-euthanasia to label newborn neurons (neurogenesis)
   a) Neurogenesis associated with memory
3. Collected brain and blood samples as well as infrared recordings of activity
4. Blood samples analyzed via ELISA
5. Brain sections stained and imaged using immunohistochemistry and Nikon A1R confocal imaging. Cell Counting ongoing

RESULTS

- Increases in average length of rest bouts
- Interaction effect observed across days specifically in SD group.
- No significant effect on corticosterone levels across all conditions and sex

DISCUSSION

- Sleep need was increased during active cycle in both groups suggesting our manipulations worked as planned
- Interaction across days suggests SD manipulation had more profound effects
- Stress should not confound our neurogenesis measures

Figure 1

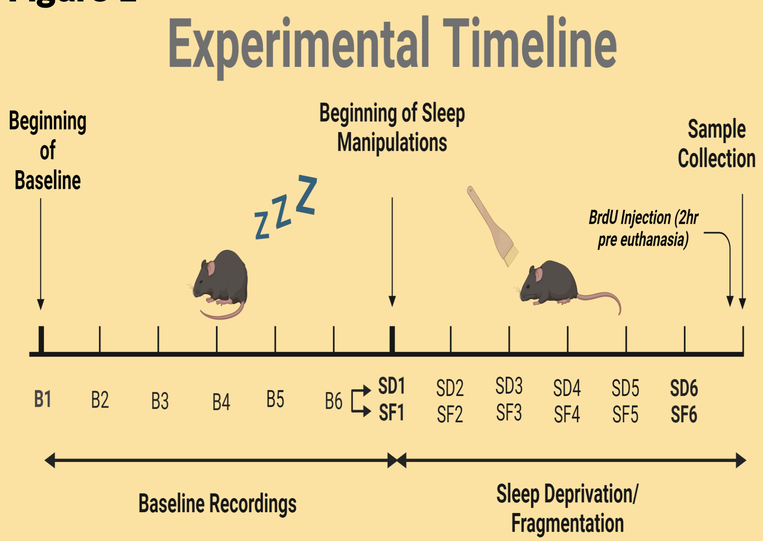


Figure 2

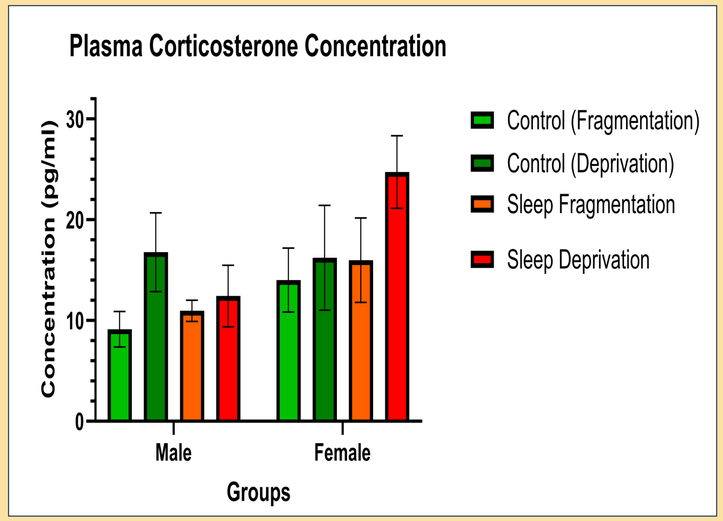


Figure 3

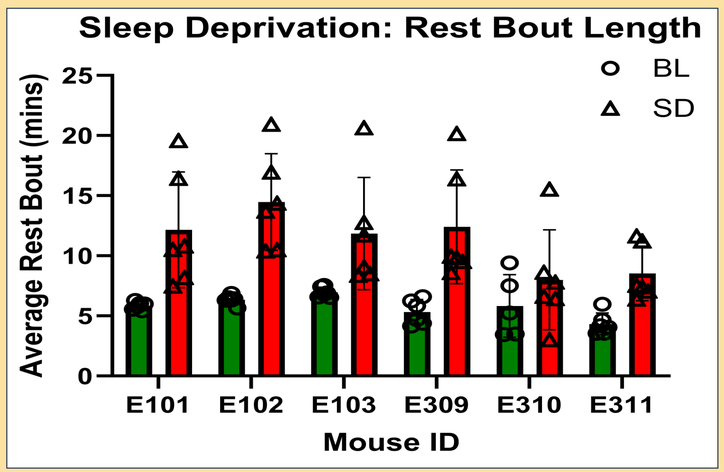


Figure 4

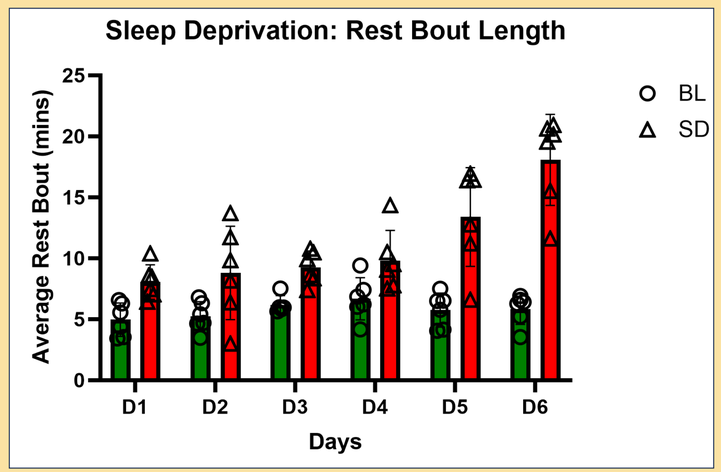


Figure 5

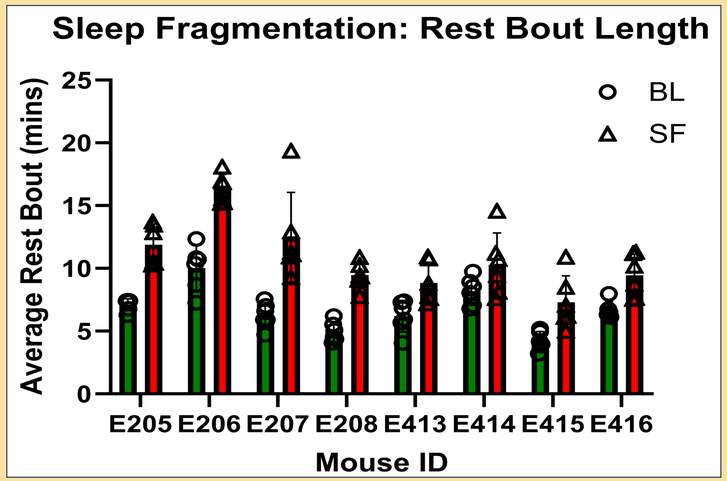
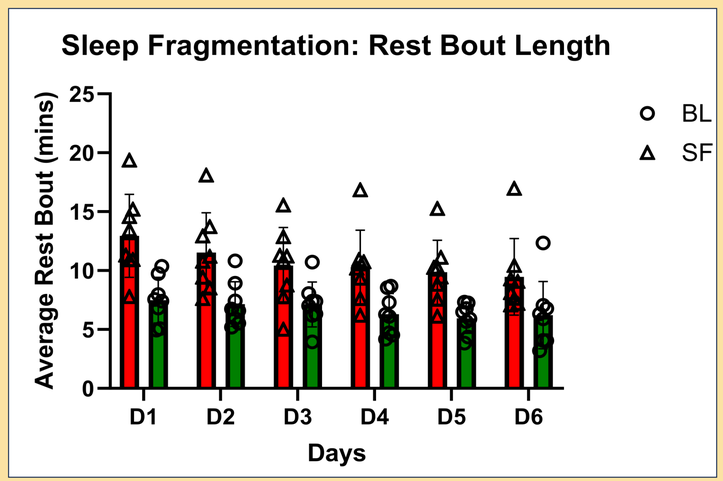


Figure 6



FIGURES

Fig. 1 – Six days of undisturbed sleep with infrared recordings of activity-> six days of sleep manipulations with recordings.
Fig. 2 – Corticosterone levels following sleep manipulations. No significant effect across all independent variables.
Fig. 3 – Length of average inactive periods for individual mice, a measure of sleep need, in the Shiftwork (SD) cohort.
Fig. 4 – Increase sleep need (Average Rest Bout) across days in Shiftwork (SD) Cohort
Fig. 5 – Length of average inactive periods for individual mice, a measure of sleep need, in AD (SF) cohort
Fig. 6 - Maintenance of sleep need (Average Rest Bout) across days in AD (SF) Cohort

REFERENCES

Kent, B. A., & Mistlberger, R. E. (2017). Sleep and hippocampal neurogenesis: Implications for Alzheimer's disease. *Frontiers in Neuroendocrinology*, *45*, 35–52. https://doi.org/10.1016/j.yfrne.2017.02.004

Timeline created by author using BioRender
Graphs created by author using Graphpad Prism

ACKNOWLEDGEMENTS

Supervised by Dr. Brianne Kent
In collaboration with Dr. Ralph Mistlberger, Kim Simon, Manthan Vekariya, Afrnan Sahibzada, Taha Yildirim, Mayuko Arai

Research funded by NSERC USRA

Robert Gibson, rga57@sfu.ca

NSERC CRSNG
undergraduate research symposium
TNL
SFU SIMON FRASER UNIVERSITY