

The Effect of Sleep Deprivation on the Startle Response

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INTRO

- Sleep deprivation has become an endemic in US and around the world¹
- Cognitive, motor, and learning abilities are impaired when sleep deprived
- Older adults struggle to learn new and retain new skills² leading to difficulties in physical therapies after an accident or illness
- Aging coupled with sleep deprivation could significantly diminish the impact of physical therapies
- Recent literature implies motor learning is, in part, mediated by the reticulospinal system³
- The startle reflex, response to a loud auditory cue measured by muscle onset latency, is a reliable predictor of the reticulospinal system⁴
- Using the startle response, we can determine if sleep deprivation correlates to delays in the reticulospinal system identifying factor for impaired learning when deprived of sleep

METHODS

- Recruited 53 young adults (21.2 ± 2.2 years) with no alcohol abuse, hearing loss or sensitivity, mental disorders, or lower limb physical impairments
- 2 experimental sessions: 1 rested(control) & 1 sleep deprived in crossover model

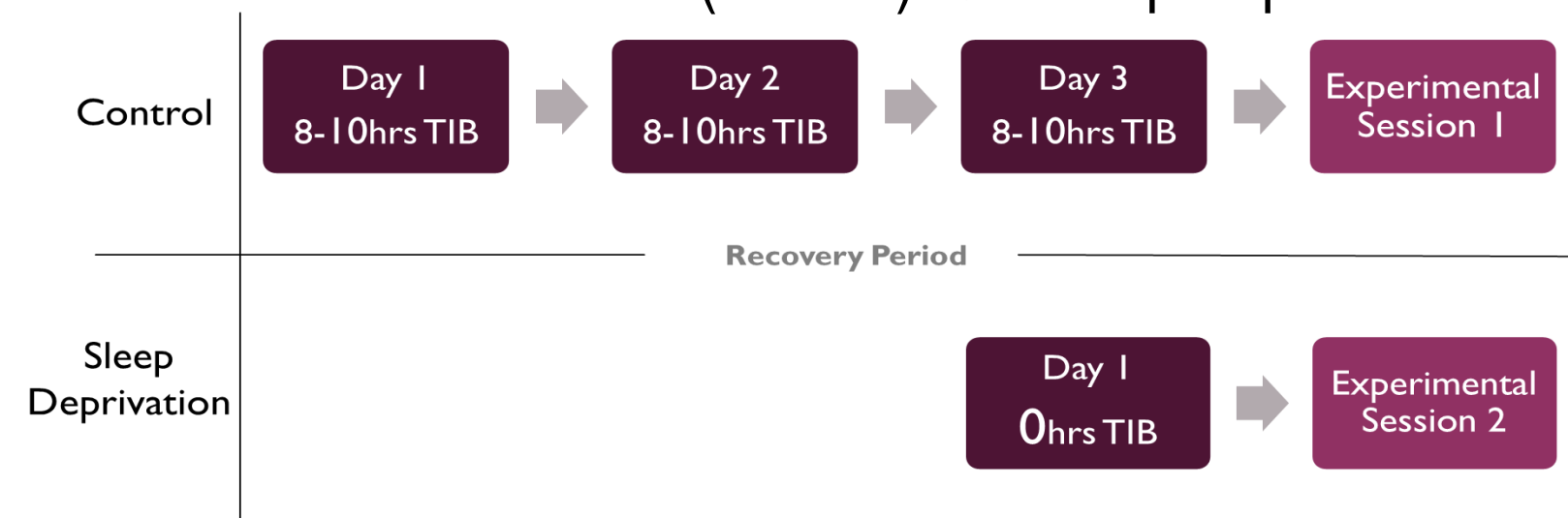


Figure 5. Experimental Design above [time in bed (TIB)]

- Electromyography (EMG) data taken from left and right SCM during passive reading task receiving 15 loud acoustic startles (120dB) within 10 minutes per session
- Functional performance assessment (8 tests) administered to determine cognitive skill (3 tests), balance (2 tests), motor ability (2 tests), and reaction time (1 tests)

CONCLUSIONS

- Significant declines observed in 7 of 8 functional performance assessments ($p < 0.05$) indicating subjects were sleep deprived during experimental session
- Left and right SCM onset latencies exhibited no significant differences suggesting this is not an effective metric to predict sleep deprivation
- Reticulospinal system may not be responsible for learning deficits in older adults
- SCM muscle onset amplitude may be a more robust indicator of reticulospinal system when sleep deprived to be explored in future work

The sternocleidomastoid (SCM) muscle onset latencies as an index of **startle** is **not** an effective **indicator** of **sleep deprivation**

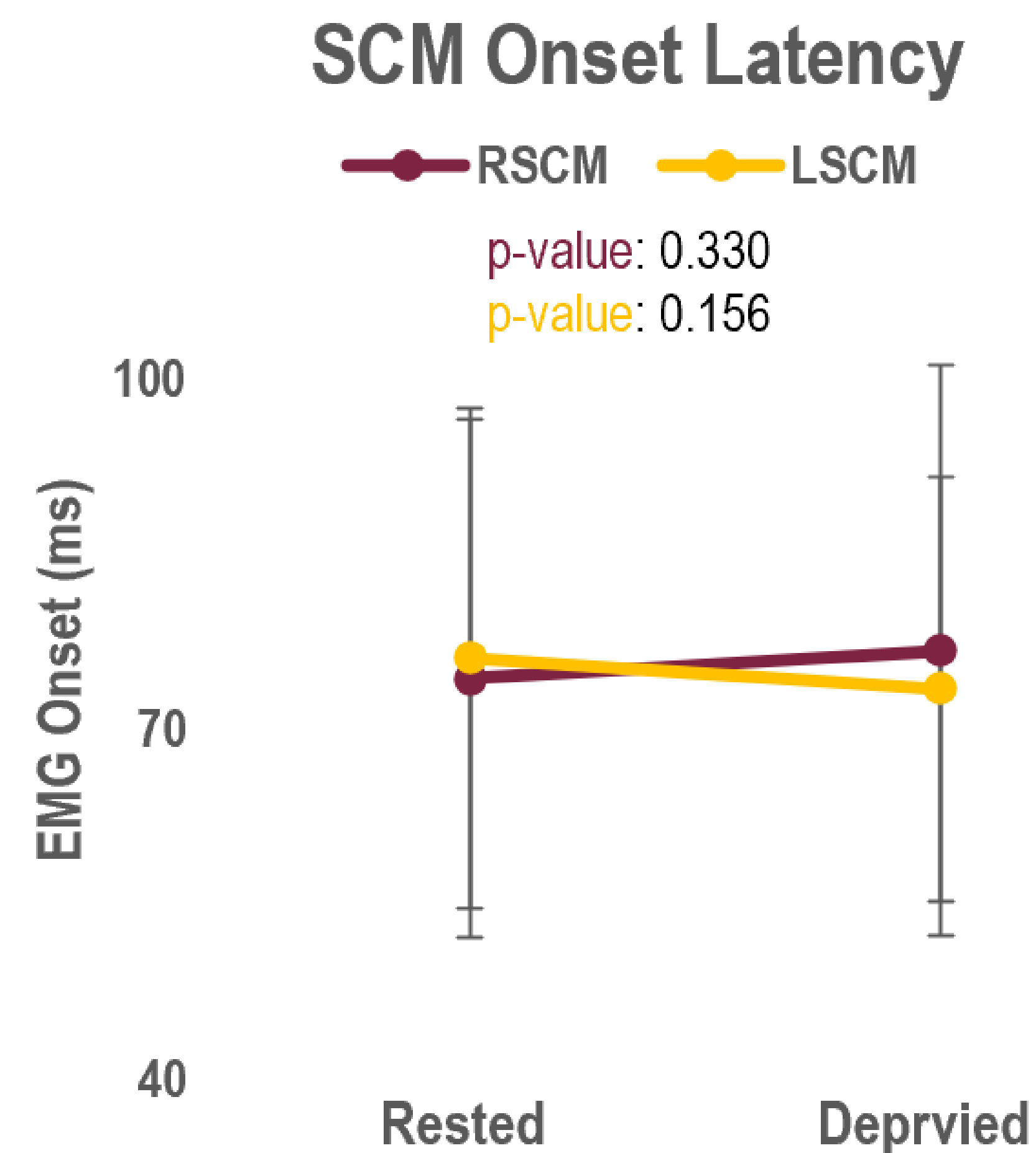


Figure 1. The right sternocleidomastoid (RSCM) [maroon] and left sternocleidomastoid (LSCM) [gold] startle response. The average SCM onset latency illustrated above when subjects were rested and sleep deprived ($n=41$). Standard deviation bars are displayed on each point. No significant differences were observed ($p = 0.330$ and $p=0.156$ respectively).

Sleep Deprived Subjects

Delayed Word Recall

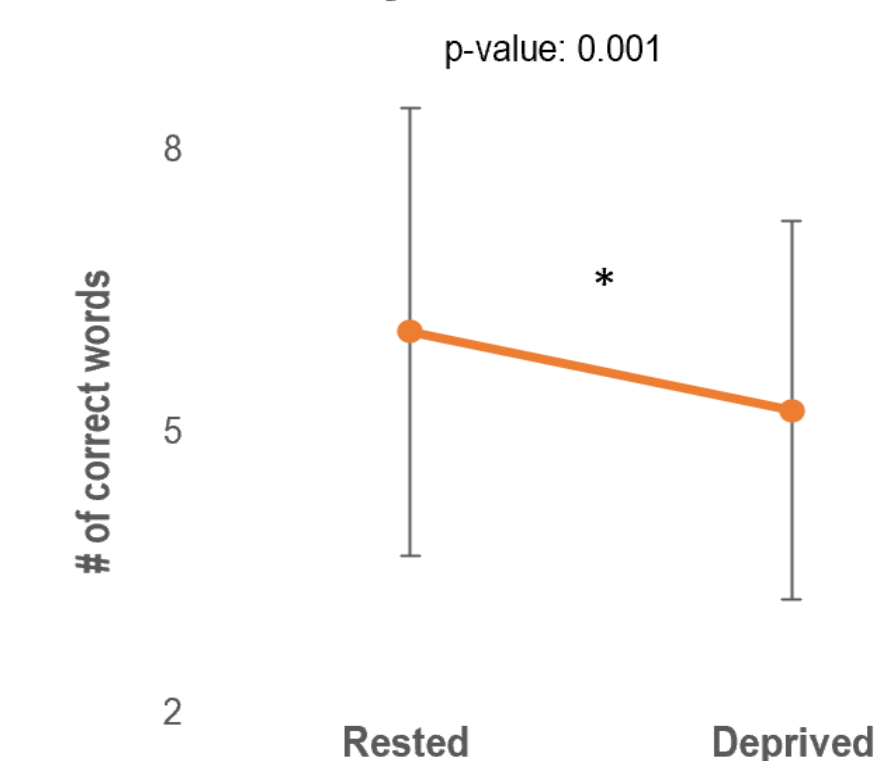


Figure 2. Delayed word Recall. The average word recalled after 10minutes from a list of 15 words ($n=41$) significant declined ($p=0.001$).

Reaction Time

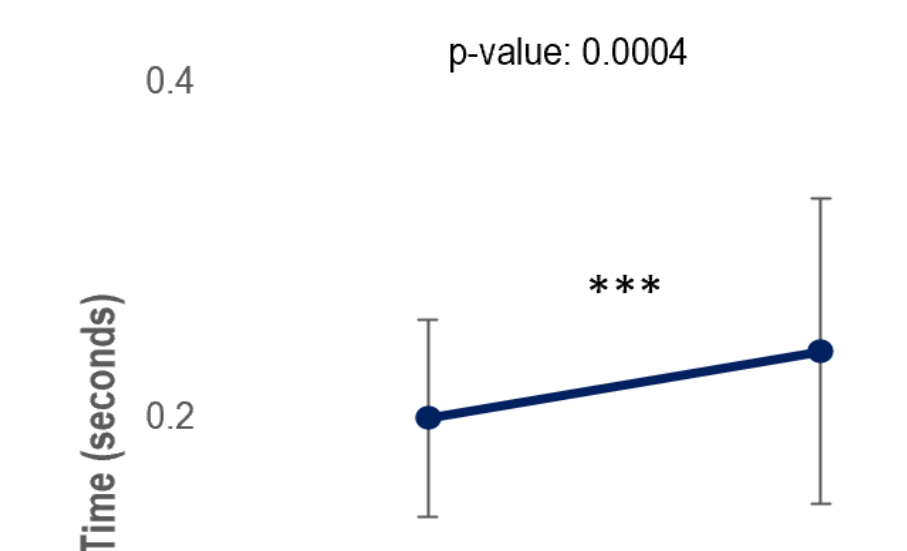


Figure 3. Reaction time test. The average reaction time from a switch box measured in seconds ($n=41$) significant increased ($p=0.0004$)

Balance Test

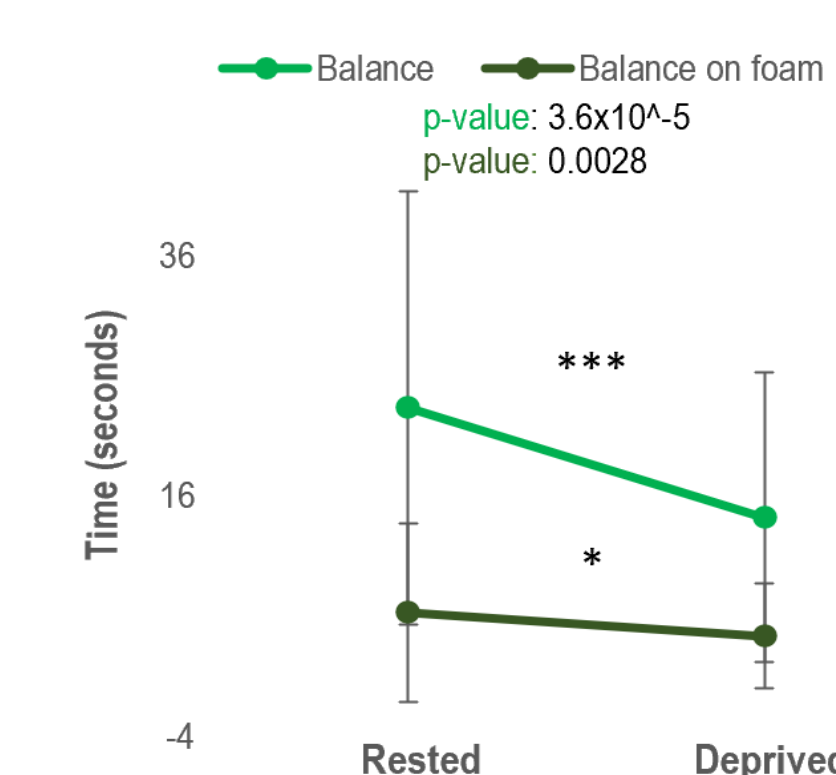


Figure 4. One leg balance with and without standing on a foam block. The average balance time after on both legs with eye closed ($n=41$) significant decreased ($p=3.6 \times 10^{-5}$ and $p=0.0028$ respectively).

Citations:

1. Chattu, Vijay Kumar, Md. Dilshad Manzar, Soosanna Kumary, Deepa Burman, David Warren Spence, and Seithikurippu R. Pandi-Perumal. "The Global Problem of Insufficient Sleep and Its Serious Public Health Implications." *Healthcare* 7, no. 1 (December 20, 2018). <https://doi.org/10.3390/healthcare7010001>
2. Ketcham, Caroline J., and George E. Stelmach. *Movement Control in the Older Adult. Technology for Adaptive Aging*. National Academies Press (US), 2004. <https://www.ncbi.nlm.nih.gov/books/NBK97342/>.
3. Kawai, Risa, Timothy Markman, Rajesh Poddar, Raymond Ko, Antoniu Fantana, Ashesh Dhawale, Adam R. Kampff, and Bence P. Ölveczky. "Motor Cortex Is Required for Learning but Not Executing a Motor Skill." *Neuron* 86, no. 3 (May 6, 2015): 800–812. <https://doi.org/10.1016/j.neuron.2015.03.024>.
4. Tresch, Ursula A., Eric J. Perreault, and Claire F. Honeycutt. "Startle Evoked Movement Is Delayed in Older Adults: Implications for Brainstem Processing in the Elderly." *Physiological Reports* 2, no. 6 (June 11, 2014). <https://doi.org/10.14814/phy2.12025>.