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Assessing Differences in Sleep Recovery From Stimulant Induced Versus non-Pharmacological Sleep Disruption in Young Adult Mice

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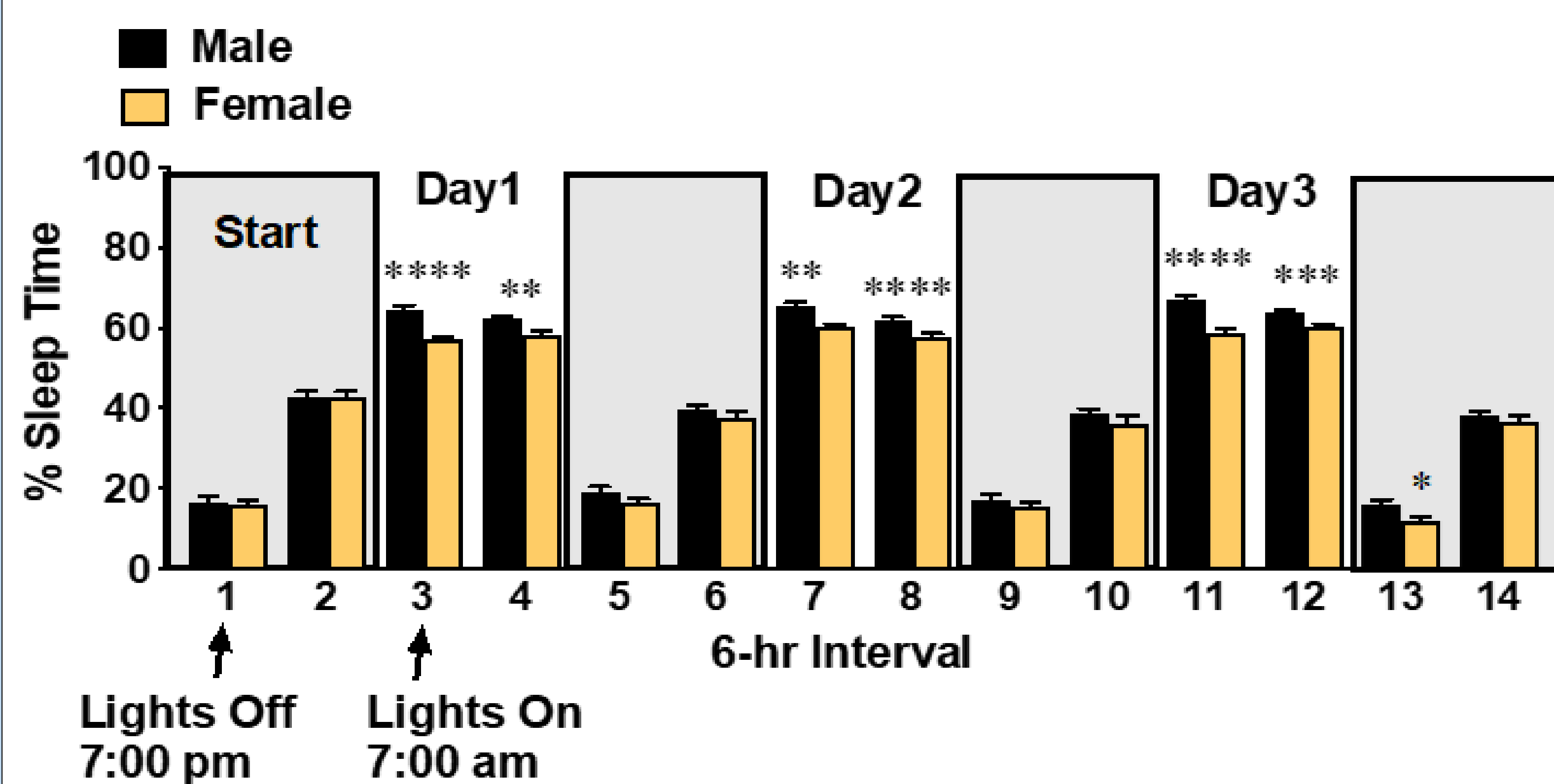
Introduction:

Researching the effects of stimulant-induced and non-pharmacological sleep disruption in mice could prove useful for understanding similar effects in humans. In 2018, The National Institute on Drug Abuse reported that 11 percent of college students used Adderall without a prescription. Additionally, a 2019 study found that 92 percent of college students consumed caffeine in the past year, with 79 percent stating that they consume caffeine “to feel awake”. (Mahoney et al., 2019). Furthermore, approximately 70 percent of college students report attaining insufficient sleep, which has a strong negative correlation with grades, memory, and mood (Hershner et al., 2014). The first step in determining how we can solve these issues is determining if a return to sufficient sleep (sleep recovery) is hindered by the use of pharmacological agents to stay awake.

Methods:

Eight-week-old male and female mice were placed in a piezoelectric sleep system for eight days. On the sixth day mice were randomly chosen to either undergo non-pharmacological Sleep Disruption (SD) for 3 hours or an injection and returned to their sleep cage. Injections were 3.0mg/kg amphetamine, 12.5mg/kg caffeine, or saline (vehicle group). Non-pharmacological SD (also known as lab disruption) consisted of introducing the mice to novel behavioral tasks. Experiments were conducted by an experimenter blinded to drug treatment. Data were analyzed using repeated measures ANOVAs (Statview, SAS, Cary, NC). Post-hoc comparisons were conducted using Fisher’s Protected Least Significant Difference (PLSD) tests only when a significant F value was found in the overall ANOVA. For all comparisons, significance was set at $p < 0.05$.

A) Sex Differences in Percent Sleep



A) Sex differences in baseline levels of sleep. Gray boxes demarcate dark intervals.

Acknowledgements:

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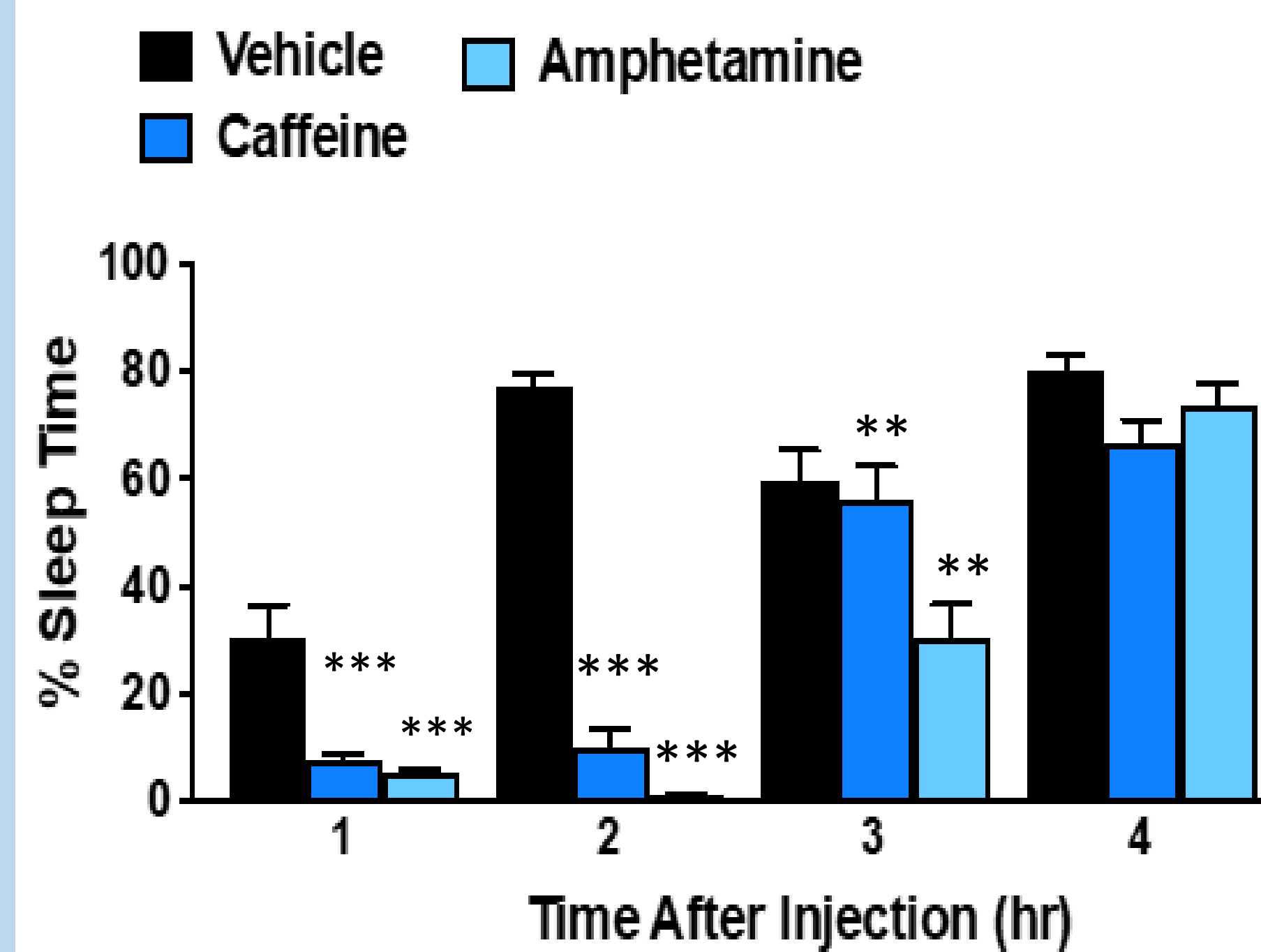
Results:

This study found significant differences between male and female sleep patterns (Figure A). The male mice, on average, slept more than the female mice. We also found that the caffeine and amphetamine did have significant effects on the amount of time that the mice slept, in both the male and female groups (Figures B and C). Mice injected with stimulants had reduced sleep for about three hours post-injection. Lastly, but perhaps most importantly for our study, we found that, in the early night, mice who underwent lab disruption slept significantly more than those who were not sleep deprived, as well as those who were sleep deprived via the use of stimulants.

Conclusion:

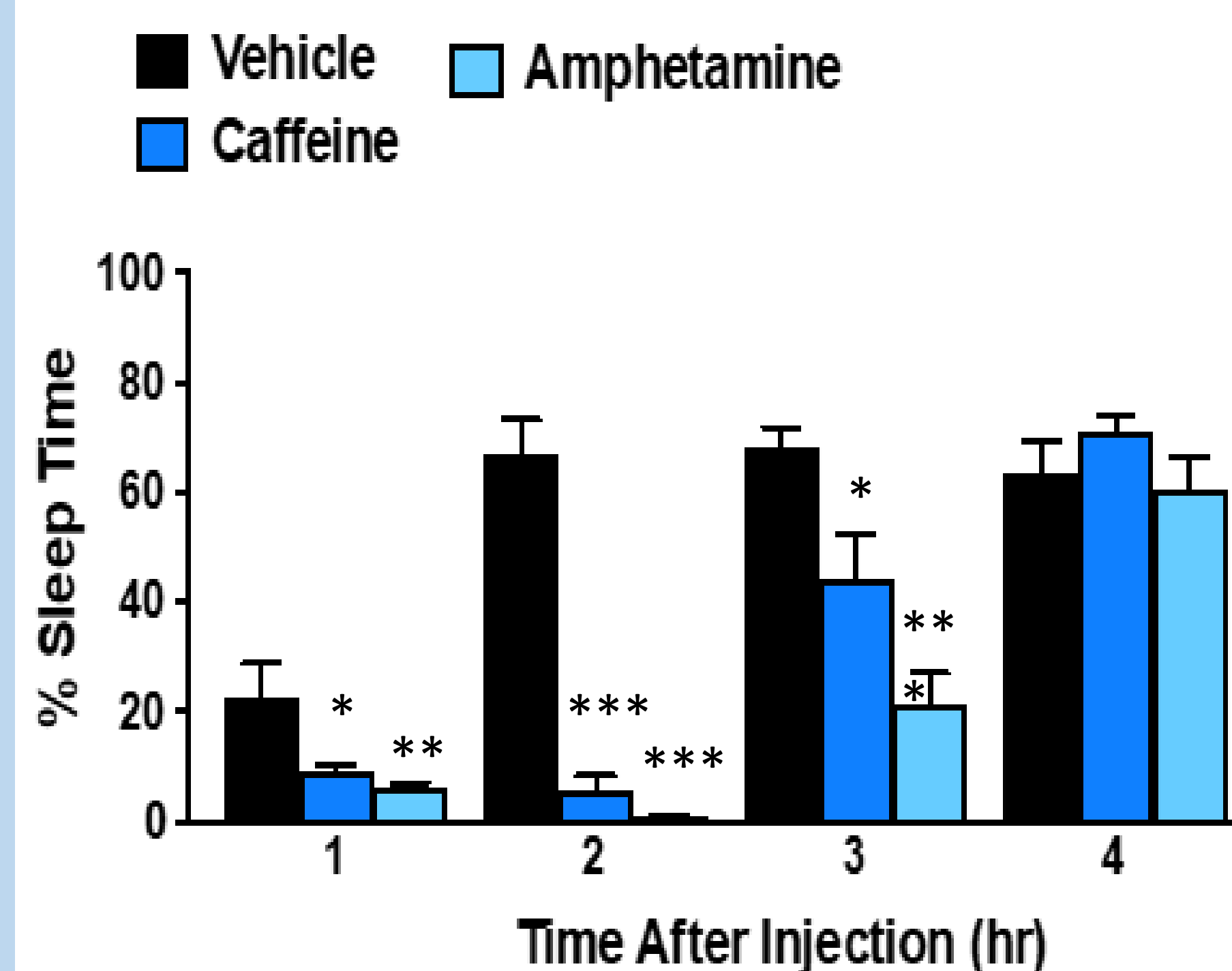
We had predicted that amphetamine would lead to the greatest amount of sleep rebound, with caffeine and non-pharmacological SD having milder effects. Instead, we found that exposing mice to a series of different laboratory conditions led to higher levels of sleep in the early dark period

B) Acute Drug Effects on Sleep, Males



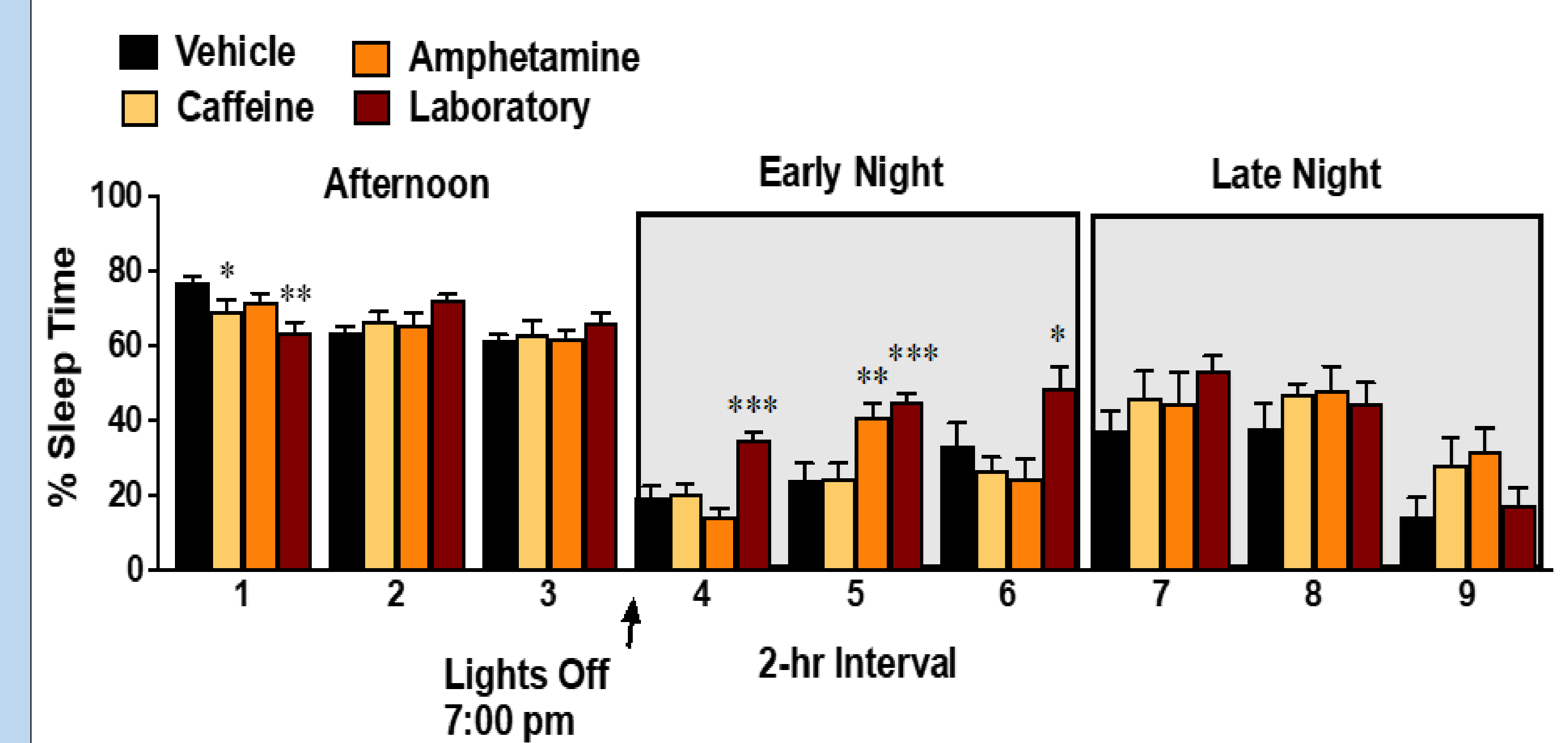
B, C) Acute effects of stimulant drug treatments on sleep in male and female mice.

C) Acute Drug Effects on Sleep, Females



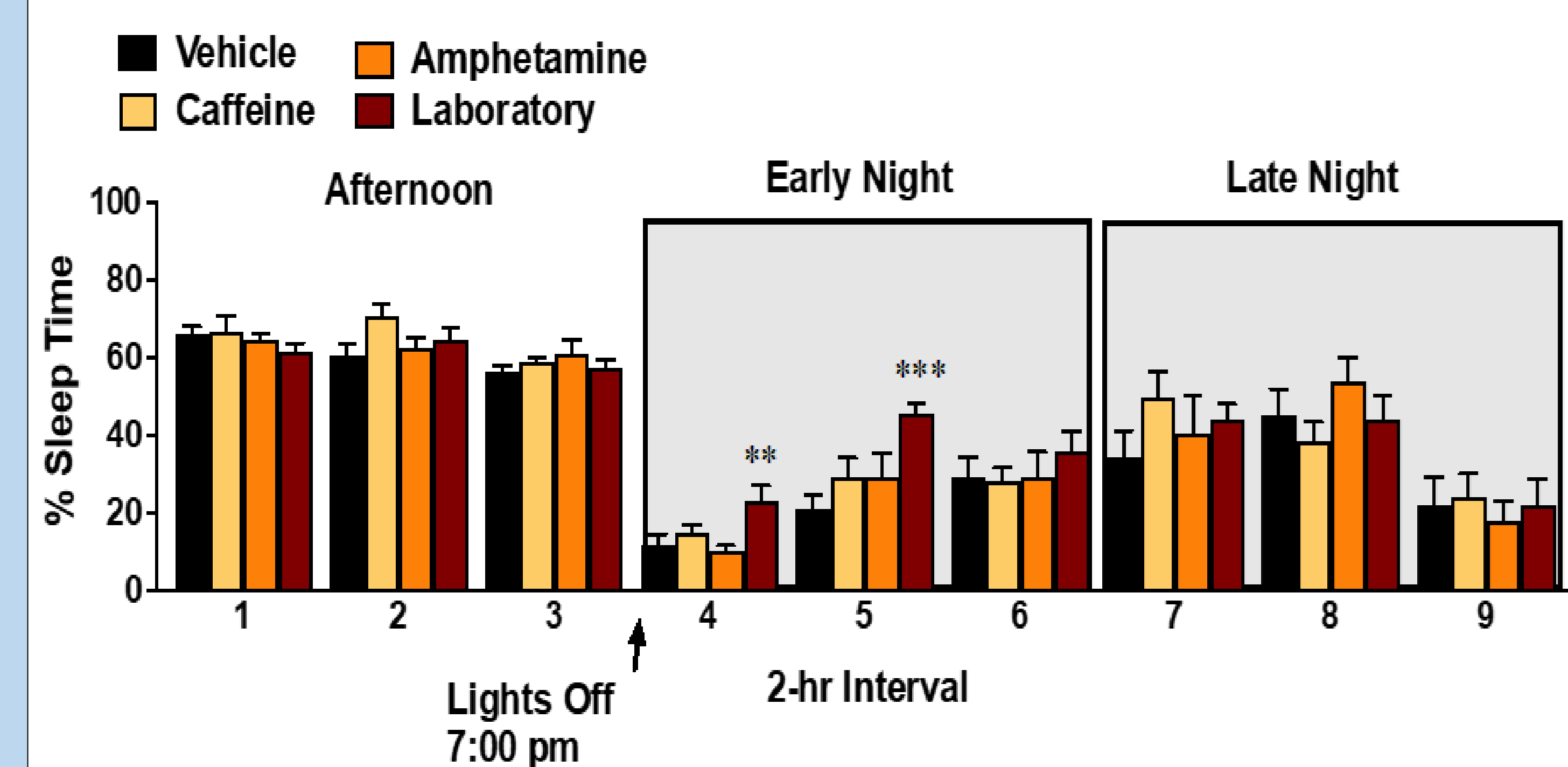
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$, **** $p < 0.0001$; comparison to Vehicle group.

D) Sleep Rebound, Males



D, E) Sleep rebound (increased sleep) during the early night hours (comparisons to vehicle group).

E) Sleep Rebound, Females



Mouse Behavioral Phenotyping Laboratory

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