Perturbations in brain functional connectivity patterns after waking from slow wave sleep under different cognitive states

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Introduction

Sleep inertia is the state of transition between sleep and wake characterized by impaired alertness, confusion, and reduced cognitive and behavioral performance. Here we attempt to answer 2 questions: (1) How does sleep inertia impact the brain as subjects wake up abruptly and engage in tasks that differ in cognitive complexities? (2) Are there interventions that mediate how sleep inertia impacts the waking brain?

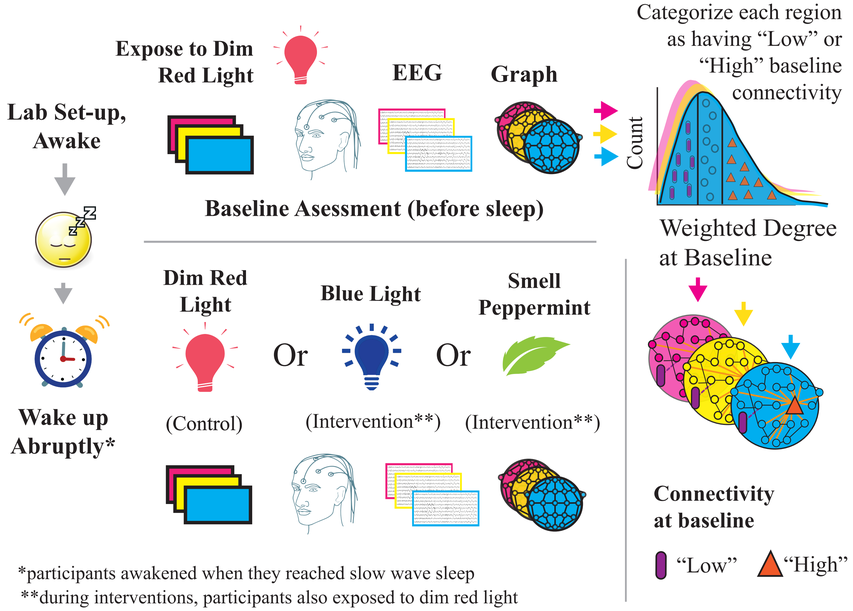
Method

Record EEG through out night.

Perform 3 Cognitive Tasks
- Vigilance
- Inhibition
- Addition

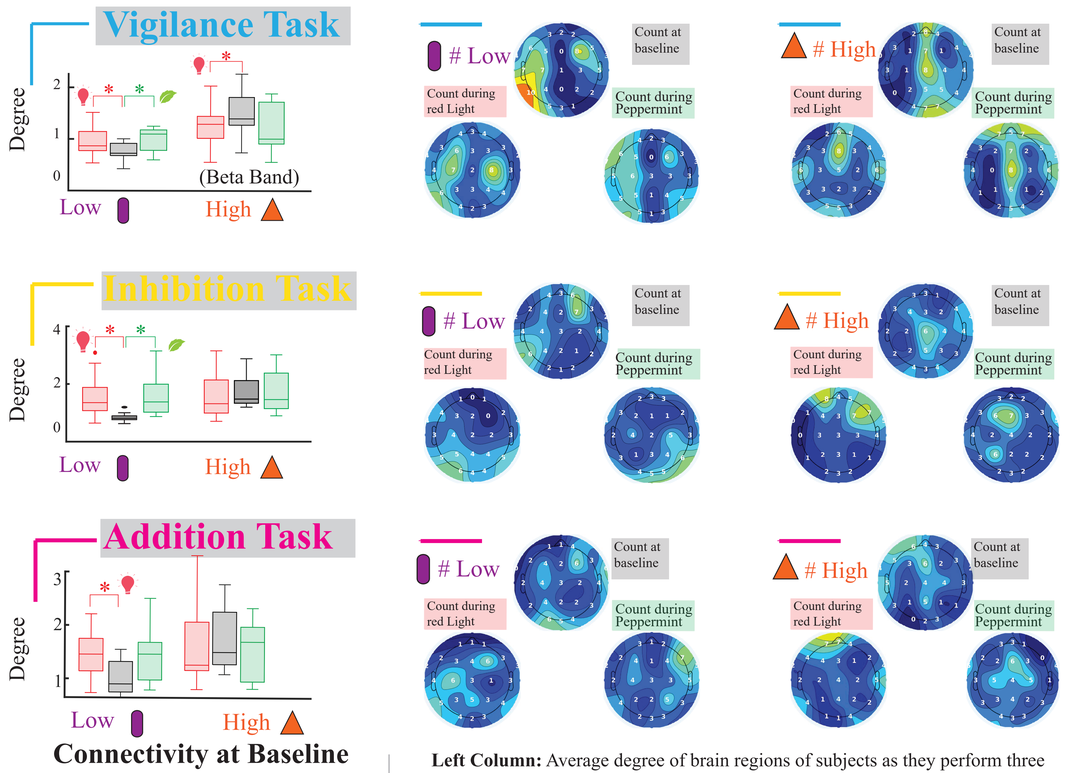
Compute pairwise weighted phase lag index of EEG sensors

Estimate "weighted degree" of each node (brain region)



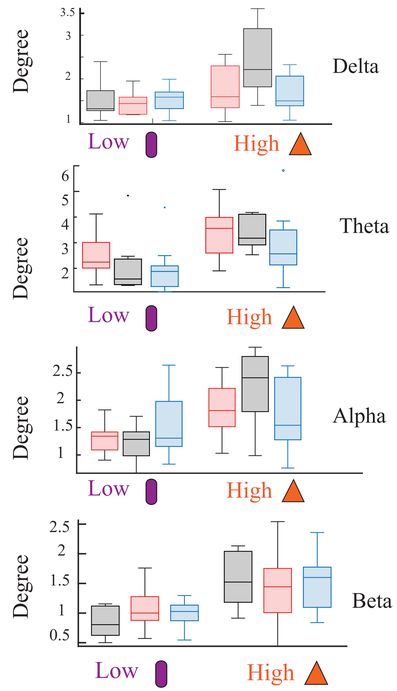
*participants awakened when they reached slow wave sleep
**during interventions, participants also exposed to dim red light

Smelling Peppermint After Abrupt Waking



Left Column: Average degree of brain regions of subjects as they perform three different cognitive tasks under three scenerios - (1) before sleep, (2) after they wake up abruptly under dim red light and (3) after waking up abruptly while smelling peppermint. The degree of a brain region is estimated from the beta frequency of the EEG. Asterisks denote significant differences between groups. **Second Column:** Number of times a brain region was categorized as having "Low" connectivity at baseline, after waking with dim red light, or after waking while smelling peppermint, for each task, seperately. **Third Column**: Same as the second column but for brain regions categorized as having "High" baseline connectivity.

Exposure to Blue Light After Waking



Connectivity at Baseline

Degree of brain regions as subjects perform a **vigilance task** in three scenerios - (1) before sleep (grey box), (2) after they wake up abruptly under dim red light (red box) or (3) after **waking up abruptly under blue light** (blue box). The degree of brain regions are estimated for 4 frequencies of the EEG. No significant differences were observed.

Summary

Connections between brain regions can be lost due to abrupt-awakening, but can also be 'reallocated' to other regions in an attempt to renormalize the brain. Such losses and gains in connectivity during the waking process may be more nuanced during complex task performance and can be minimized if subjects smell peppermint after waking.

References

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FOR FURTHER INFORMATION:
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