Detection and Analysis of Sleep Spindles

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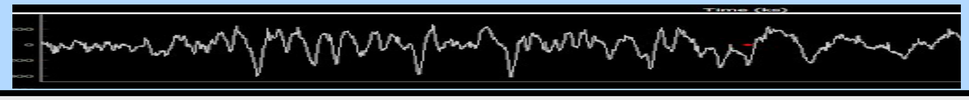


What Are Sleep Spindles?

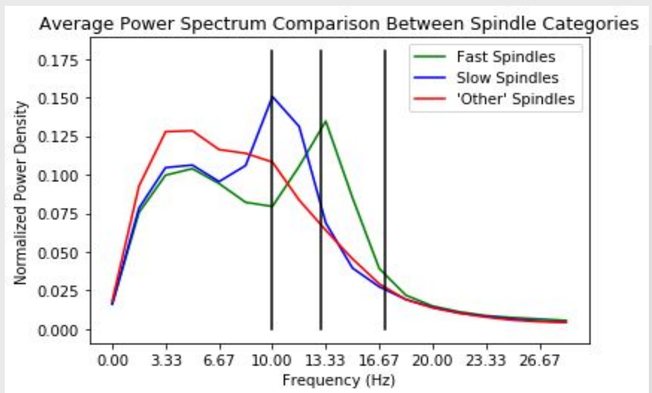
Sleep spindles are neural bursts that occur in NREM sleep. They typically last half a second to two seconds and have a signature spindle-like shape on an EEG recording--hence the name sleep spindle. Sleep spindles are thought to be involved in learning and memory, and sleep spindle abnormalities are present in neural disorders such as schizophrenia, autism, and epilepsy.

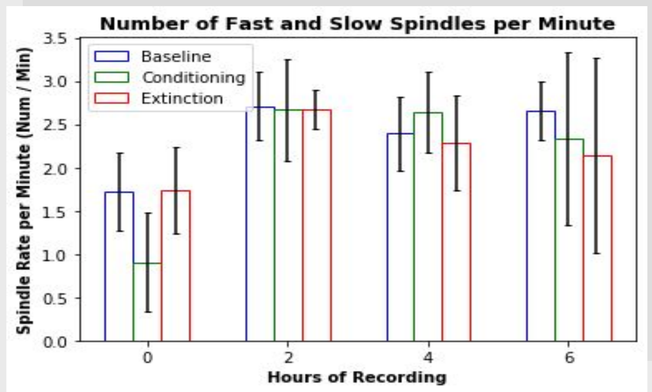
Research Path

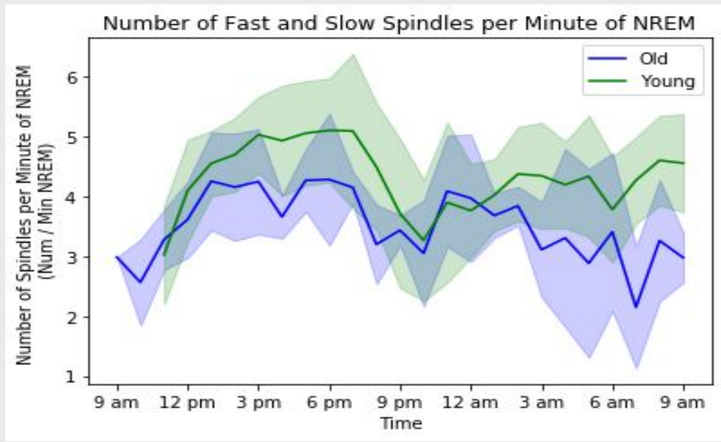
- Read literature on sleep science, focusing on sleep spindles
- Learned Python by doing tutorials
- Created sleep spindle detection software
- Created documentation of sleep spindle detection software
- Created graphing module to analyze data
- Used output from sleep spindle detection software as input for graphing analysis module to produce hundreds of graphs to reveal patterns and relationships involving sleep spindles

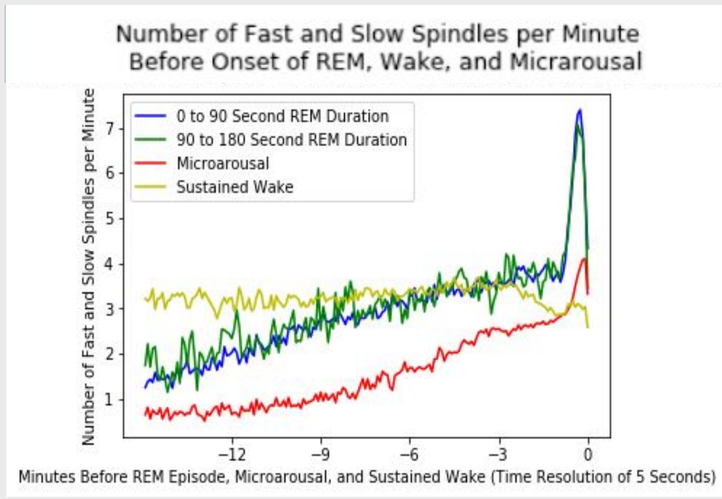
An Overview of the Detection Software

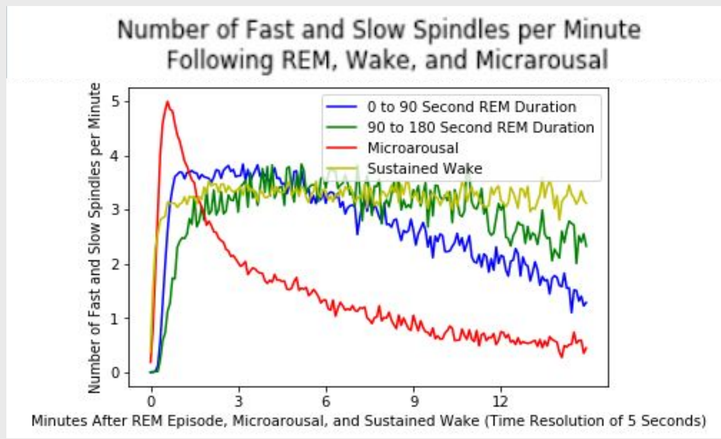
In the brain, there is electrical activity that an EEG can measure. This electrical signal is composed of waves of different frequencies, and the Fourier Transform can separate the individual frequencies of the electrical signal from each other. Sleep spindles have a peak frequency in the range 10-17 Hz, called the sigma frequency range, and my algorithm uses this fact to classify spindles based on if their peak frequency falls into this range. However, as I developed my algorithm, I found there were events which had a peak frequency in the sigma range, but had peaks of very small magnitude, and so I added the requirement of a minimum peak threshold that would vary between recordings to account for differences in EEG signal strength. For the interested reader, there are two in depths documentations which I wrote that describe my sleep spindle detection software in more detail called "Preliminary Documentation of Automation of Detection of Sleep Spindles" and "2nd Documentation of Spindle Detection of Automation of Sleep Spindles."

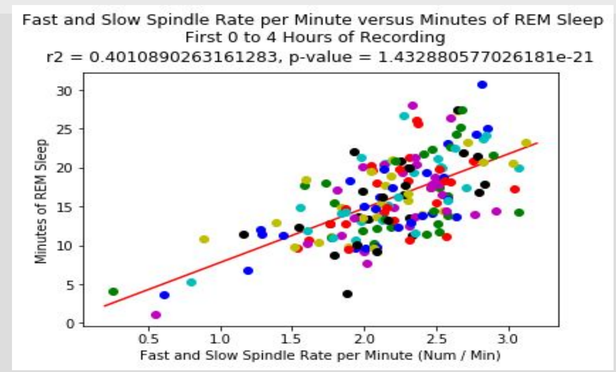












Results

- Fear conditioning suppresses spindles in the first two hours following conditioning.
- Young mice have a greater NREM spindle rate than old mice.
- Right before onset of REM and microarousal to a lesser degree, there is a large increase in both number of spindles per minute and NREM spindle rate.
- After REM and microarousals, number of spindles per minute and NREM spindle rate decays after an initial increase.
- Number of spindles per minute is positively correlated with minutes of REM, number of REM episodes, and number of microarousals.

Acknowledgements

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References

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