From Setup to Data Processing: Learning How to Use EEG To Advance the Neuroscience of Meditation

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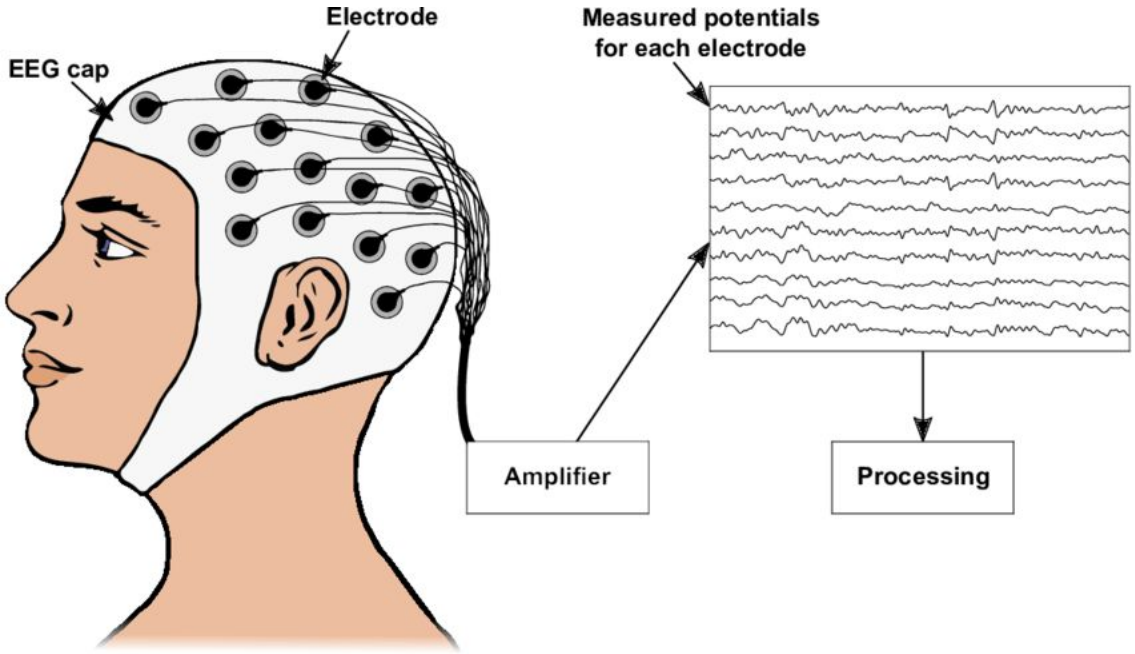
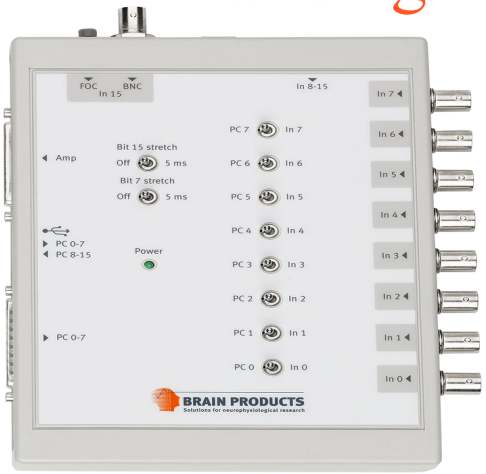
Washington University in St. Louis Undergraduate Research Symposium 2021

What is EEG?


Electrode
Measured potentials
for each electrode
EEG cap
Amplifier
Processing

Building an EEG Lab Space: Necessary Materials

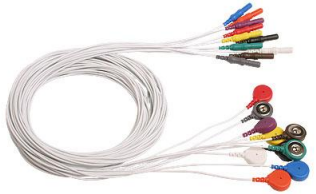


Trigger Box

Amplifier

BrainCap

2 Computers (recording computer and task computer)



Electrodes

Building an EEG Lab Space: Putting it All Together

Participant space

Task computer (left), recording computer (right)

*These are actual pictures of our EEG lab space at WashU!

Building an EEG Lab Space: Putting it All Together

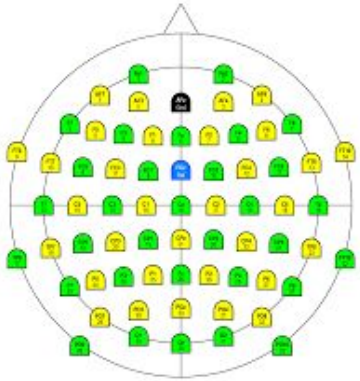
BrainCaps

Electrodes

*These are actual pictures of our EEG lab space at WashU!

Participant Setup

1. Choose cap



2. Plug electrodes into cap

3. Place cap on person's head

4. Plug electrodes into the amplifier

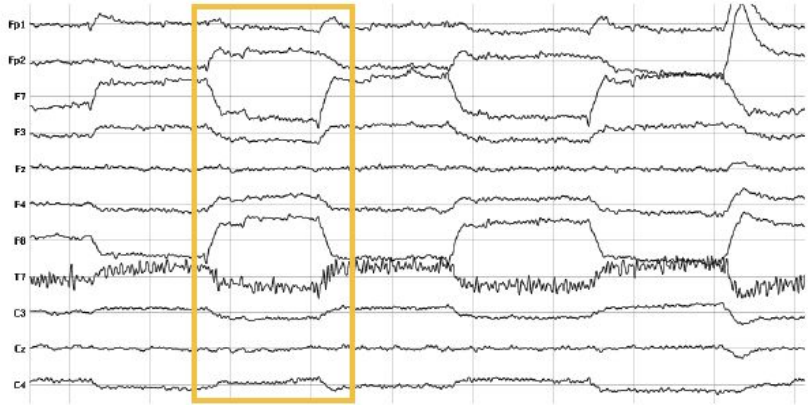
5. Apply gel

6. Ensure that data looks good, and begin recording!

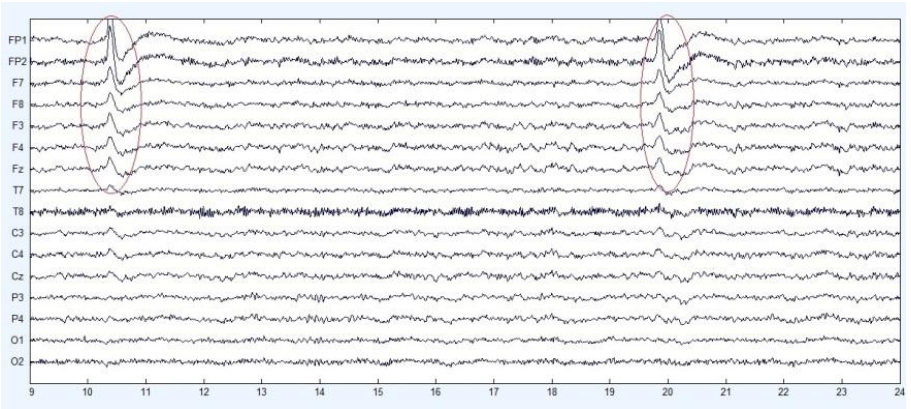
7. Clean up.

EEG Preprocessing/Analysis Steps

1. Filter data (specify frequency range)
2. Reference data
3. Ocular correction
4. Segment data



Eye movement artifact example

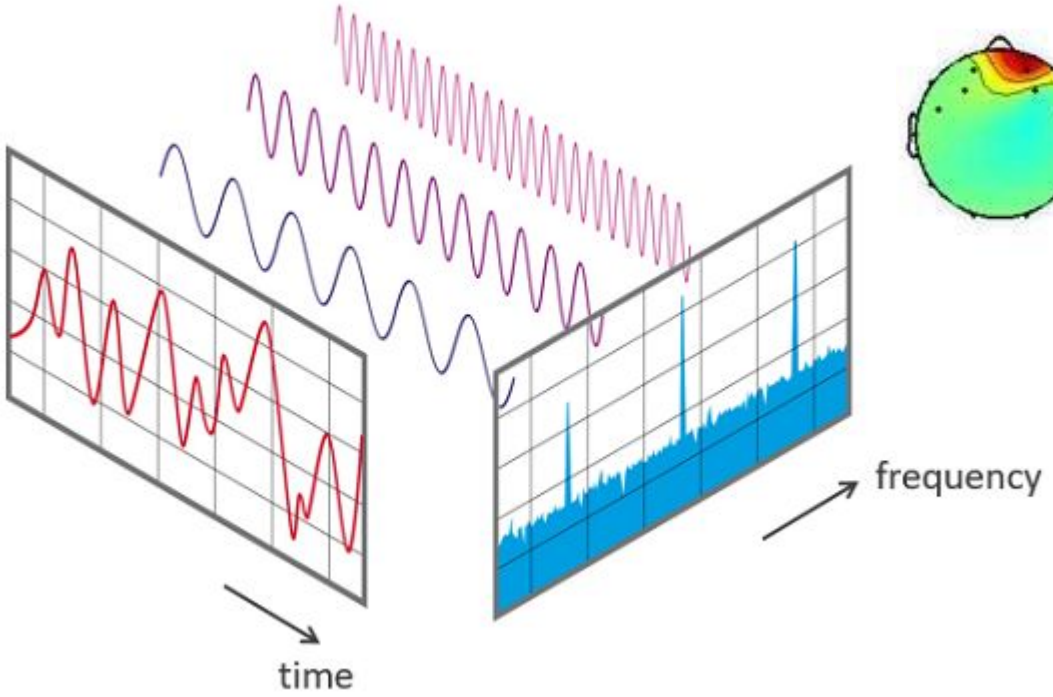


Eye blink artifact example

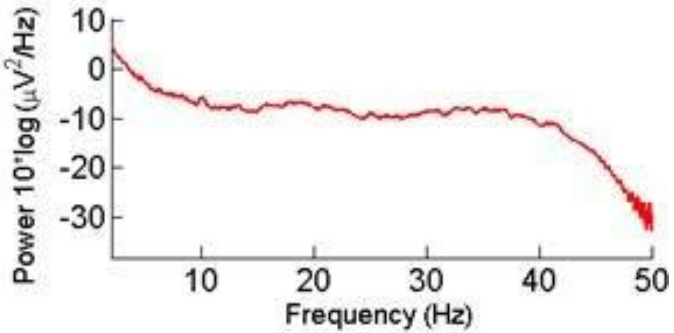
Data I Collected & Analyzed:

Spectral Power Analysis Before and After a 10-Day Meditation Retreat

EEG Spectral Power: Time to Frequency Domain



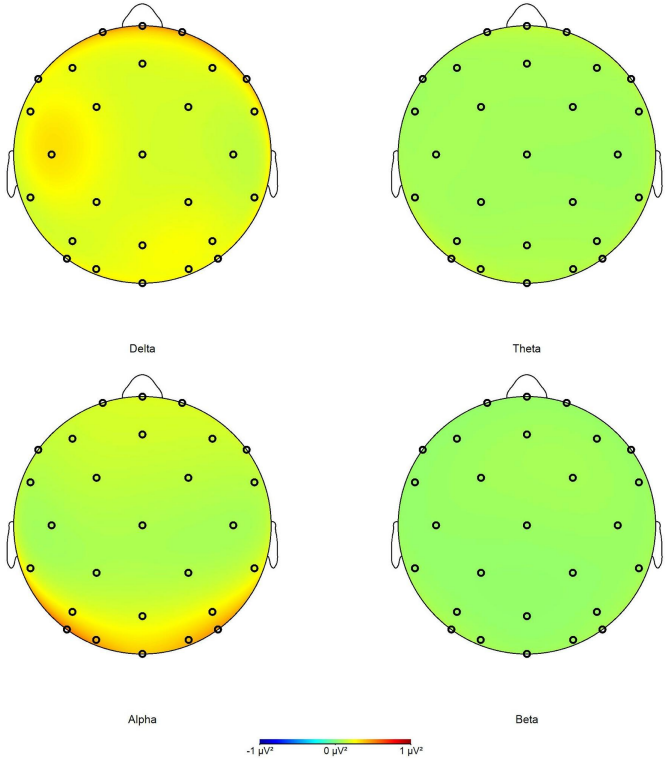
Fast Fourier Transform (FFT)



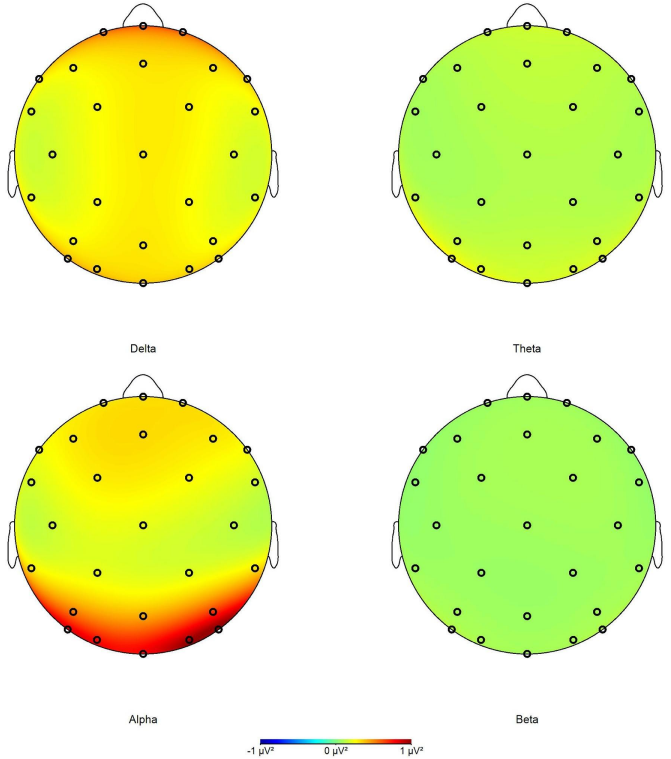
Frequency band map and
FFT output example

Meditation -> increased alpha
- **Lee et al., 2018**

Focused Attention (FA) Meditation

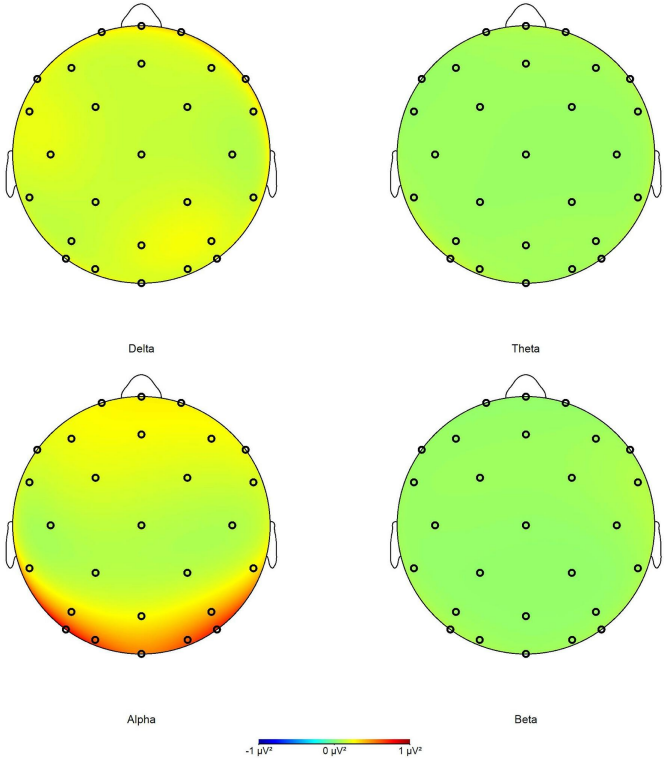


Before

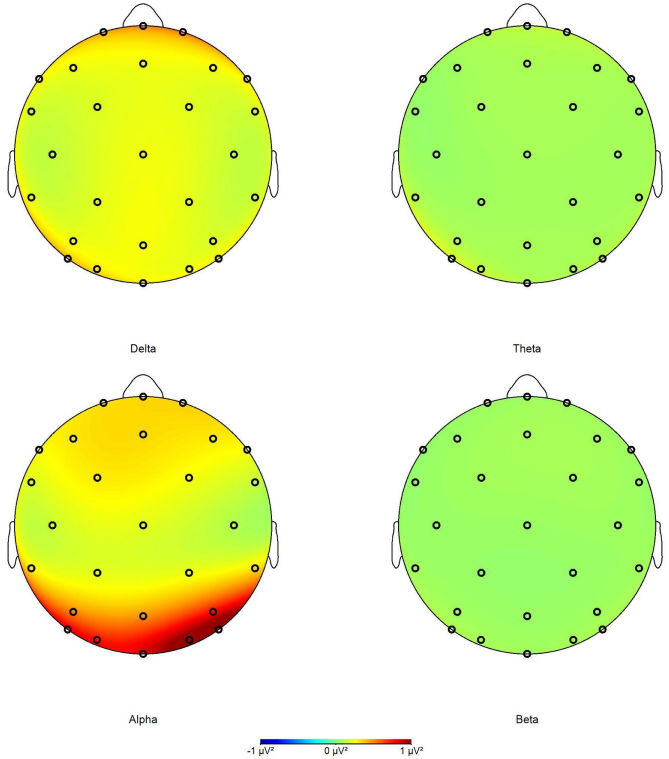


After

Mind Wandering (MW) Condition

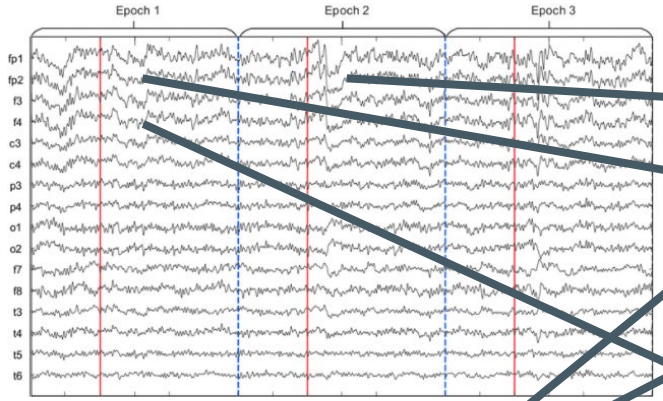


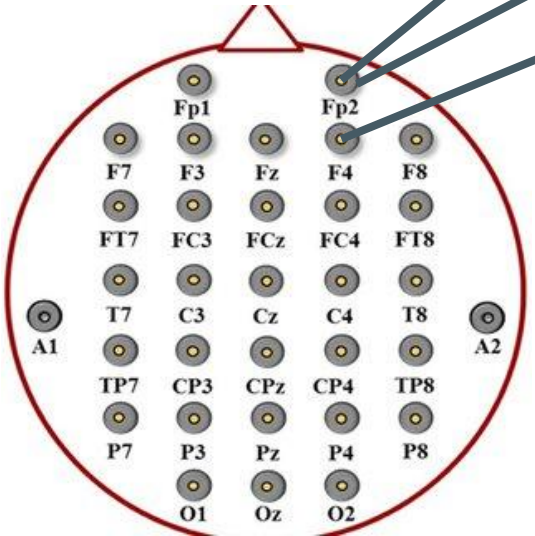
Before

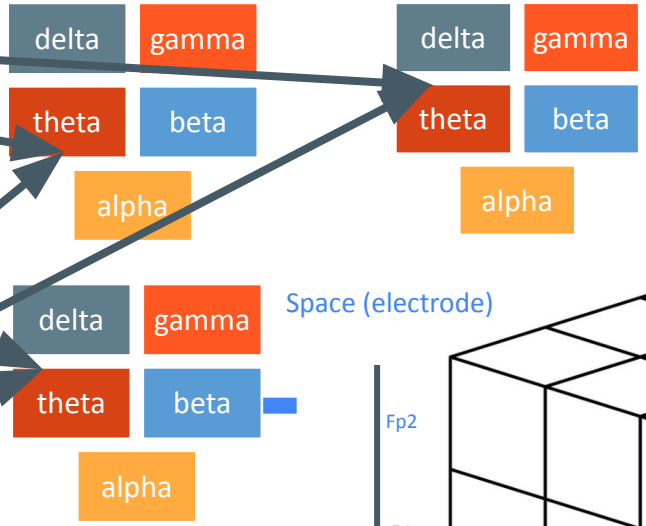


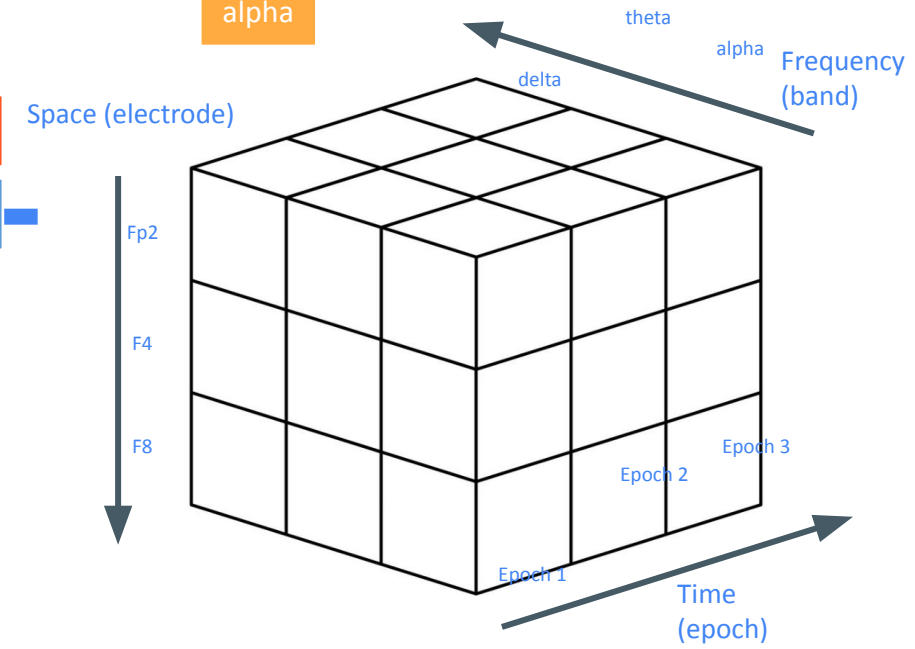
After

Devising Our Own Pattern Similarity Analysis Technique





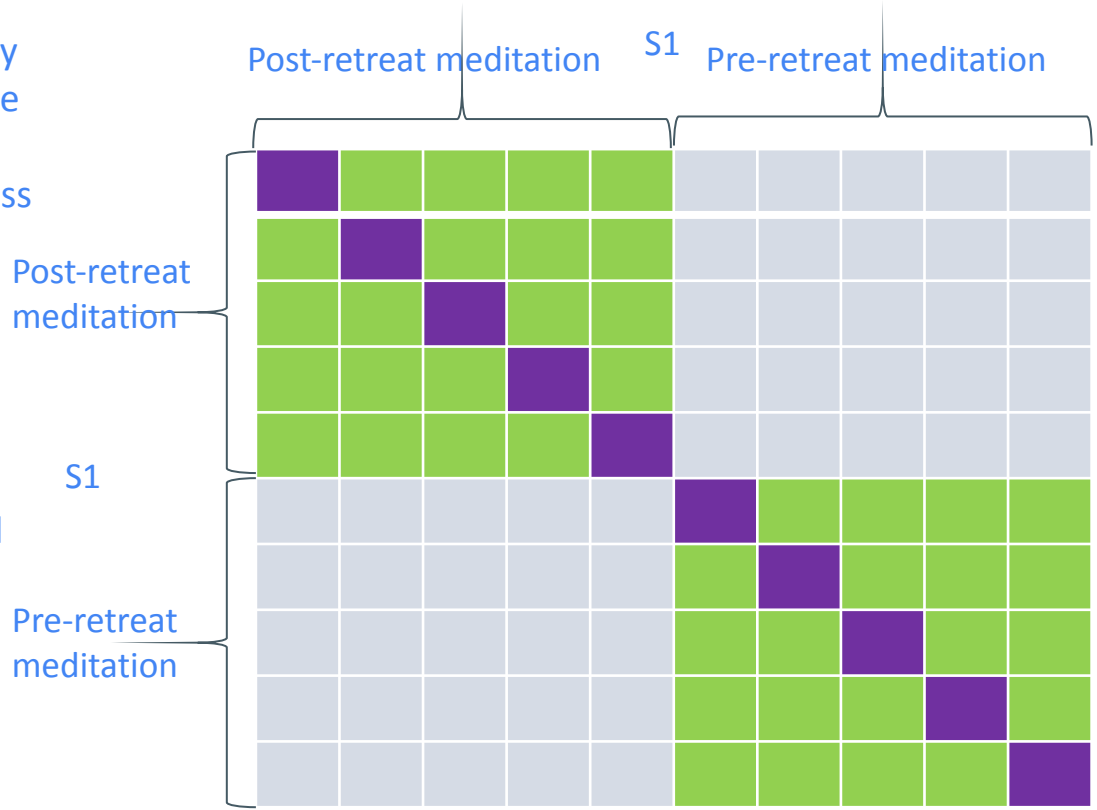




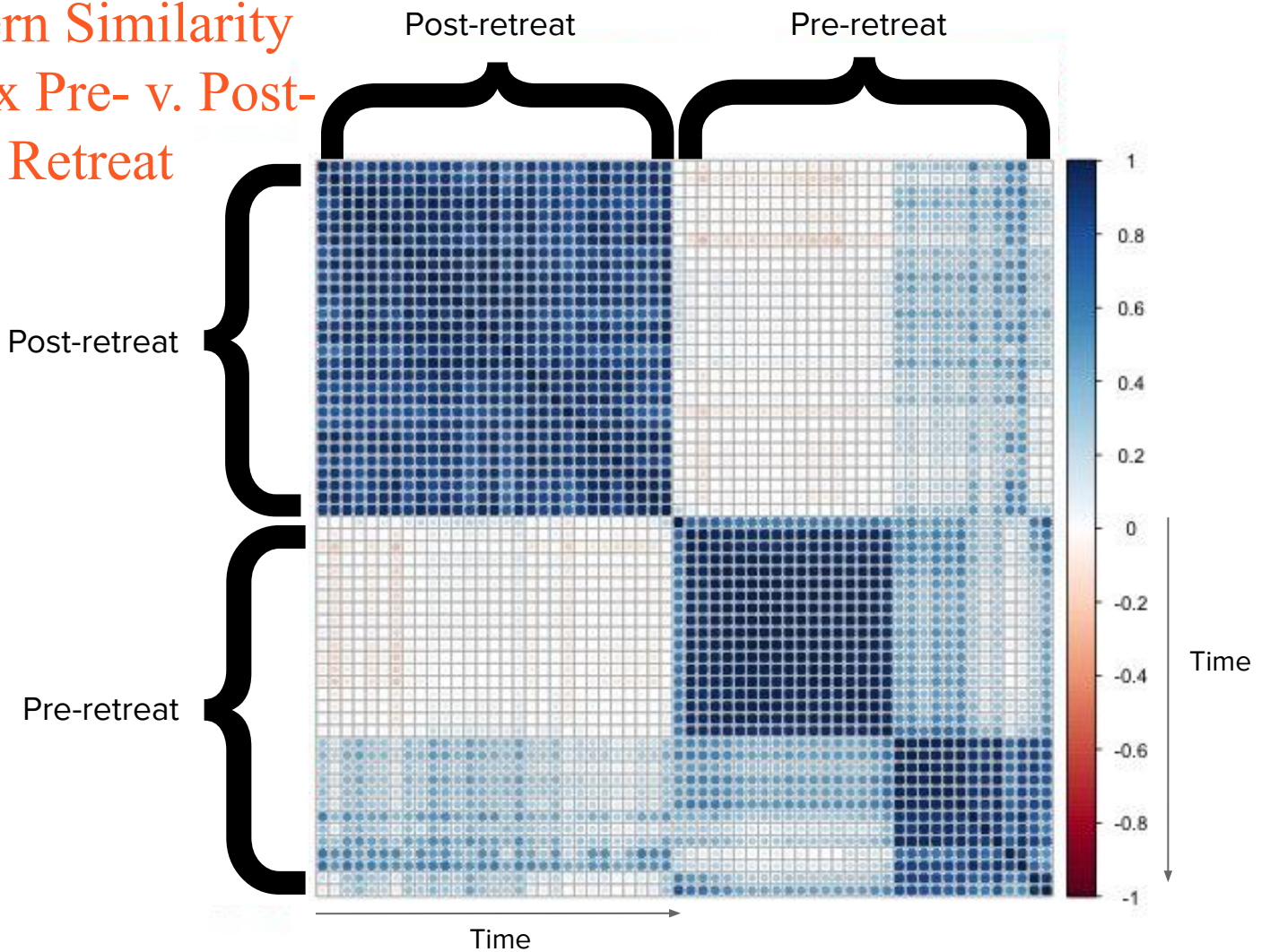
Similarity Matrix comparing a 10-minute guided meditation pre- and post-meditation retreat within the same subject over time.

Green and purple squares estimate similarity across different time epochs within the same meditation. The diagonal (purple squares) within each square estimates similarity across the same time points (epoch 1 vs. epoch 1 etc).

Can extend to include multiple meditations, time points, and subjects, but basic idea is best illustrated using one subject, one meditation, across two time point. Data and size of matrices can increase substantially with more conditions.



Pattern Similarity Matrix Pre- v. Post-Retreat



Thank you

1. Thank you to SURA for the generous support!
2. Thank you to the Cognitive Control and Psychopathology (CCP) Lab!
   a. PI: Dr. Todd Braver, Professor in the Psychological and Brain Sciences Dept (right image)
   b. Research Mentor: Dr. Yanli (Jeff) Lin, Clinical Psychologist Postdoctoral Scholar (middle image)