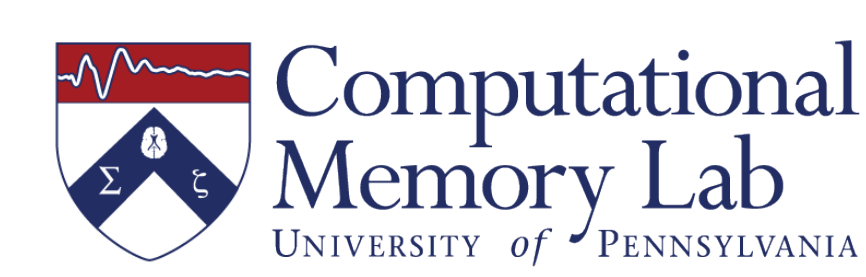


# Theta Networks of Memory In Traumatic Brain Injury

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## Introduction

Traumatic brain injury (TBI) produces lasting impairments in context-based episodic memory and executive function. (Vakil, 2020)

Previous work has identified a set of electrophysiological biomarkers of human memory function. (Burke, 2015; Solomon, 2017)

- Are these memory biomarkers conserved across people with Traumatic Brain injury?
- Can we use these biomarkers to predict memory success?

## Methods

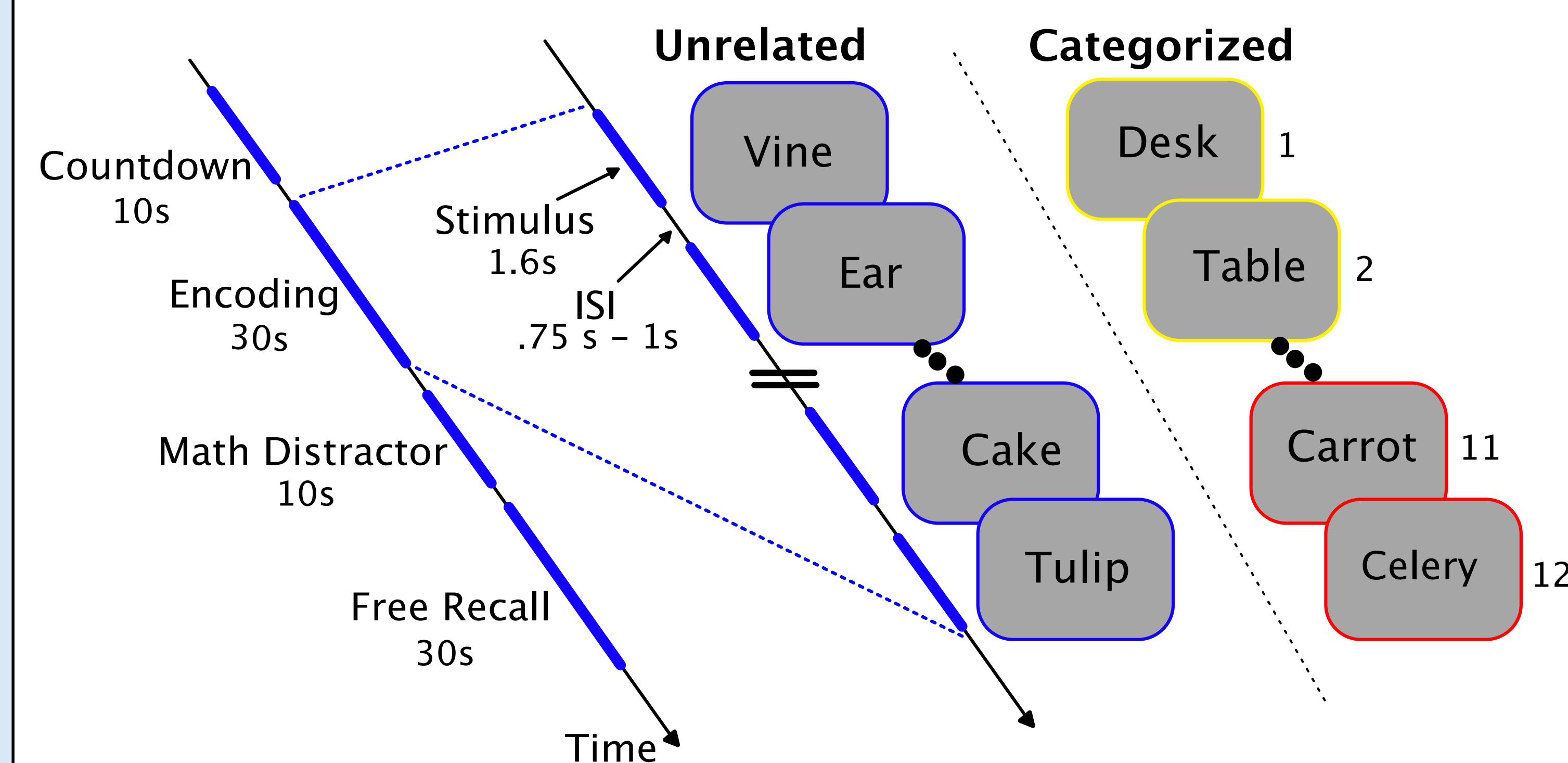
### Participants:

- 148 epilepsy patients with implanted intracranial electrodes (iEEG)
- 37 with history of moderate-severe TBI, 111 non-TBI matched controls
- Matching algorithm identified 3 subjects from a 346 subject database that had similar characteristics to each TBI subject.

### Significant matching covariates

	Age	Male (%)	Right Frontal Coverage (%)	Left Temporal SOZ (%)	Right Temporal SOZ (%)
<b>TBI</b>	42.9 ± 11.0	73.0	75.0	2.8	5.6
<b>Matched non-TBI</b>	40.0 ± 11.5	70.3	73.3	2.9	5.7
<b>All non-TBI</b>	36.4 ± 11.3	48.0	65.4	15.1	11.0

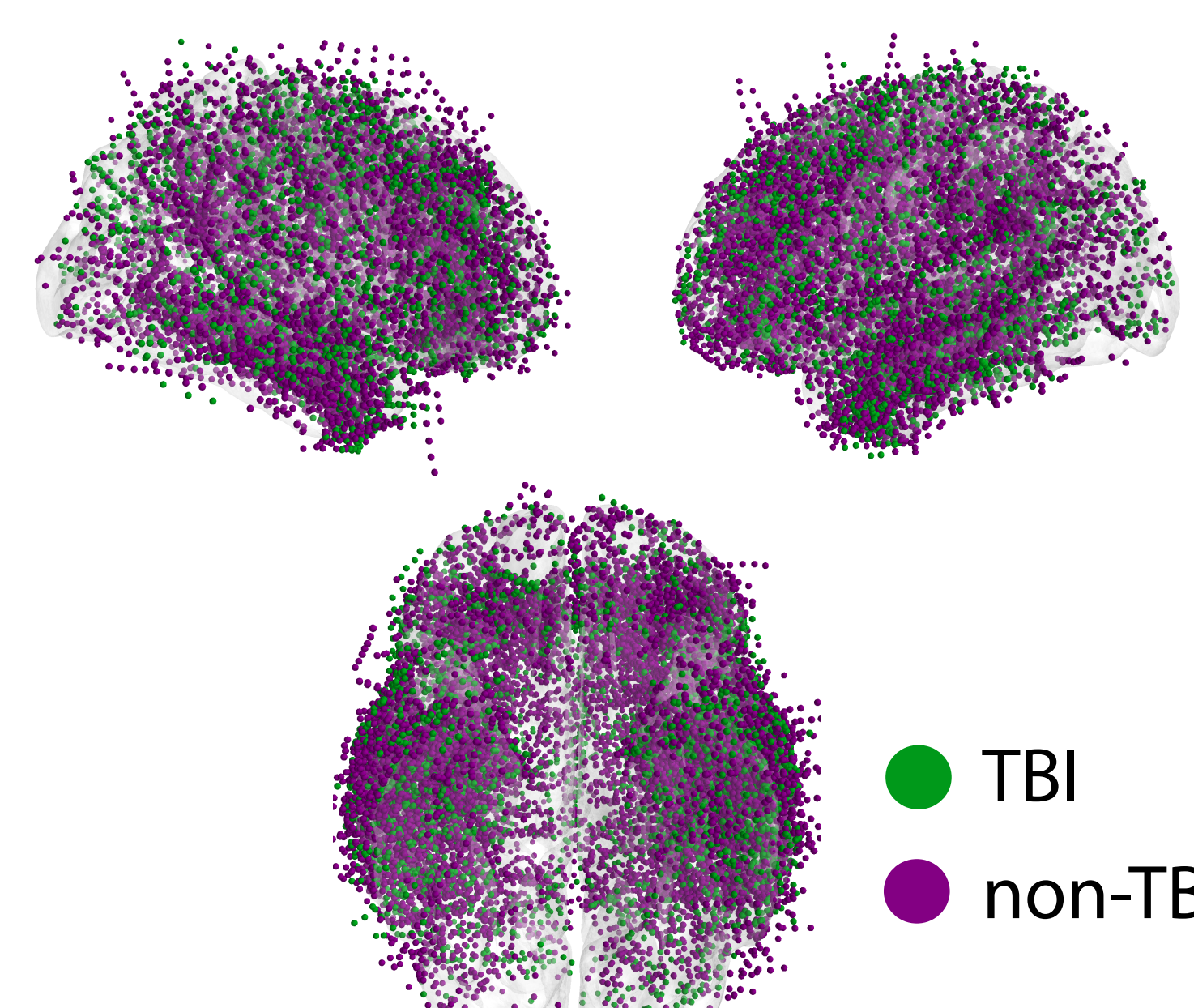
### Task: Each subject completed a delayed free-recall task



### Recording of neural signals:

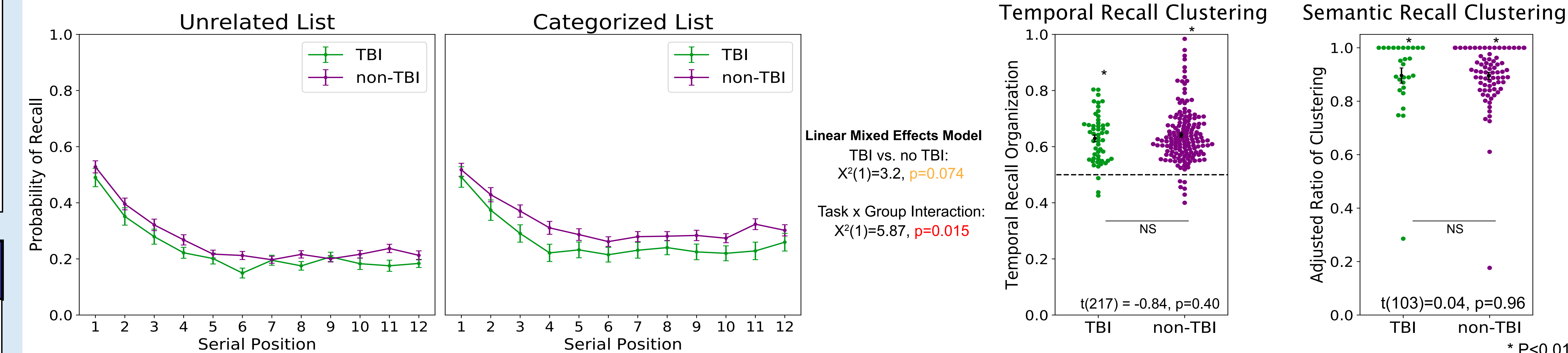
EEG signals from subdural grids, strips and depth electrodes dispersed throughout the brain.

- ~129 electrode contacts per subject

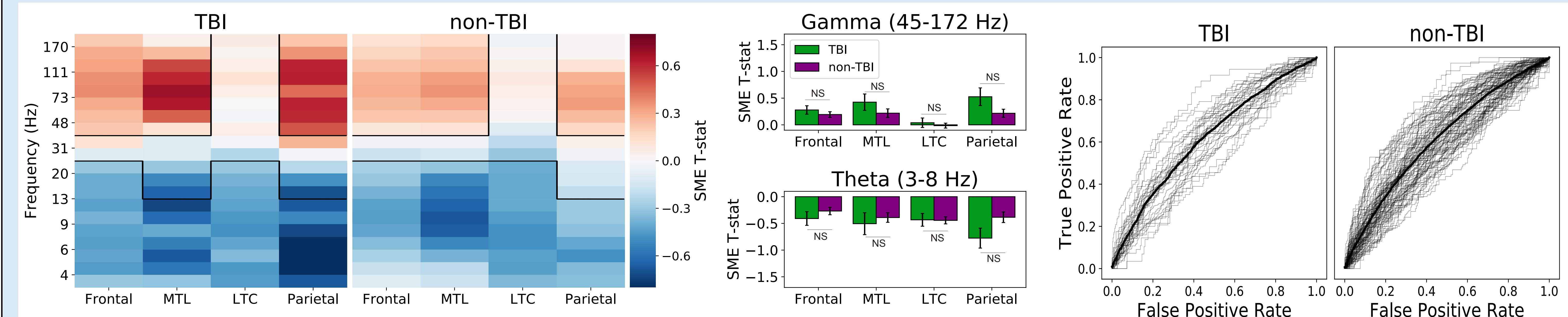


## Analyses and Results

### TBI subjects had lower recall rates than non-TBI subjects, and similar recall clustering



### Statistically similar spectral power trends during successful memory encoding (SME) in the TBI and non-TBI groups



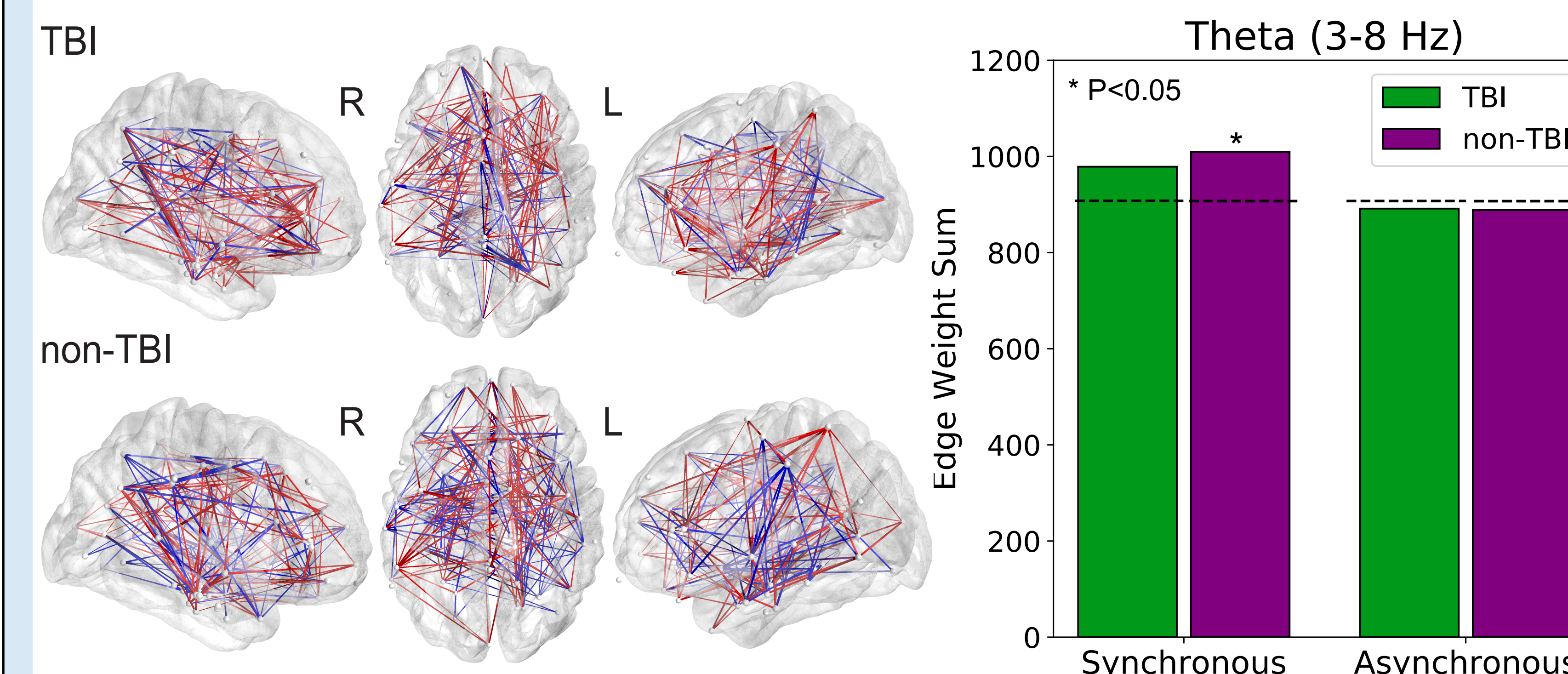
Single sample t-test for each frequency-band/region SME distribution compared to chance (0.0). Boxed regions =  $p < 0.05$

Welch's t-test between each frequency-band/region ( $p > 0.3$ )

Logistic regression classifier to predict recall from power during encoding period. Same diagnostic ability in both groups ( $p = 0.77$ )

### Weaker theta connectivity during successful encoding in the TBI group

Both groups have an increase in whole-brain theta connectivity during successful encoding. Only the non-TBI group has significantly more synchronous connections than chance ( $p < .05$ )



## Conclusions

- Biomarkers of local memory processing are generally conserved in those with a history of traumatic brain injury.
- Our ability to predict memory using spectral power information is similar in subjects with and without a history of TBI.
- Brain-wide theta synchrony was lower in the TBI group, but nonetheless replicated prior results that theta synchrony increases during successful memory encoding.

## References

Burke, J. F., Ramayya, A. G., & Kahana, M. J. (2015). Human intracranial high-frequency activity during memory processing: neural oscillations or stochastic volatility? *Current opinion in neurobiology*, 31, 104–110.

Solomon, E., Kragel, J., Sperling, M. R., Sharan, A., Worrell, G., Kucewicz, M., . . . others (2017). Widespread theta asynchrony and high-frequency desynchronization underlies enhanced cognition. *Nature communications*, 8(1), 1704.

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