

Introduction

Previous work has shown that successful recall of prior experiences is associated with reactivation of the same brain regions that were active during the encoding of these experiences. Here we quantify the time scale of the neural activity reinstatement and show that the brain replays its encoding dynamical activity on a faster time scale during recall.

Methods

We collected data from 34 subjects with medication-resistant epilepsy who underwent intracranial electroencephalography while they participated in a verbal paired-associates memory task. The average spectral power for each brain region was computed in the theta and high gamma bands yielding an average encoding and retrieval power trace. A time-warping algorithm was then applied to the retrieval trace to best fit it to the encoding trace. For each region, we tabulated the time scaling factor that led to the best correlation between the two traces. For each subject, the average scale factor was computed for all the regions that achieved a significant correlation.

Results

For theta and high gamma, the mean time scaling factors of recall activity with encoding activity across subjects were 0.92 +/- 0.03 and 0.95 +/- 0.02. The mean scale factors for theta and high gamma were significantly smaller than 1 indicating that the brain replays its encoding activity during recall at a significantly faster scale. While this was true for the average data across all regions and subjects, few regions exhibited reversal of this pattern.

Conclusions

Our results demonstrate that on average, spectral dynamics are replayed on a faster timescale during memory retrieval. This complements previous animal work. However, further investigation is needed to explore the differences between replay time scale in different brain regions as well as its behavioral correlates.

Learning Objectives

By the conclusion of this session, participants should be able to: 1) Describe the evolution of cortical activity during memory encoding and recall.

References

Yaffe, R., et al., Reinstatement of distributed patterns of oscillatory power occurs with precise spatiotemporal dynamics during successful recall. PNAS, 2014. 111(52): p. 18727-18732

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