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The LFP represents the synchronous firing activity of ~~hundreds of thousands~~ of neurons (xx) in an area around 250 µm from the recording electrode (Katzner, Nauhaus, Benucci, Bonin, Ringach et al., 2009, Neuron; Xing, Yeh, & Shapley, 2009, J Neurosc). In contrast, because the amplitude of single neurons rapidly declines with an increasing distance to the neuron soma, we cannot reliably record single neuron activity further than 100 μm away with current methods (doi.org/10.1529/biophysj.107.111179; doi.org/10.1038/nn1233).

POS is a measure of phase opposition between to conditions. That means even if there is a high Inter Spike Consistency (ISC) within each condition (e.g., encoding and retrieval) if the phase preference is the same between conditions the phase opposition will be low. In order to compute the POS, we require at least 11 spikes in each condition. We computed the POS on the level of the neuron to account of inter-neuron difference in phase preference. The formular for POS is given by:

(1)

ISC is defined as (xx Tallon-Baudry et al., 1996; Lachaux et al., 1999 10.3389/fnins.2016.00426 xx?):

(2)

(3)

(4)

is a complex number that represents the theta component at the times when the spikes occur (| is the magnitude of the signal and () is the phase at that time point). nenc and nret correspond to the numbers of spikes in the encoding and retrieval episodes, respectively, and nall  = nenc + nret.

To test the statistical significance of the empirical POS we shuffled the group identity for each trial 1,000 times and recomputed the POS. This allowed us to generate a baseline against which we compared the empirical POS. We have analysed the POS between encoding and encoding separately for ESN for reinstated trials contrasting the phase preference during encoding and retrieval, for later non-reinstated trials and for all other single neurons. We also calculated the POS for ESNs between reinstated and non-reinstated trials where we pooled the encoding and retrieval trials because there was no significant POS between encoding and retrieval trials for later reinstated and non-reinstated ESN trials.

I also show figures for SFC for encoding and retrieval for rESNs and SUs (?) and tested it using the Rayleigh test (cite toolbox)

-> calculate the difference and visualize

-> how do I shuffle for POS??

-> POS shuffling for rESN does not work because you just shuffle the one trial

However, there was a significant fast theta oscillation during encoding for reinstated episodes and non-reinstated episodes (reinstated episodes: *trein*(122) = 3.4233, *meanrein* = 6.9518, *serein* = 2.0307, *prein* = 0.00084282; non-reinstated episodes: *tnon-rein*(122) = 3.8151, *meanno-rein* = 10.4919, *seno-rein* = 2.7501, *pnon-rein* = 0.00021506) and during retrieval (reinstated episodes: *trein*(122) = 4.6513, *meanrei*n = 6.7263, *serein* = 1.4461, *prein* = 0.0000084372; non-reinstated episodes*: tnon-rein*(122) = 4.5176, *meanno-rein* = 10.4407, *seno-rein* = 2.3111, *pnon-rein* = 0.000014556).

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We next determined if there is significant oscillatory (i.e., periodic) activity in the (2-5 Hz) and fast (5-9 Hz) theta ranges. Using one-sample t-tests we found no significant slow theta oscillatory activity in experiment 1 (all p > 0.18). However, there was a significant fast theta oscillation in reinstated episodes and non-reinstated episodes during encoding (reinstated episodes: trein (122) = 3.4233, prein = 0.00084282; non-reinstated episodes: tnon-rein (122) = 3.8151, pnon-rein = 0.00021506) and during retrieval (reinstated episodes: trein (122) = 4.6513, prein = 0.0000084372; non-reinstated episodes: tnon-rein (122) = 4.5176, pnon-rein = 0.000014556) in experiment 1. In experiment 2 we found a significant slow and fast oscillation in reinstated and non-reinstated episodes during encoding (t slow rein (32) = 3.1599, pslow rein = 0.0034; t slow non-rein (32) = 4.9958, pslow non-rein = 0.000020117; t fast rein (32) = 3.7464, pfast rein = 0.00070996; t fast non-rein (32) = 3.9249, pfast non-rein = 0.0004323) and retrieval (tslow rein (32) = 3.8057, pslow rein = 0.00060249; t slow non-rein (32) = 5.4284, pslow non-rein < 0.00001; t fast rein (32) = 2.8623, pfast rein = 0.0074; tfast non-rein (32) = 3.4827, pfast non-rein = 0.0015).