

Experience-Dependent Trends in CA1 Theta and Slow Gamma Rhythms in Freely Behaving Mice

66

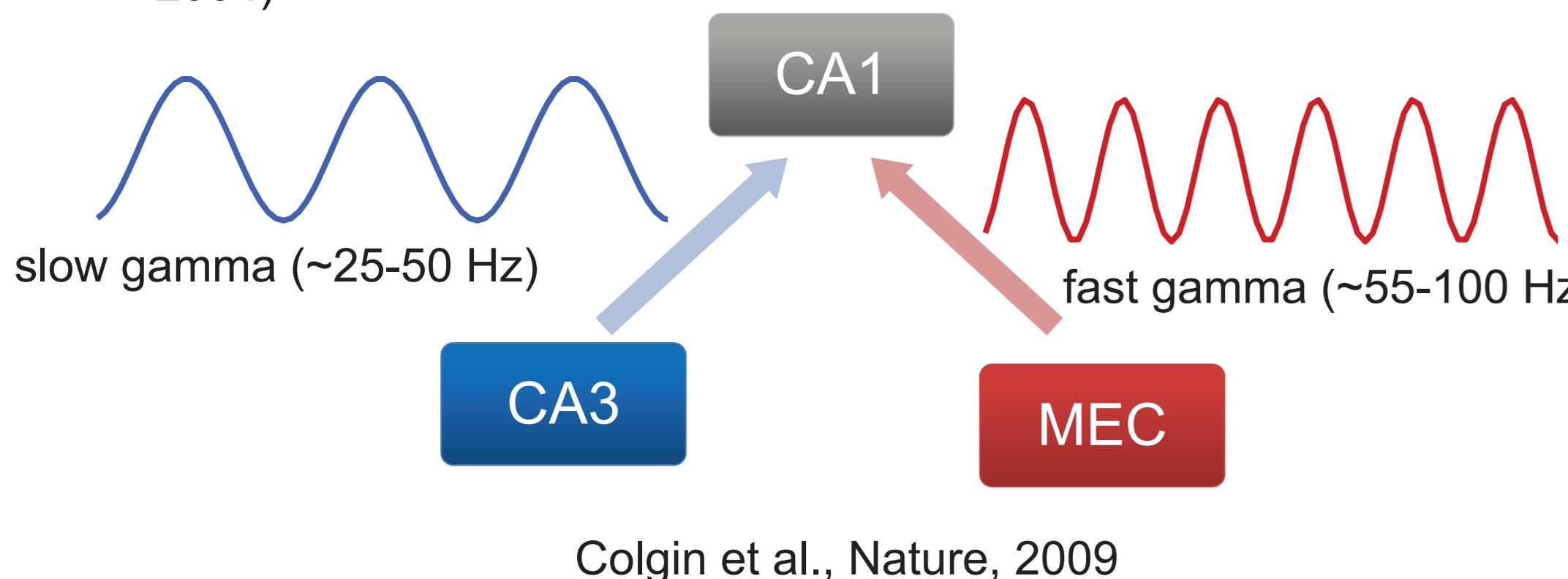
Brian J. Gereke¹, Alexandra J Mably², Laura Lee Colgin^{1,2}

CENTER for
LEARNING and
MEMORY
The University of Texas at Austin

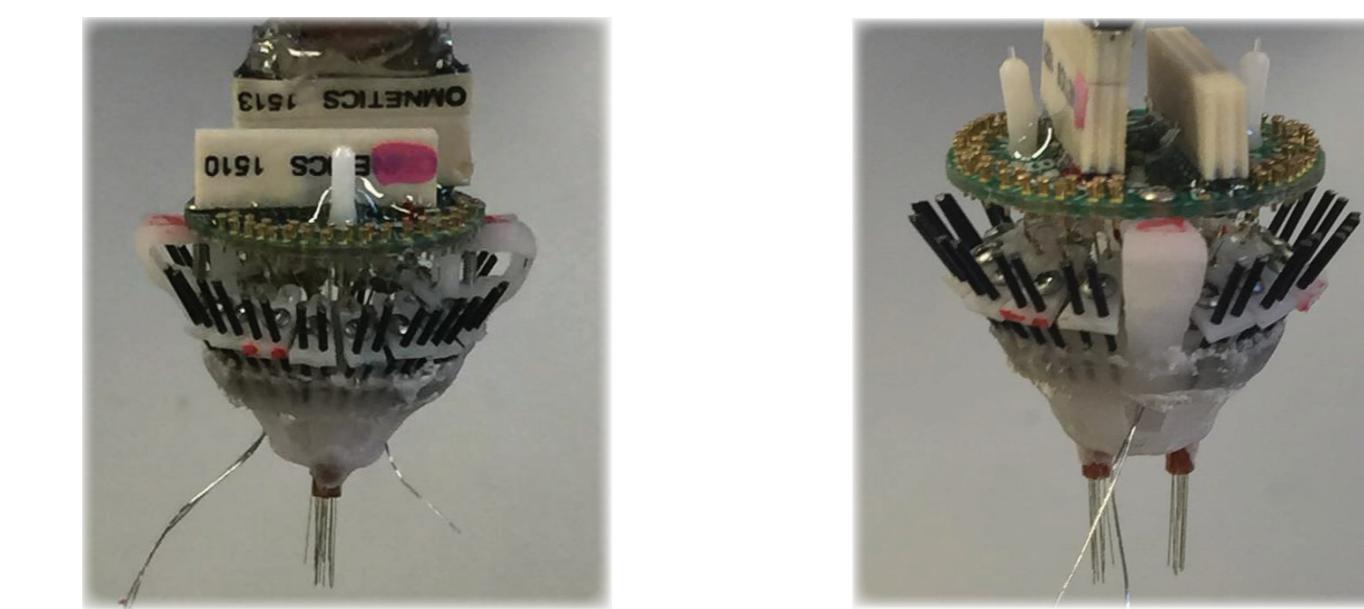
1. Institute for Neuroscience, 2. Center for Learning and Memory, University of Texas at Austin, Austin, TX USA

Background

- CA1 place cell backward expansion has been suggested to reflect the NMDA receptor dependent strengthening of CA3->CA1 synapses (Mehta et al., PNAS, 1997; Mehta et al., Neuron, 2000; Ekstrom et al., Neuron, 2001; Lee et al., Neuron, 2004)

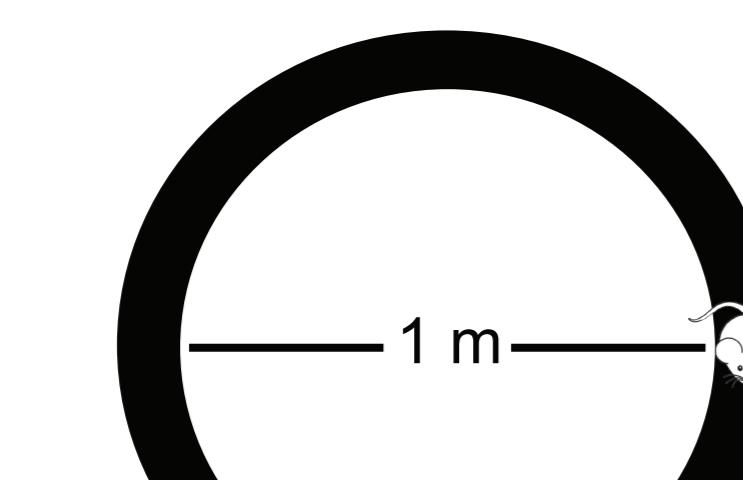
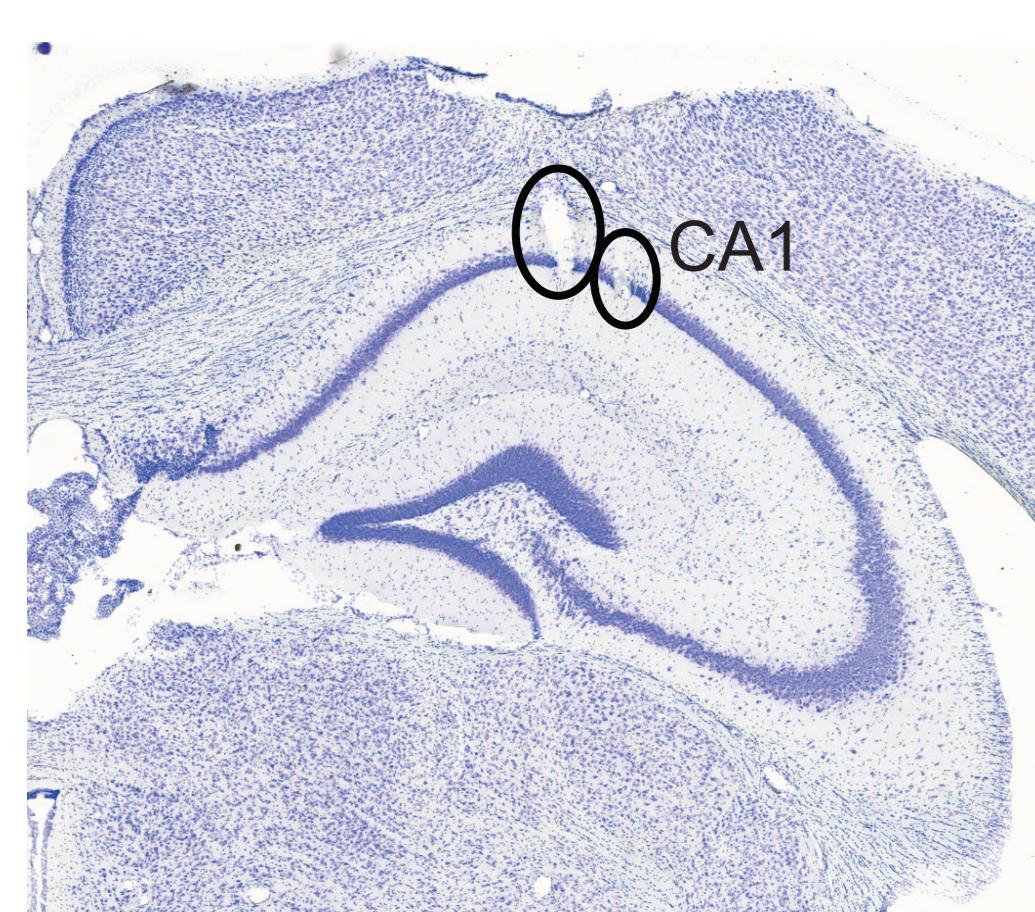


Experimental Methods



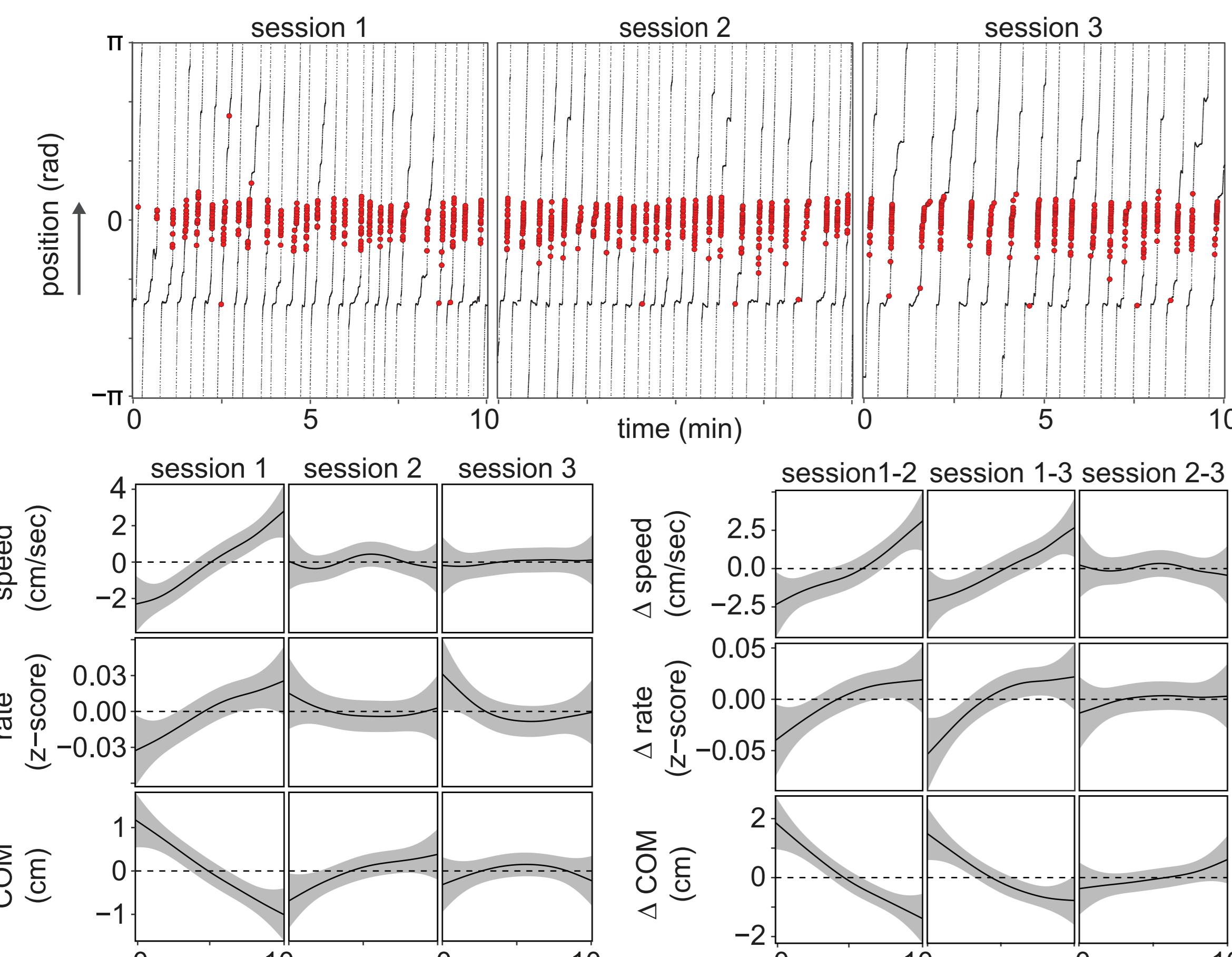
Microdrives with 16 independently movable tetrodes were implanted. Local field potentials and single units were recorded bilaterally from hippocampal subfield CA1 (3 C57BL/6 + 3 C57BL/6 x 129 hybrid mice).

*design modified from Voigts et al., Front. Syst. Neurosci., 2013.

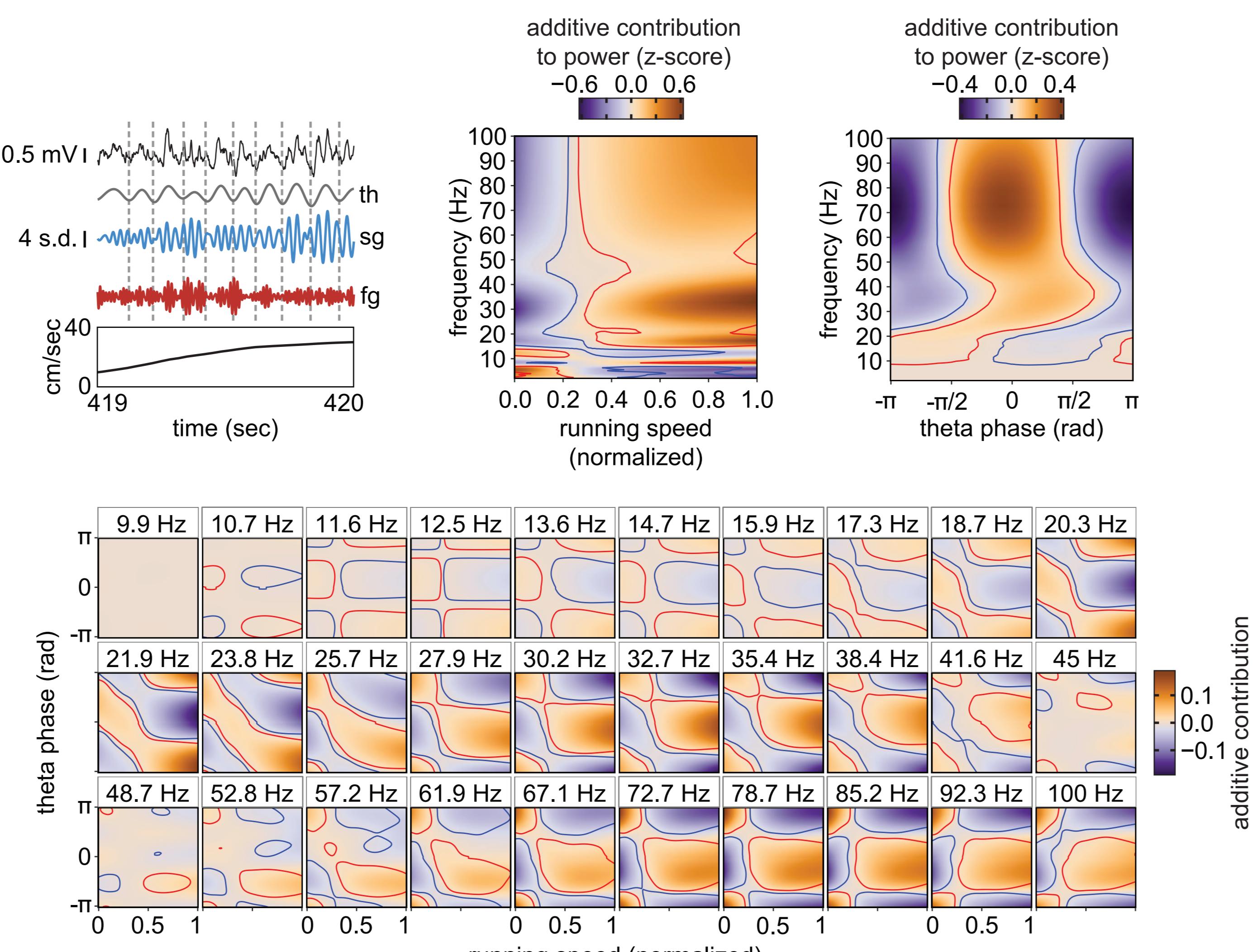


Mice were trained to run unidirectionally around a 1 m circular track for food reward delivered at a single location.

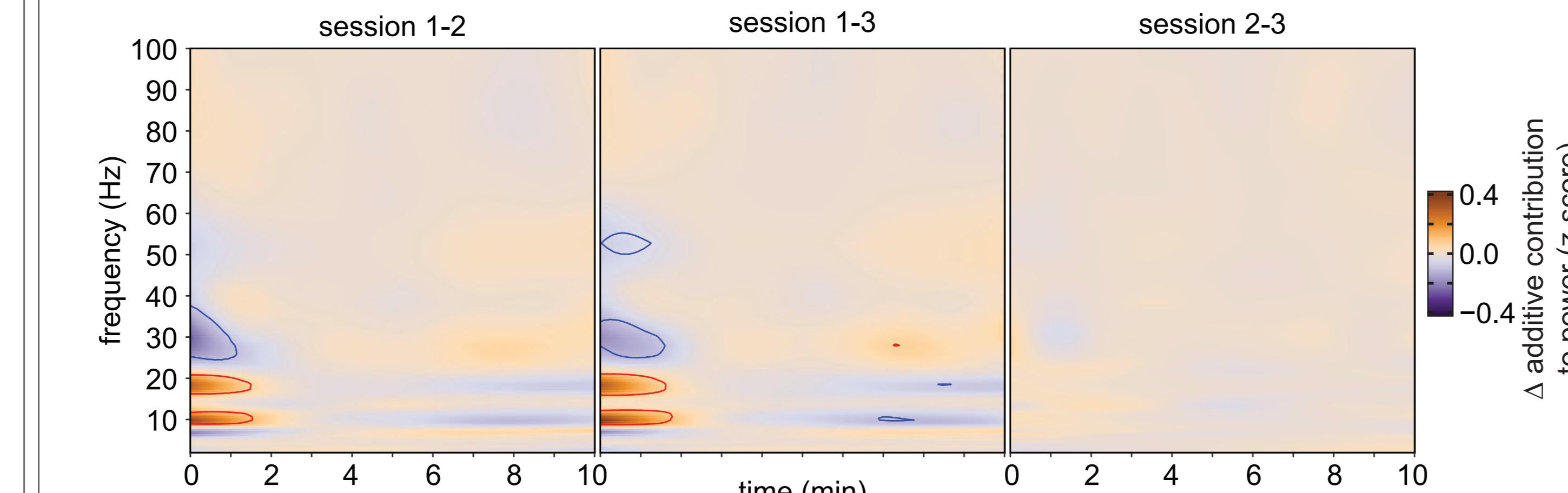
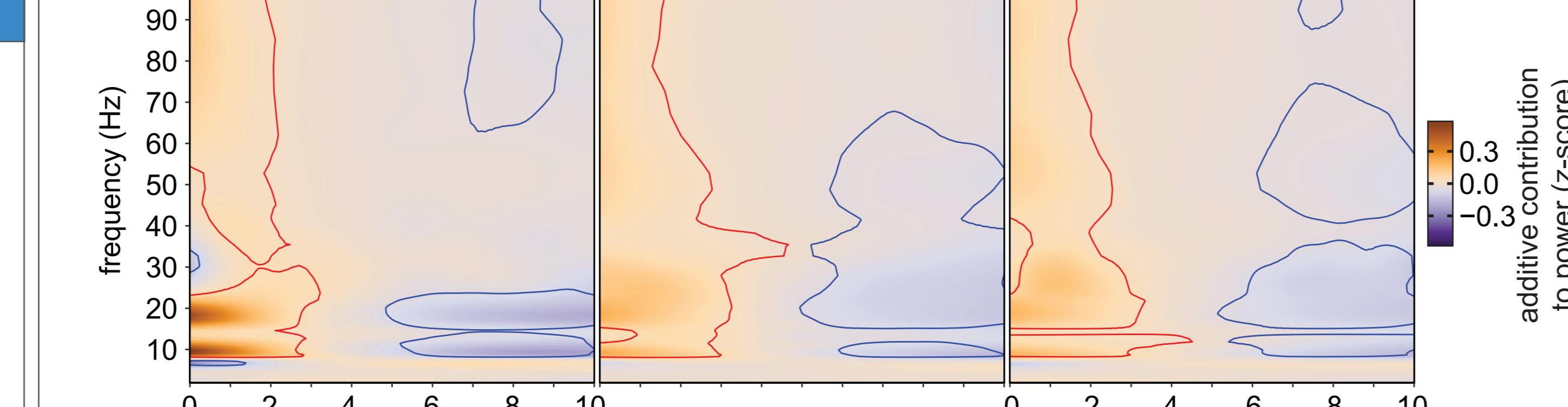
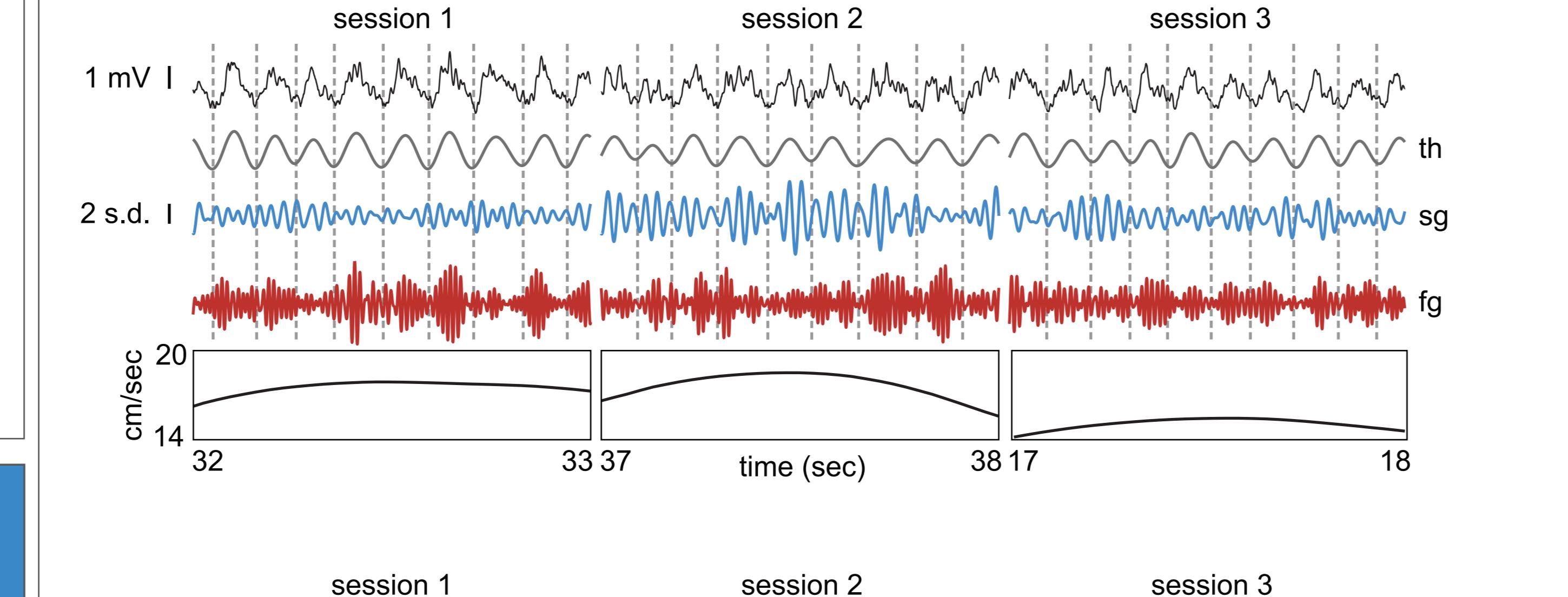
Place Fields Expand Backward with Experience



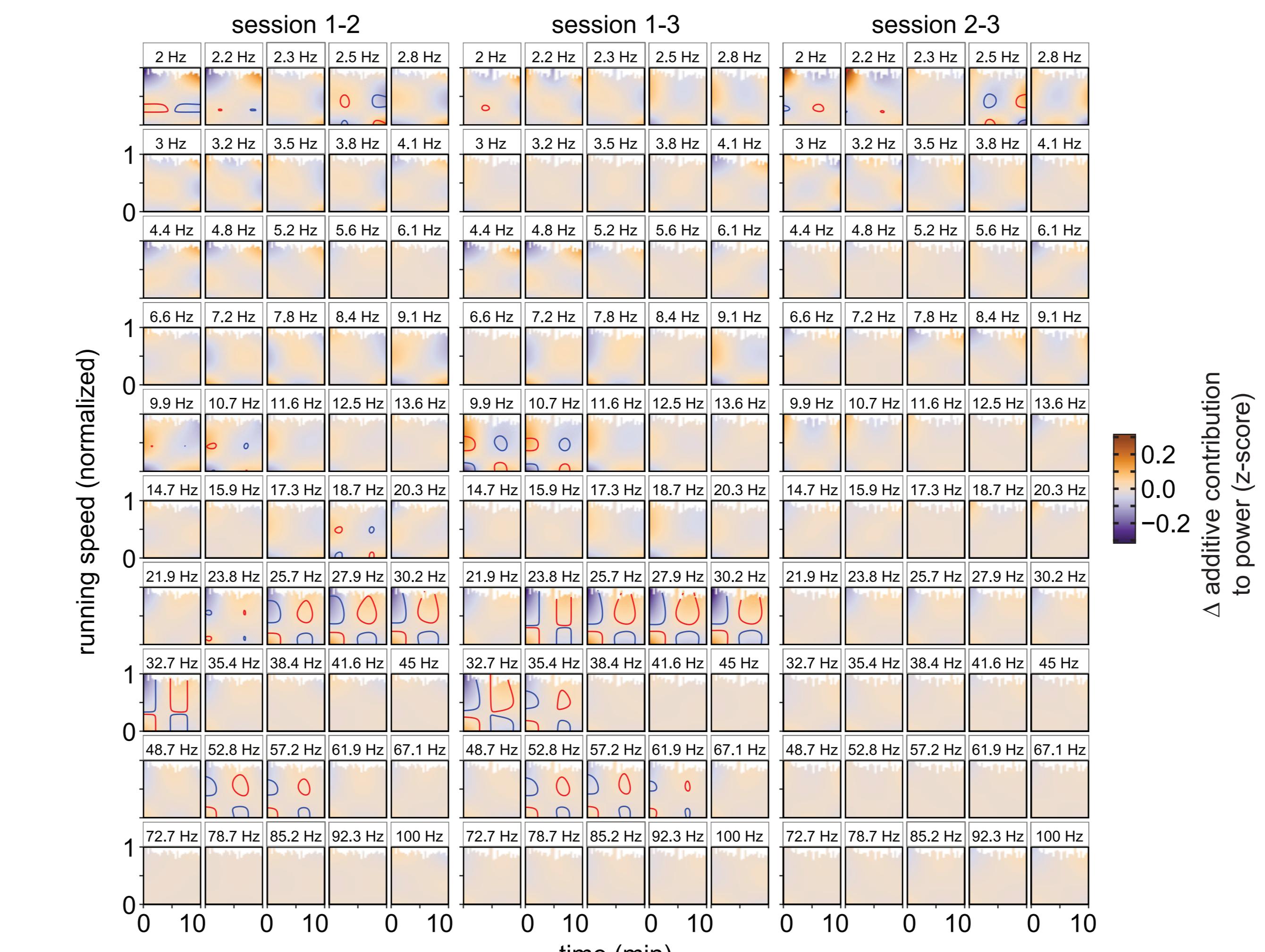
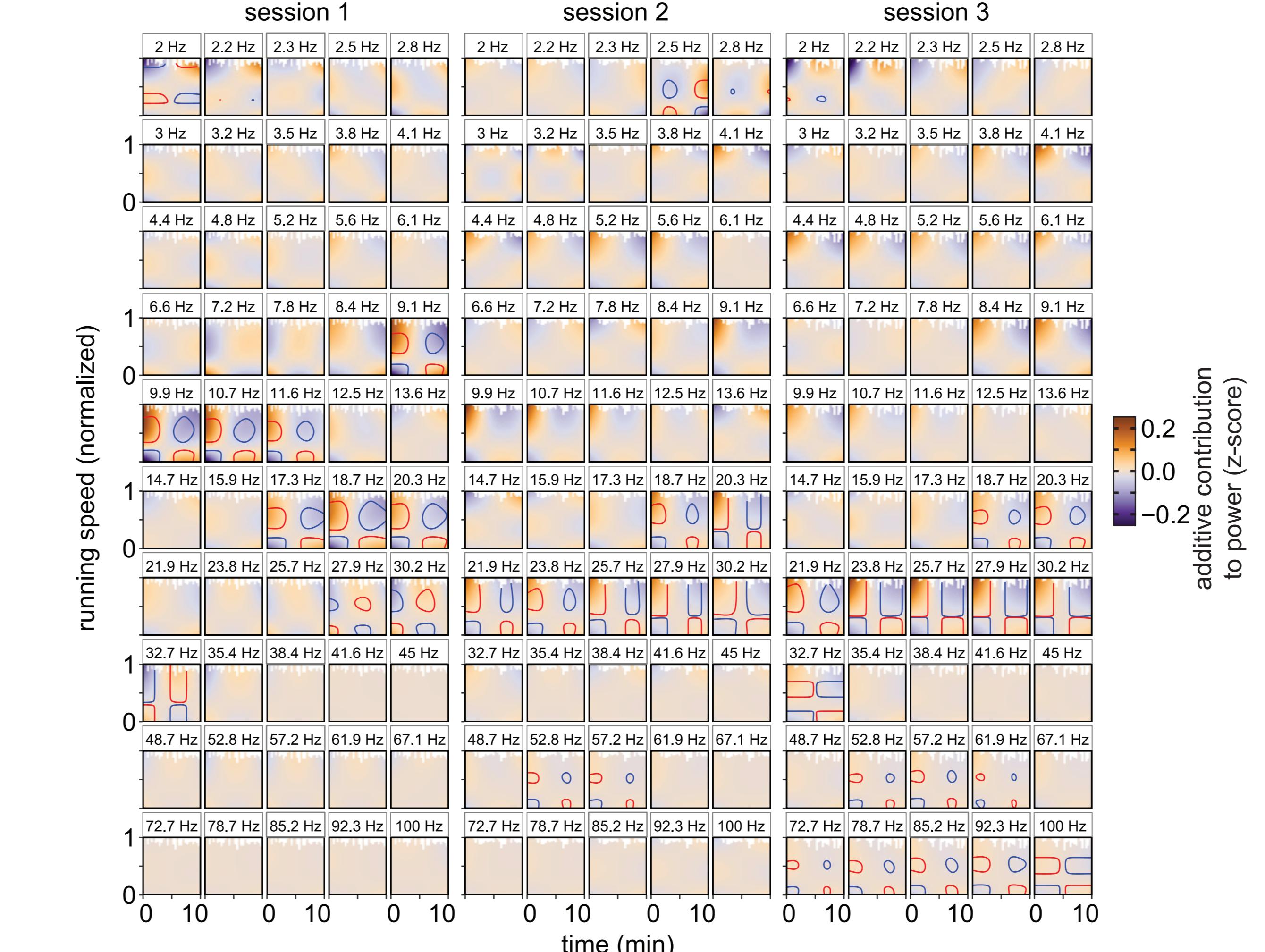
Theta-Gamma Dynamics are Amplified by Running Speed



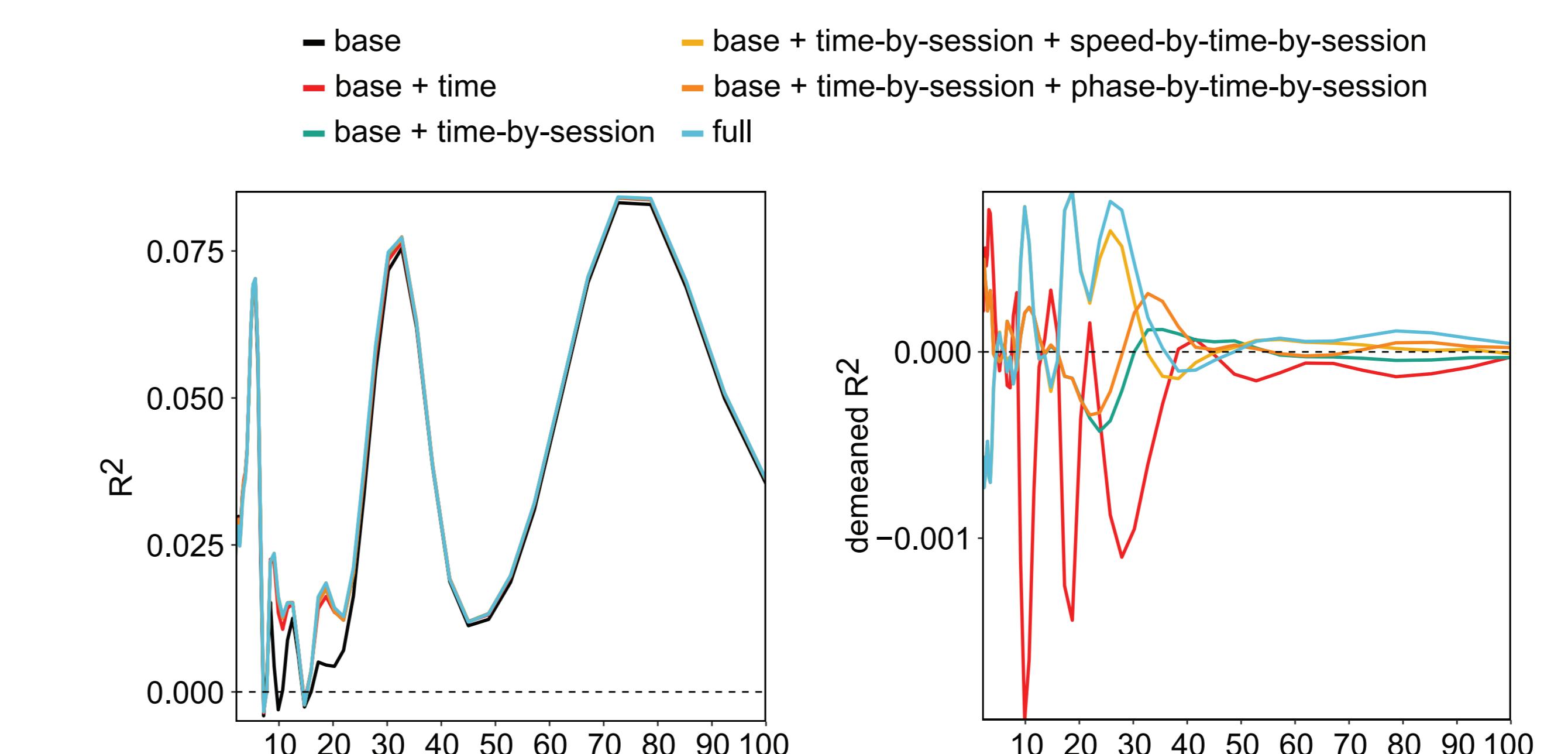
Theta Power Decreases and Slow Gamma Power Increases with Experience



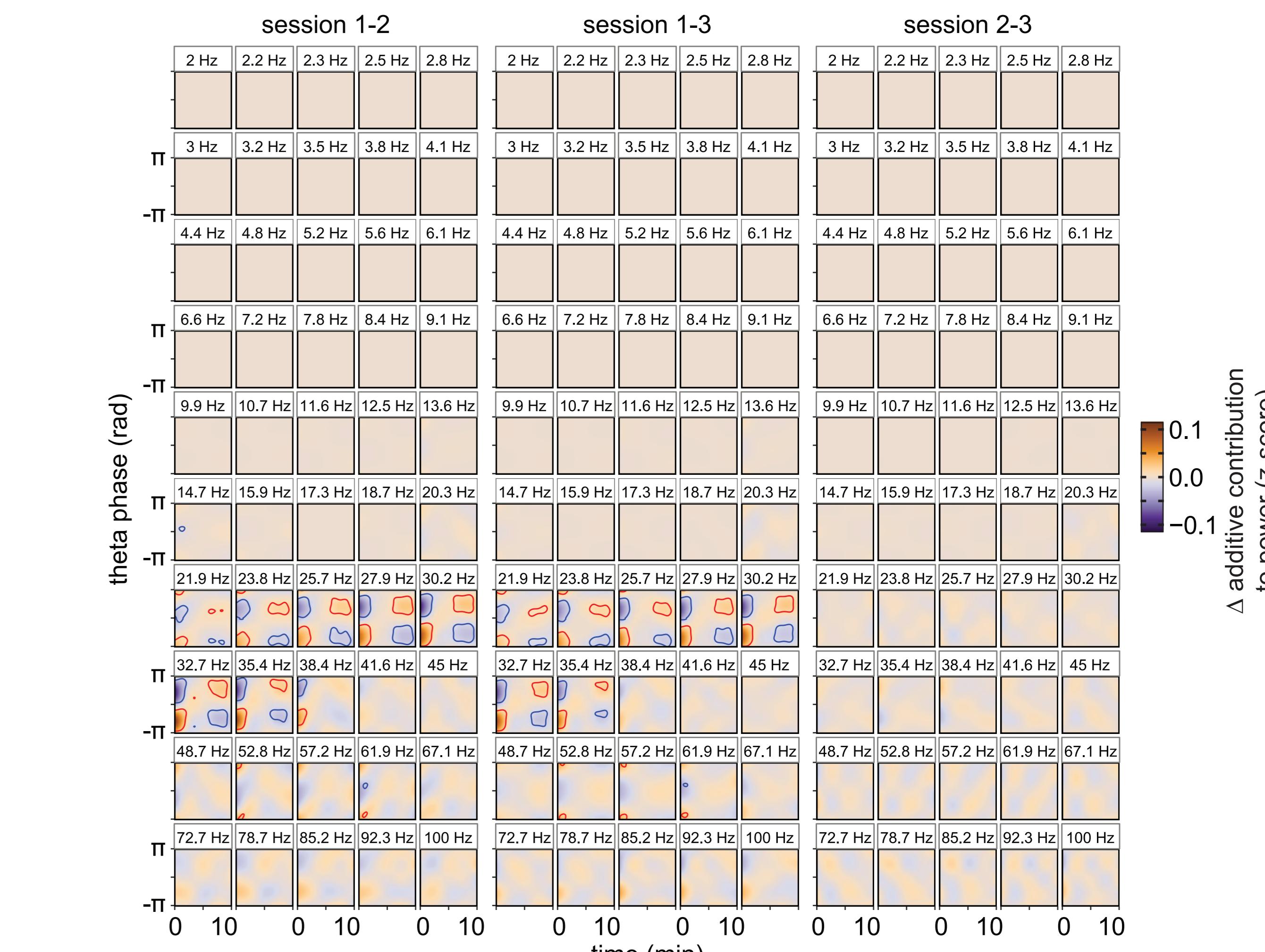
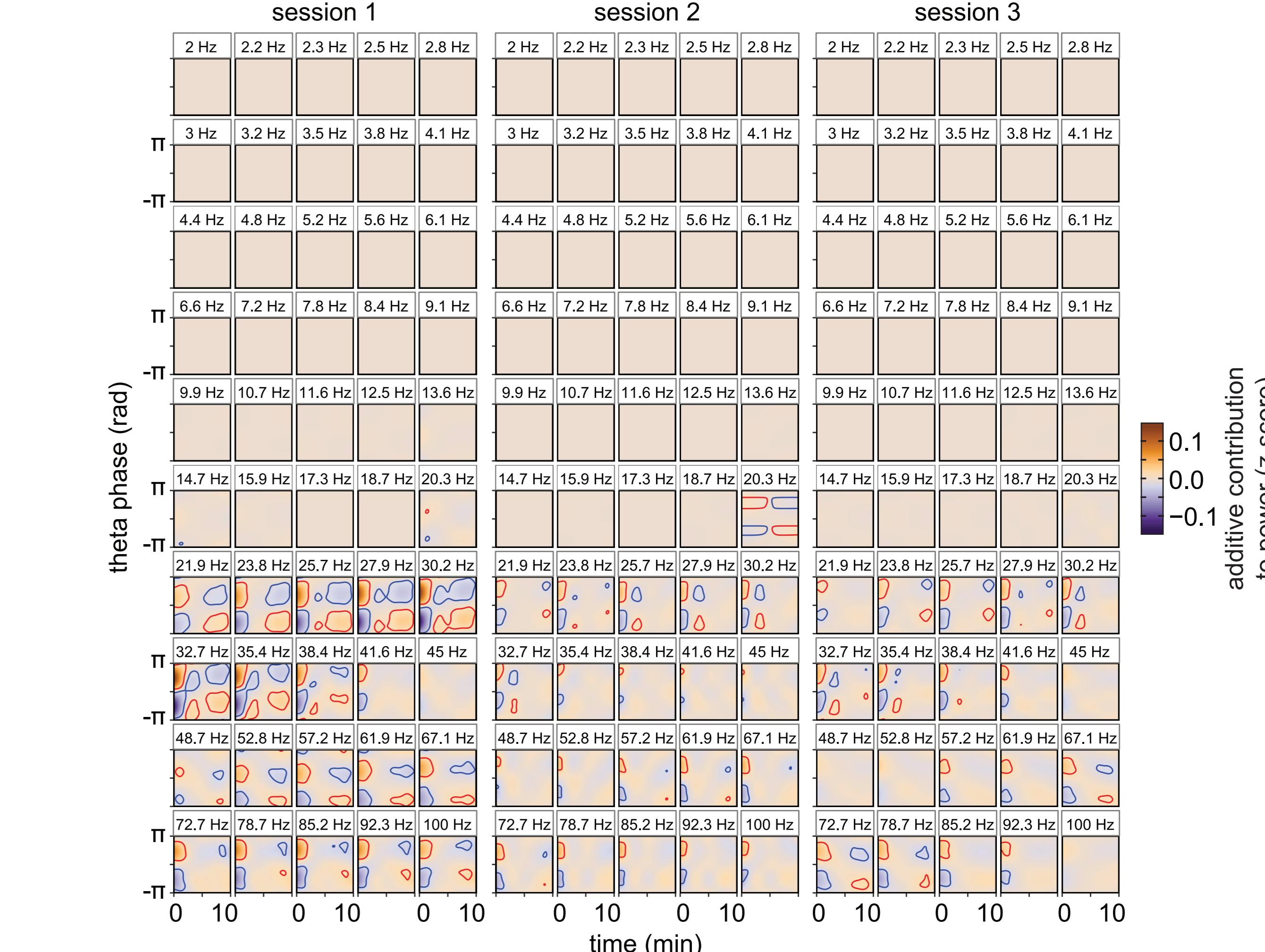
Theta Amplification Decreases and Slow Gamma Amplification Increases with Experience



Leave-One-Mouse-Out Cross-Validation



Theta Phase-Slow Gamma Power Correlations Change with Experience



Conclusions and Future Directions

- Place field backward expansion is accompanied by an experience-dependent decrease in theta power and increase in slow gamma power
- During this same period, theta power amplification by running speed is reduced while amplification of slow gamma power is enhanced
- Theta phase-slow gamma power correlations also change over time and with experience
- Are similar effects evident in rats, which show slow gamma power decreases with running speed?
- Does disruption of theta and/or slow gamma prevent predictive coding?

Acknowledgements: We thank Katelyn Bobbitt for contributing to drive design and Kayli Kallina for preparing histological sections.

Supported by the Esther A. and Joseph Klingenstein Fund, the Alfred P. Sloan Foundation, ONR (N00014-14-1-0322), and Alzheimer's Association (NIRP-14-305205). This material is based upon work supported by the National Science Foundation Graduate Research Fellowship Program under Grant No. DGE-1110007 (to B.J.G.).