Online supplementary material for

# Reactivation of previous experiences in a working memory task

Gi-Yeul Bae and Steven J. Luck

Center for Mind & Brain and Department of Psychology
University of California – Davis
Davis, CA, 95618

**Address for correspondence:**

Gi-Yeul Bae, Ph.D.
Center for Mind & Brain
University of California, Davis
267 Cousteau Pl.
Davis, CA 95618
(M) 410-491-5540
(E) gybae@ucdavis.edu

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*1. Decoding of previous-trial orientation using the prestimulus period of the previous trial as the baseline.*

In the main analyses, we performed baseline correction by subtracting the mean voltage during the prestimulus baseline of the current trial from each time point in the waveform from that trial, which is important for minimizing DC offsets that would otherwise decrease statistical power (Luck, 2014). This baseline correction procedure would be expected to force decoding accuracy to chance during the baseline period, making it difficult to determine whether any information about the previous-trial orientation was present during this period. To test whether information about the previous-trial orientation was present in the period immediately prior to the onset of the current-trial sample stimulus, we conducted additional decoding analyses using the mean voltage during the prestimulus period of the previous-trial as the baseline period of the current trial. Given that the baseline period was several seconds before the time period being decoded in this analysis, we expected that slow voltage drifts would make the data more variable, decreasing decoding accuracy. As a result, any significant decoding would be impressive, but a lack of significant decoding should not be taken as strong evidence against the presence of information about the previous-trial orientation.

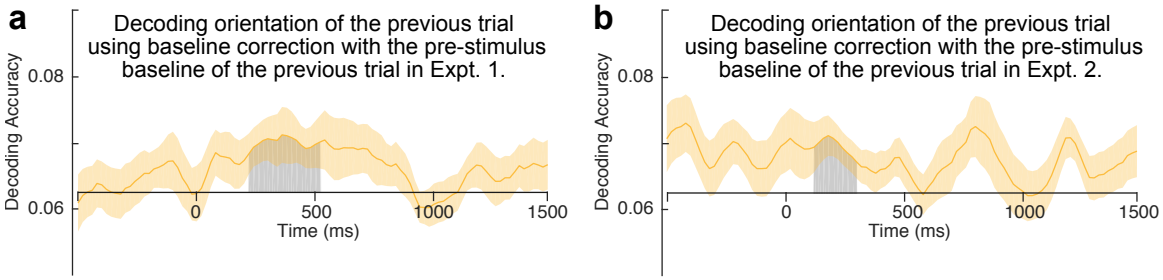


Figure S1. Decoding accuracy of the previous-trial orientation when using the prestimulus period from the previous trial as the baseline in (a) Experiment 1 and (b) Experiment 2. Orange shading represents ±1 S.E. of the mean. Gray areas indicate clusters of time points that produced above-chance decoding after correction for multiple comparisons using a permutation-based cluster mass analysis.

As can be seen in Figure S1, decoding accuracy rose above chance shortly after the onset of the current-trial sample stimulus in Experiment 1 (1 cluster, $p = .007$, cluster mass permutation test). Thus, there was no evidence that the previous-trial orientation was active during the period immediately prior to the current-trial sample stimulus, but decodable information about the previous-trial orientation was present after the onset of the current trial. Decoding accuracy was also significantly above chance shortly after the onset of the current-trial sample stimulus in Experiment 2 (1 cluster, $p = .013$, cluster mass permutation test). However, decoding accuracy was also numerically (but not significantly) above chance during the prestimulus baseline in Experiment 2. Thus, we cannot conclude with confidence that information about the previous-trial orientation was completely absent prior to the onset of the current-trial sample stimulus. However, these results converge with the main analyses to indicate that decodable information about the previous-trial orientation was clearly present after the onset of the current-trial sample stimulus, consistent with a reactivation or boosting of the previous-trial orientation following the current-trial sample stimulus.

*2. Decoding previous trial information using alpha-band activity in Experiments 1 & 2*

Our main decoding analyses focused on sustained ERP activity. This was an a priori choice that was based on previous results demonstrating that sustained ERP activity contains location-independent object identity information whereas alpha-band EEG oscillations primarily reflect the allocation of spatial attention to a task-relevant location (Bae & Luck, 2018). However, we also conducted decoding analyses based on alpha-band EEG activity (8-12 Hz). The alpha-band decoding was identical to ERP-based decoding except for the preprocessing of EEG. In the alpha-based decoding analysis, the segmented EEG was bandpass-filtered at 8-12

Hz, and the filtered EEG segments were submitted to a Hilbert transform to compute the phase-independent magnitude of the signal, and then this magnitude was squared to compute alpha-band power at each time point.

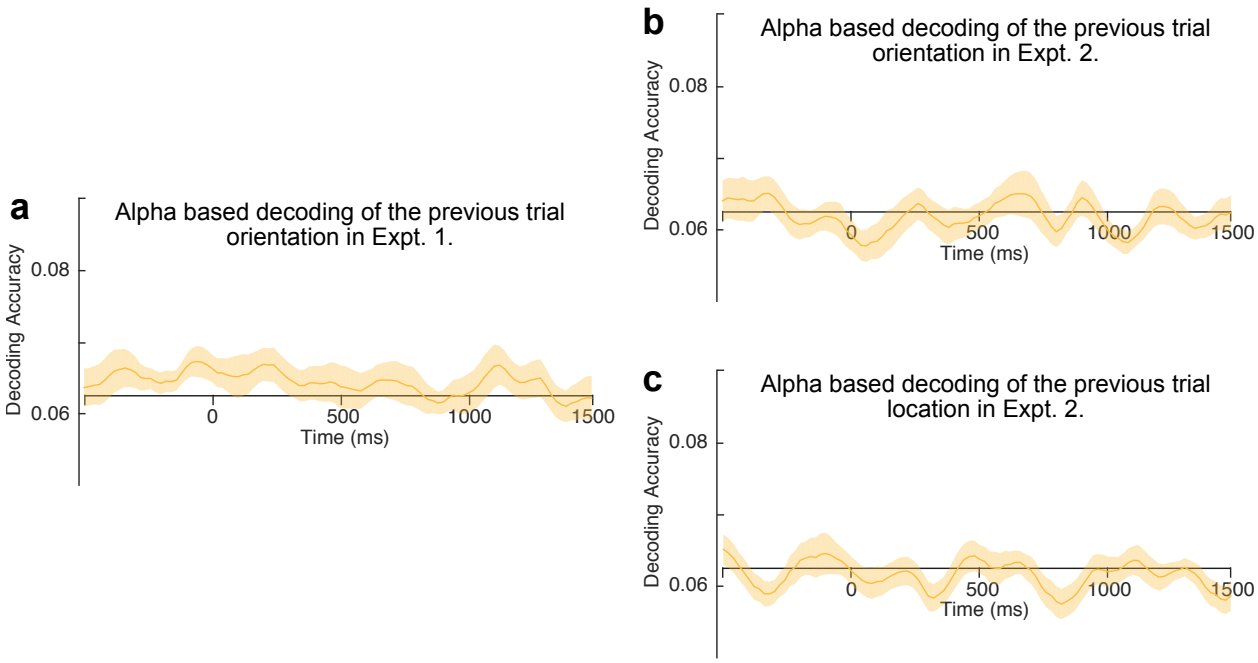


Figure S2. Alpha based decoding accuracy of the previous-trial orientation in (a) Experiment 1 and (b) Experiment 2, and (c) of the previous-trial location in Experiment 2. Orange shading represents ±1 S.E. of the mean.

As can be seen from Figure S2a and S2b, alpha-based decoding accuracy was not significantly above chance (0.0625) at any time point in either experiment. Because the location and orientation of the stimulus were independently manipulated in Experiment 2, we also attempted to decode the previous-trial location from the alpha-band activity. As can be seen from Figure S2c, alpha-based decoding of the previous-trial location was also at chance level. Although it is difficult to draw a strong conclusion based on null results, these results suggest that the current-trial stimulus did not trigger a reactivation of the orientation or location of the previous-trial stimulus that involved alpha-band EEG oscillations.

*3. Decoding of the orientation from trial N-2 in Experiments 1 & 2*

Our main analyses focused on decoding the orientation from the previous trial (i.e., trial N-1). Here, we tested whether we can also decode orientation in the orientation from trial N-2 from the current-trial EEG. The decoding method for the N-2 orientation was identical to the decoding method for the N-1 orientation except that we organized the EEG data from the current trial with respect to the orientation presented on trial N-2, irrespective of orientation on trials N and N-1. This required eliminating the first two trials of the session from the analyses.

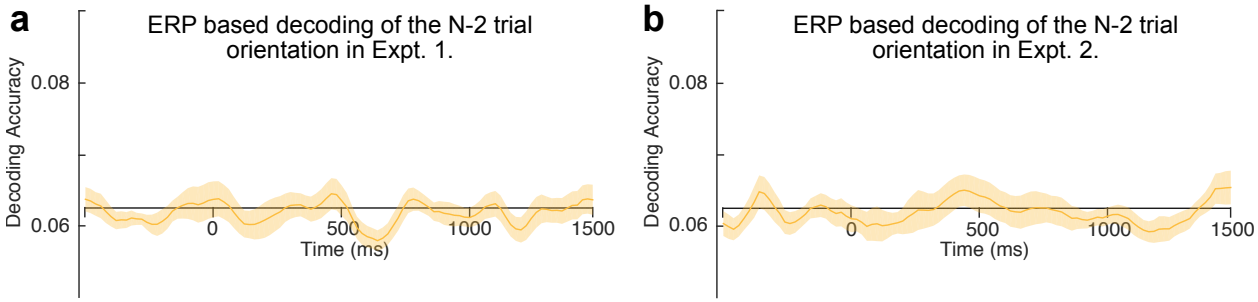


Figure S3. ERP based decoding accuracy of the orientation from trial N-2 trial in (a) Experiment 1 and (b) Experiment 2. Orange shading represents ±1 S.E. of the mean.

As can be seen from Figure S3, decoding of the orientation from trial N-2 was near chance in both experiments. This may indicate that the N-2 orientation was not reactivated during the current trial. However, it may instead indicate that the N-2 signal is simply too weak to be detected from scalp EEG signals.

Reference

Bae, G.-Y., & Luck, S. J. (2018). Dissociable Decoding of Spatial Attention and Working Memory from EEG Oscillations and Sustained Potentials. *The Journal of Neuroscience*, *38*(2), 2860–17. https://doi.org/10.1523/JNEUROSCI.2860-17.2017

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