Title: Tracking stimulus representation across a 2-back visual working memory task

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Abstract:

In the dual serial retrocueing (DSR) task, after two items are encoded into working memory, a retrocue indicates which of the two will be the first to be tested (thereby designating it the "attended memory item" (AMI). Because there is a *p* of .5 that the initially uncued item will be tested later in the trial, it temporarily takes the status of "unattended memory item" (UMI). Although previous studies using multivariate pattern analysis (MVPA) often find that evidence for an active representation of the UMI drops to baseline levels (e.g., Rose et al, 2016), more recent studies employing multivariate inverted (or "forward") encoding modeling (IEM) suggest that the UMI may be held in an active state, but in a representational format that is different from the AMI (Yu & Postle, 2018). On question that remains unclear is whether the differential coding of AMI vs. UMI reflects a general property of varying attentional state, or, rather, is idiosyncratic to the DSR task. Here, we used a task in which memory items are also held in differing states of attentional priority, but one that lacks overt cuing, and for which the *p* of a UMI-to-AMI transition is 1 – the 2-back task. If subjects know with certainty that a memory item will be needed later during the trial, is it nonetheless recoded into a different format than the AMI, or is it held in the same state (as would be the case for, e.g., a conventional load-of-2 delayed-recognition (DR) task)? Stimuli were drawn randomly, with replacement, from 6 black-and-white gratings of 6 orientations. IEMs were successfully trained on EEG voltages from a 1-item DR task, with k-fold cross-validation, although the failure of cross temporal generalization indicated that the representational format at encoding differed from that during the delay. IEM reconstruction of stimuli during the 2-back task also revealed a dynamic representational trajectory: 1) After stimulus offset, when an item became a UMI, it could be reconstructed with the delay-period IEM, but not the encoding IEM; 2) after the offset of the subsequent item in the 2-back sequence, however, the opposite was true. These results suggest that a general principle of neural coding during working memory may be that information is recoded into a format that is different from visual perception while it is being retained for later use, then recoded back into a perceptual format when needed to guide behavior (e.g., with a recognition decision or a recall response).