

Neural transformations supporting the representation of context and priority in visual working memory

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How does the brain keep future-relevant information accessible while preventing it from interfering with other items in working memory (WM) and with ongoing behavior? Recent simulations with recurrent neural networks (RNNs) have provided mechanistic insights into the neural transformations that support visual WM performance by demonstrating that distinct items are held in separate “context-encoded” subspaces that undergo priority-related transformations according to the status assigned by an external cue (i.e., ‘relevant now’ vs. ‘possibly relevant later’). Here we employed time-resolved representational similarity analysis (RSA) of human electroencephalography (EEG) data to track these representational dynamics in human WM performance. Sixteen subjects performed a double serial retrocuing (DSR) task in which two gratings were presented serially, followed by a retrocue indicating the item to be recalled (“1” or “2;” 100% valid cues, each with 50% probability), followed by a second retrocue and a second recall test. In RNNs the presentation of the second item in the memory set prompts the first item to rotate into a new representational subspace, suggesting that order in WM may be encoded chronologically (not ordinally). With EEG, RSA of voltages suggested a similar scheme, with the representational format of the second sample grating (‘S2’) being more similar to the initial format of the first sample grating (‘S1’) than was the contemporaneous format of S1. Interestingly, dynamics in RSA timecourses suggested that encoding of S2 entailed a “tug of war” between S2 and S1 for occupancy of the “initial S1 subspace,” with the representational geometries of the two items moving in and out of the “initial S1 subspace” at a rate of ~15Hz. Future analyses will assess timelocked dynamics in the beta band of the spectrally-transformed EEG data. For prioritization, RSA revealed rapid shifts in the representational geometry of the two items in WM, timelocked to retrocue onset, a pattern consistent with rapid priority-based stratification of representational subspaces observed in RNNs. Furthermore, a similar pattern of rapid transformation was observed timelocked to the recall response, consistent with the ‘reset’ of priority status observed in RNNs.