Inter-hemispheric mechanisms of within- and across-trial working memory in prefrontal cortex

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Working memory (WM) refers to short-term information maintenance and its processing. Recent evidence suggests an interplay of persistent activity and activity-silent mechanisms in the prefrontal cortex (PFC) to support WM maintenance and history effects (serial dependence). However, the bilateral PFC has so far often been viewed as one single entity, even though neurons in each hemisphere of the PFC display a spatial lateralization. It is therefore still unclear how neural representations of WM maintenance within a trial and serial dependence between trials relate across hemispheres. Here, we answer this question by analyzing behavior and bilateral PFC neural recordings from three macaque monkeys performing a visuospatial delayed response task. We found behavioral and neural evidence for slowly diffusing memories during the delay period within a trial, and a drift towards the previously remembered item across trials. Interestingly, the neural correlates of single-trial memory drift were weakly, but significantly, correlated across hemispheres, suggesting weak hemispheric interactions. When comparing several two-area bump-attractor models with varying degrees of tuned and untuned across-area connections, we found that tuning of across-area connections is necessary for error correlations to emerge. The model further predicted either a private or a shared serial dependence drift across hemispheres based on increasing connectivity strength between the areas. The data confirmed a private history-dependent memory drift towards the previously memorized item and therefore suggests that faint, but spatially-specific connections underlie continuous working memory across prefrontal hemispheres.