Shared neural representations of orientation and location information during working memory

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Categorical biases influence the recall of visual stimuli during working memory. This effect is well documented for colors, which are easily categorized into named color categories (‘red’, ‘green’, ‘blue’), and behavioral evidence suggests that this categorization can bias delayed recall toward prototypical color hues. For orientations and locations, cardinal stimuli (i.e. ‘horizontal’ and ‘vertical’) are remembered with significantly higher accuracy than non-cardinal ones and recall of noncardinal stimuli is biased away from these cardinals. We have recently shown that this difference in recall between categories seems to be reflected by different labeling strategies for cardinal and noncardinal stimuli. Words describing cardinal stimuli were used more selectively, while terms for non-cardinal stimuli (i.e. ‘diagonal’) were used more liberally and broadly. This suggested that subjects used verbal or categorical encoding strategies which in turn resulted in biased recall. Here, we investigated whether these different behavioral encoding strategies for cardinal and non-cardinal stimuli are also evident in neural representations during working memory. Subjects performed a standard orientation and location delayed recall task in an MRI scanner with no additional instruction regarding the use of verbal or non-verbal strategies. After these tasks, we also recorded the brain activity evoked when reading and listening to a set of spatial words used frequently to describe orientation and location stimuli (e.g., ‘horizontal’, ‘vertical’). We find that encoding cardinal and noncardinal stimuli evokes subject-unique neural activity patterns in posterior parietal cortices which are replicated for orientation and location stimuli. These neural activity patterns can entail both univariate and multivariate changes in neural recruitment. These results suggest that cardinal biases for orientation and location stimuli are a result of shared categorical-spatial representations outside of visual cortex. This highlights how both sensory and more anterior regions in concert enable working memory behavior using sensory, categorical, and potentially even verbal codes.

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