The influence of storage capacity versus control in visual working memory capacity limitations

Keywords: visual short term memory, inverted encoding model, fMRI

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Many studies of visual working memory (VWM) capacity confound the constructs of "storage capacity," "context binding," and “inter-item interference.” During fMRI of a delayed-estimation task (n = 16), we dissociated the experimental factor of load -- one bar that could vary in orientation ("1O") vs. three differently oriented bars ("3O") – from that of category homogeneity -- 3O vs. one bar, one patch that could vary in chrominance, and one concentric-circle stimulus that could vary in luminance contrast ("1O1C1L"). Fitting behavioral data to a 3-factor mixture model revealed no difference in memory precision between 1O and 1O1C1L conditions, but significantly worse precision for 3O. Subjects with higher VWM capacity, estimated offline with color change-detection, had a smaller decline in precision of 3O relative to 1O1C1L. Probability of target responses was highest for 1O, followed by 1O1C1L, followed by 3O. Delay-period BOLD signal in parietal and frontal areas was comparable in 1O and 1O1C1L conditions, and higher for 3O. Orientation reconstruction with multivariate inverted encoding modeling (IEM) of this delay-period signal was only successful for 1O trials, a pattern most consistent with a context binding function. IEM of encoding-related signal in occipital cortex, in contrast, produced successful orientation reconstruction for 1O and 1O1C1L, but not for 3O. Furthermore, dividing subjects into homogeneity-sensitive versus homogeneity-insensitive groups (based on the behavioral measures) indicated that the 1O1C1L-3O reconstruction difference was most pronounced in the homogeneity-sensitive group, a pattern most consistent with an inter-item interference. Fronto-parietal VWM activity reflects control, an important determinant of VWM capacity.