Supplementary Information for

Concurrent contextual and time-distant mnemonic information co-exist as feedback in human visual cortex.

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Supplementary Information Text

Behavioural analysis

Participants' responses from the memory tests at the end of each learning block are shown in Figure S1. Responses from three participants were not recorded, so the total sample for behavioural data is twenty-six. As expected, performance for both the scene-object pairs and for the object position improved over blocks and was maintained in the last block after the scanner training task. The average vividness judgement of each participant during the scanner training task is also shown in Figure S1. Average responses to the post-scan memory tests are also shown in Figure S1 (bottom panel).

Spatial specificity tests: Periphery vs. fovea

In line with previous literature showing that foveal voxels can be recruited to accurately represent objects shown in the periphery of the visual field (Williams et al. 2008), we were also able to measure object reinstatement from the foveal subregions of V1 and V2 during episodic retrievals (both ps $< .001$, one-sided Wilcoxon signed rank tests, Bonferroni corrected) but not during semantic ones (semantic trials: $p = .084$ and $p = .508$). The spatial specificity of the mnemonical content was assessed by contrasting reinstatement on the peripheral ROIs with the foveal ROIs for both retrieval conditions. Object reinstatement indices of each participant were submitted to a repeated-measures ANOVA with ROI (v1 periphery, v2 periphery, v1 fovea and v2 fovea) and retrieval type (episodic and semantic) as within-participants factors. As expected from the original positioning of the objects within the images, the results revealed a main effect of ROI, $F(3,84)=9.591$, $p<.001$ and a main effect of retrieval condition, $F(1,28) = 115.72$. These effects were further characterized by a significant interaction, $F(3,84) = 15.717$, $p<.001$ which indicated that the differences between V1 and V2 were found only in episodic and not in semantic trials. This interaction was driven by the lack of object reinstatement in semantic trials with reinstatement being weaker in foveal voxels than in peripheral voxels in V1: $F(1,28)=4.39$, $p<.001$ and V2: $F(1,28)=4.95$, $p<.001$ and $F(1,28)=7.05$, $p<.001$.

<u>Comparison of PPI maps with different seed regions.</u>

Comparing PPI maps with V1 and LOC as see regions, we found a cluster of voxels located at the right superior parietal cortex that was effectively connected to both seed regions more strongly during episodic retrieval compared to semantic retrieval. Despite a reduced cluster size for PPI-V1$_{EPI>SEM}$ compared to PPI-LOC$_{EPI>SEM}$, the clusters fully overlap, both streaking parietal regions and Precuneus. Additionally, for PPI-LOC$_{EPI>SEM}$, another cluster emerged within the inferior right LOC. Furthermore, increased bilateral functional connectivity with clusters located over the postcentral and supramarginal gyrus (SMG) was measured exclusively during episodic trials and with LOC as seed region. For detailed information see Table S2.

The opposite contrast (i.e., semantic > episodic) revealed considerable overlap for both seed ROIs. A cluster over the right superior LOC, including parts of the angular gyrus, was more strongly connected to both seed regions during semantic than during to episodic trials. Another area that showed substantial voxel overlap for both seed ROIs during semantic retrieval was the bilateral fusiform area. In the right hemisphere, both fusiform clusters extended to the lingual gyrus whereas in the left hemisphere, only the fusiform cluster of the PPI-LOC$_{SEM>EPI}$ contrast reached to the angular gyrus. For full report see Table S2.

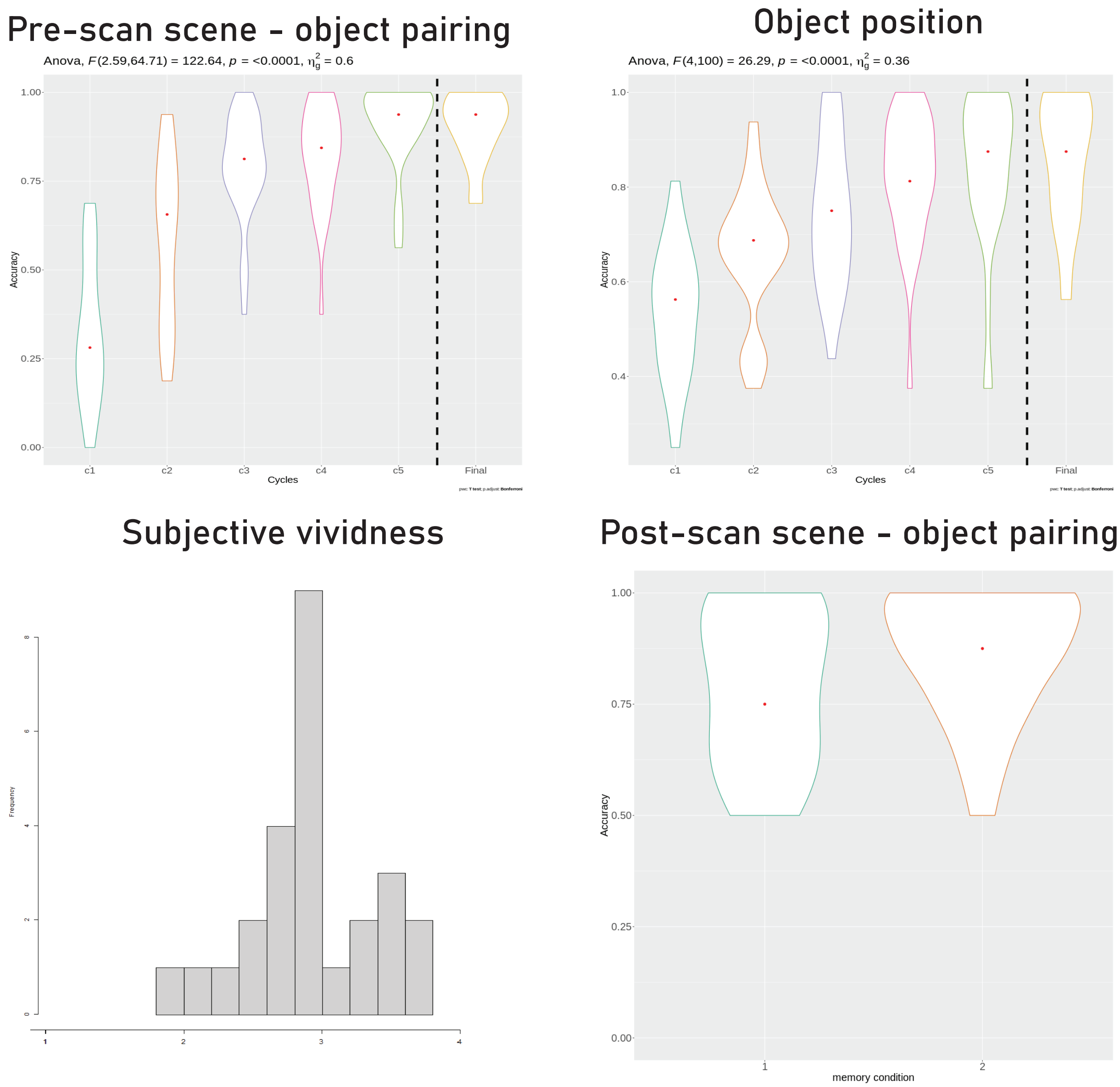

Fig. S1. Behavioural performance. (**A and B**) Accuracy for scene-object pairing and for object position over the six learning cycles. (**C**) Histogram of average subjective vividness rating for the retrieved objects during the scanner training phase. Participants used a 4-point Likert scale (1 = "not remembered", 2 = "remembered but not visualized", 3 = "visualized with a few details", 4 = "visualized with a lot of detail"). Participants were encouraged to try to get as many 3s and 4s as possible. (**D**) Post-scan memory test performance for episodic (1) and semantic (2) conditions.

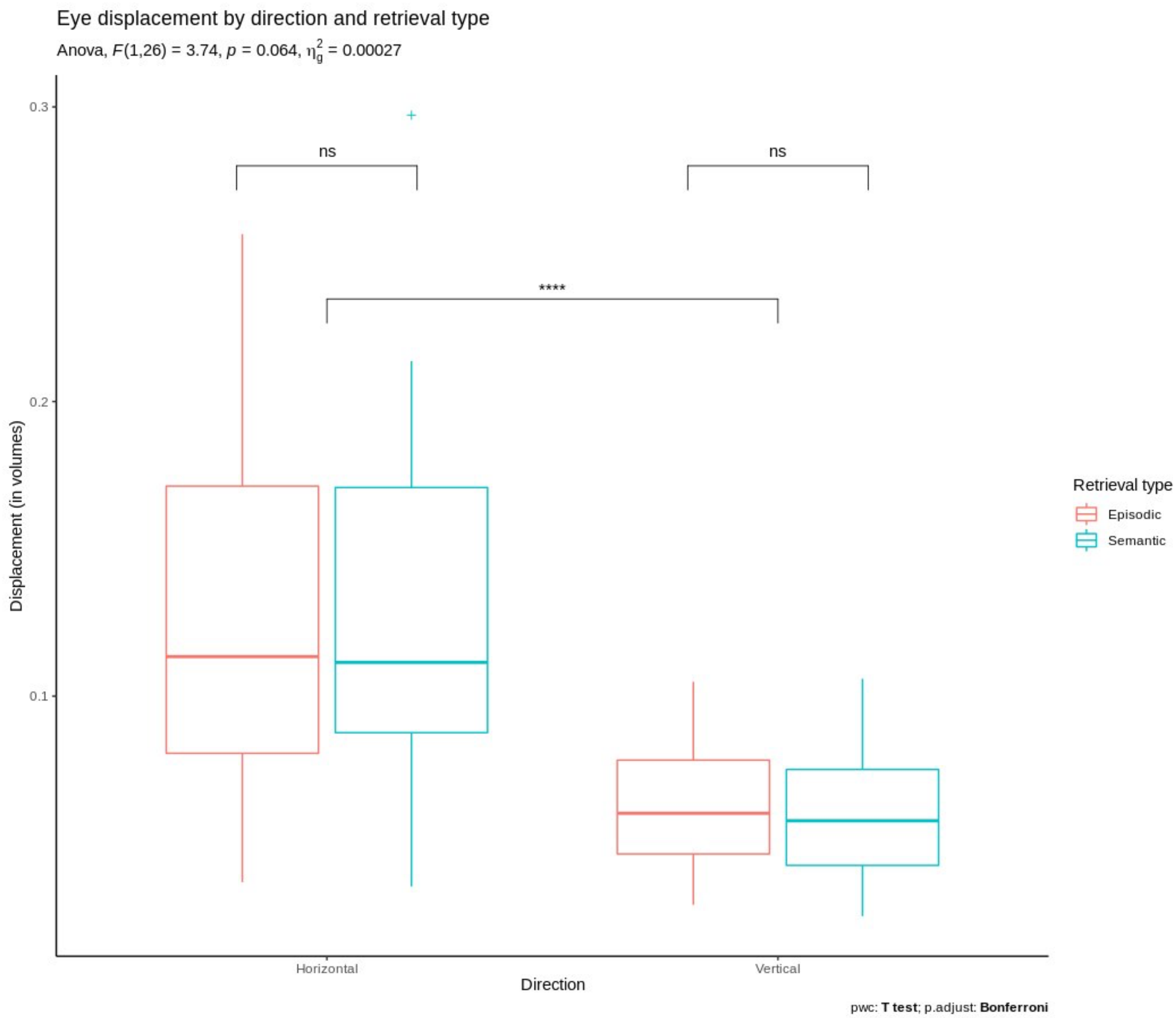

Fig. S2. Eye displacement by direction and retrieval type. Box plot showing the motion of the eye bulb estimated from the EPI images. Motion is computed as displacement from the start of the trial. Box whiskers indicate 95% CI and asterisks denote significant main effect of direction with larger values for horizontal than vertical. One participant was identified as outlier and was removed from the analysis reported here (participant's data is shown here with a cross). Note that there were no differences between memory conditions (see Supplementary Text for statistics).

Table S1. Summary of classification results. Sample-averaged accuracies for each classifier. Asterisks denote significance for the corresponding one-sided signed rank test, p<.05.

Classification analysis	Visual field region	ROI	Retrieval condition	Accuracy	Std	Cohen's D	Z
Concurrent	Periphery	V1	Episodic	0.67	0.08	0.87	4.69*
			Semantic	0.64	0.09	0.85	4.58*
		V2	Episodic	0.62	0.05	0.87	4.69*
			Semantic	0.6	0.08	0.86	4.62*
	Fovea	V1	Episodic	0.61	0.06	0.87	4.67*
			Semantic	0.6	0.08	0.86	4.61*
		V2	Episodic	0.57	0.05	0.82	4.39*
			Semantic	0.57	0.07	0.76	4.07*
Cross-classification	Periphery	V1	Episodic	0.49	0.11	0.08	-0.45
			Semantic	0.51	0.11	0.08	0.43
		V2	Episodic	0.51	0.08	0.14	0.74
			Semantic	0.5	0.1	0.04	-0.21
	Fovea	V1	Episodic	0.48	0.09	0.13	-0.72
			Semantic	0.5	0.07	0.05	-0.26
		V2	Episodic	0.51	0.06	0.01	0.12
			Semantic	0.5	0.06	0.04	-0.27

Table S2. Summary of clusters surviving correction in PPI analysis.

ROI	Contrast	Hemisphere	Region (Harvard-Oxford Cortical Structural Atlas)	Z - Local maxima MNI coordinates			Cluster size (no. of voxels)	Peak *Z*	Cluster-level (FWE-corrected)
				X	Y	Z			
V1	EPI>SEM	right	**Cluster 1** LOC, superior division	11.5	-66.5	69.5	197	.25	0.00028
LOC	EPI>SEM	right	**Cluster 4** LOC, superior division	11.5	-66.5	71.5	439	4.52	8.27e-09
		right	**Cluster 3** Postcentral gyrus	31.5	-32.5	43.5	139	4.33	0.00253
		left	**Cluster 2** SMG; Postcentral gyrus	-50.5	-30.5	41.5	134	4.05	0.0033
		right	**Cluster 1** LOC, inferior division; middle temporal Gyrus	53.5	-62.5	-0.5	119	3.93	0.00742
V1	SEM>EPI	right	**Cluster 4** LOC, superior division; Angular Gyrus	41.5	-62.5	31.5	222	4.82	9.45e-05
		right	**Cluster 3** Fusiform Cortex; Fusiform Gyrus; Lingual Gyrus	23.5	-58.5	-8.5	185	3.99	0.000478
		left	**Cluster 2** LOC, inferior division	-44.5	-82.5	-8.5	110	4.45	0.0187

		left	**Cluster 1** Fusiform Cortex	-28.5	-44.5	-16.5	102	4.12	0.0287
LOC	SEM>EPI	right	**Cluster 3** Fusiform Cortex; Fusiform Gyrus; Lingual Gyrus	**X**	**Y**	**Z**			
		right	**Cluster 2** LOC, superior division; Angular Gyrus	41.5	-60.5	31.5	109	3.99	0.0132
		left	**Cluster 1** Fusiform Cortex; Fusiform Gyrus; Angular Gyrus	-30.5	-56.5	-6.5	91	4.45	0.0374