Supplemental Materials

Supplementary Table S1. Participant demographics and *M (SD)* scores from the neuropsychological test battery

	Younger Adults	Older Adults	p-value
Years of Education	15.46 (2.65)	16.71 (2.44)	NS
MMSE	29.25 (0.90)	29.33 (0.70)	NS
CVLT Short Delay – Free	13.75 (2.00)	11.88 (2.86)	<0.01
CVLT Short Delay – Cued	13.83 (2.32)	13.08 (2.15)	NS
CVLT Long Delay – Free	14.13 (2.11)	12.79 (2.62)	NS
CVLT Long Delay – Cued	14.38 (1.93)	13.46 (2.13)	NS
CVLT recognition – Hits	15.71 (0.46)	15.25 (1.07)	NS
CVLT recognition – False alarms	0.33 (0.70)	1.67 (1.61)	<0.01
Logical Memory I	33.00 (4.76)	28.00 (4.11)	<0.01
Logical memory II	32.00 (4.80)	25.83 (5.49)	<0.01
SDMT	62.33 (11.27)	49.29 (7.91)	<0.01
Trails A (s)	20.20 (5.26)	25.11 (6.46)	<0.01
Trails B (s)	44.12 (10.18)	62.48 (16.77)	<0.01
Digit Span Total	19.71 (4.14)	18.79 (3.49)	NS
Category fluency	23.71 (4.91)	22.46 (5.35)	NS
F-A-S	49.17 (12.85)	46.29 (12.75)	NS
WTAR	42.42 (3.46)	44.54 (4.06)	NS
Raven's	11.04 (0.86)	9.50 (1.89)	<0.01

Reinstatement strength as a function of ROI voxel counts

The size of the feature sets used for PSA was selected to correspond with the smaller of the two univariate reinstatement effects. As pointed out by a reviewer, this selection strategy may bias the PSA results as it takes into account the entire extent of the face ROI (the smaller of the two ROIs), but only the most active voxels of the scene ROIs. To address this concern, we performed follow-up item- and category-level encoding-retrieval PSAs using set sizes of 50, 100, 250 and 500 voxels. As with the original feature selection, voxel sets were defined as the *n* voxels with the highest z-scores for the respective reinstatement contrasts. Category- and item-level pattern similarity computed from each voxel set are reported in Table S2, along with the results of separate *t*-tests comparing the two age groups separately for each stimulus category and voxel set. We limited these analyses to source correct trials as it was these trials where age differences were observed using the 151 voxel counts.

For category-level reinstatement of face information, young and older adults did not differ across any of the set sizes. By contrast, category-level reinstatement of scene information was significantly lower in older relative to younger adults across each voxel set, and these effects generally became more reliable as the set sizes increased. Turning to the item-level effects, reinstatement of trial unique face information was significantly greater in young relative to older adults when computed over 500 voxels, but did not differ within any of the smaller voxel sets. Reinstatement of trial unique scene information did not differ between young and older adults in any of the voxel sets.

Supplementary Table S2. PSA Voxel Count Analyses

Set Size	Faces			Scenes		
	YA	OA	t-score	YA	OA	t-score
Category-Level						
50	.007	.004	-0.90	.002	-.006	-2.11*
100	.004	.002	-0.74	.004	-.003	-2.19*
250	.009	.006	-0.63	.024	.002	-4.54***
500	.008	.009	0.06	.044	.010	-5.96***
Item-Level						
50	.012	-.001	-1.41	.005	.014	0.95
100	.009	.000	-1.00	.005	.012	0.72
250	.014	.002	-1.43	.003	-.001	-0.58
500	.021	-.001	-2.75**	.009	.006	-1.07

Note: YA = younger adult; OA = older adult; *p<.05, **p<.01, ***p<.001

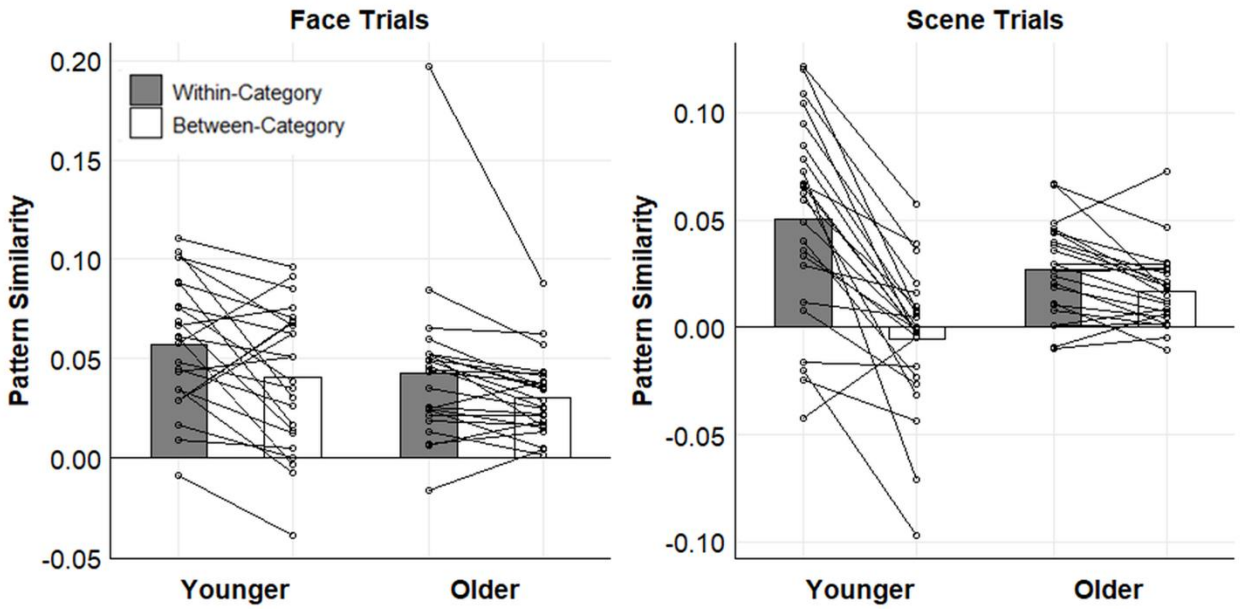

Figure S1. Within- and between-category similarity indices are presented for each stimulus category for their respective preferred voxel set. Note that the similarity metrics shown are for source correct trials only. Weaker category-level scene reinstatement in older adults was driven by greater between-category similarity. For display purposes, raw data from one outlying older adult were excluded from the scenes plot.

Comparing encoding- and retrieval-phase neural differentiation

We employed pattern similarity analysis (PSA) to quantify retrieval-related neural selectivity in the face and scene voxel sets using an approach identical to that used to quantify neural differentiation at encoding. For the face-selective voxel set, the within-category measure was the average across-voxel similarity between a given face trial and all other face trials, and the between-category measure was the average correlation between a given face trial and all scene trials. The same approach was used for the scene-selective voxel set, except that scene trials were used for the within-category measures, and face trials were used for the between-category measures. A measure of neural selectivity for each voxel set was computed as the difference between the respective within and between similarity metrics, averaged across all trials. As before, PSA was computed across different scanning sessions to avoid the possibility of bias from temporal autocorrelations between trials occurring in the same scanning session.

A 2 (age) x 2 (category) mixed-factorial ANOVA revealed a significant main effect of age ($F_{(1,46)} = 5.33$, $p = .026$, partial-$\eta^2 = .10$). The main effect of category and age x category interactions were both nonsignificant (*ps* > .2). Post-hoc comparisons revealed that neural selectivity at retrieval was significantly lower for scenes in older relative to younger adults ($t_{(86.7)} = -2.58$, $p < .012$) but, echoing category-level encoding-retrieval pattern similarity, no age differences were observed for face selectivity ($t_{(86.7)} = -1.06$, $p = .291$). Partial correlations between neural selectivity at encoding and retrieval, controlling for age, were significant for both face ($r_{partial} = .44$, $p = .002$) and scene ($r_{partial} = .33$, $p = .022$) trials. Multiple regression analyses confirmed that age did not significantly moderate any of these relationships (*ps* > .6 for both interaction coefficients). An ANCOVA contrasting selectivity at retrieval in young and older adults, controlling for selectivity at encoding, gave rise to a non-significant main effect of age ($F_{(1,45)} = 3.31$, $p = .089$, partial-$\eta^2 = .07$). When the analysis was conducted after excluding the covariate, the main effect of age was significant ($F_{(1,46)} = 9.87$, $p = .003$), producing a nearly three-fold increase in the effect size ($\eta^2 = .18$).

Across-participant item- and category-level reinstatement metrics do not predict source memory accuracy independently of age.

We ran a series of multiple regression analyses in which age group and, respectively, participant-wise item- and category-level pattern similarity metrics for each stimulus category were employed as predictors of source accuracy (pSR). All age x reinstatement interaction terms were all far from significant (all *ps* > .2) and were therefore not included in the models reported here. In no case did reinstatement reliably predict source accuracy over and above the factor of age group (all *ps* > .09, max *r* = .25).

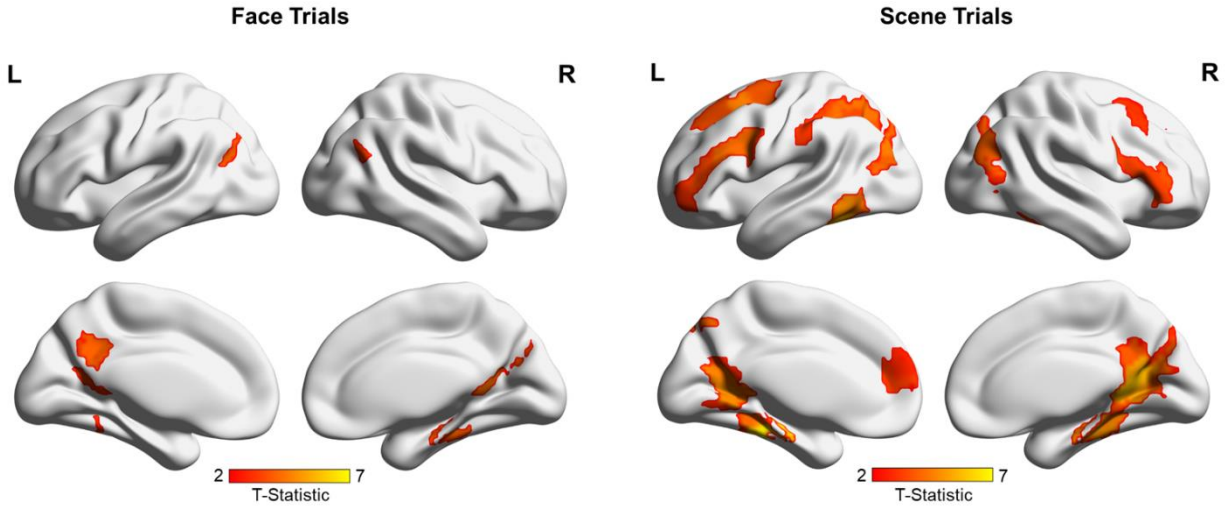

Figure S2. Whole brain category-level pattern similarity. Regions where category-level pattern similarity effects were reliably greater than zero in either of or both of the age groups.

Table S3. Labels for regions where whole brain category-level pattern similarity results were significantly greater than zero in either of or both of the age groups.

Region Name (AICHA IDX)	Face Trials	Scene Trials
L Superior Frontal Sulcus (13)		YA
L Superior Frontal Sulcus (15)		YA
R Superior Frontal Sulcus (16)		YA
L Superior Frontal Sulcus (17)		YA
R Middle Frontal Gyrus (26)		YA
L Inferior Frontal Sulcus (29)		YA
R Inferior Frontal Sulcus (30)		YA
L Inferior Frontal Sulcus (31)		YA
R Inferior Frontal Gyrus (34)		YA
L Mid Orbital Frontal Gyrus (39)		YA
L Precentral Sulcus (51)		YA
R Precentral Sulcus (52)		YA
L Precentral Sulcus (53)		YA
L Precentral Sulcus (59)		YA
L Postcentral Sulcus (75)		YA
L Supramarginal Gyrus (91)		YA
L Angular Gyrus (105)	YA	
R Angular Gyrus (106)	YA	
L Intraparietal Sulcus (109)		YA
L Intraparietal Sulcus (111)		YA
L Intraparietal Sulcus (113)		YA
L Intraoccipital Sulcus (115)		YA
R Intraoccipital Sulcus (116)		YA
L Middle Occipital Gyrus (133)		YA
R Middle Occipital Gyrus (134)		YA
R Middle Occipital Gyrus (136)		YA
L Middle Occipital Gyrus (137)		YA & OA
L Middle Occipital Gyrus (139)		YA & OA
R Middle Occipital Gyrus (140)		YA
L Inferior Temporal Gyrus (191)		YA
L Inferior Temporal Gyrus (193)		YA
L Superior Medial Frontal Gyrus (207)		YA
L Superior Medial Frontal Gyrus (209)		YA
L Precuneus (265)	YA	YA & OA
R Precuneus (266)	YA	YA & OA
L Precuneus (267)		YA
R Precuneus (268)		YA & OA
L Precuneus (269)	YA	
R Precuneus (270)		YA
L Precuneus (281)		YA
L Parietooccipital Sulcus (283)		YA & OA
R Parietooccipital Sulcus (284)		YA & OA
L Parietooccipital Sulcus (285)		YA

R Parietooccipital Sulcus (286)		YA
R Parietooccipital Sulcus (288)		YA
L Parietooccipital Sulcus (289)		YA & OA
R Parietooccipital Sulcus (290)		YA & OA
L Parietooccipital Sulcus (291)		YA
R Parietooccipital Sulcus (292)	YA	YA & OA
R Parietooccipital Sulcus (294)	YA	YA
R Calcarine Gyrus (300)		YA
R Lingual Gyrus (306)		YA & OA
L Lingual Gyrus (309)		YA
L Parahippocampal Gyrus (323)		YA
R Parahippocampal Gyrus (324)	YA	YA
L Parahippocampal Gyrus (329)		YA
R Parahippocampal Gyrus (330)		YA
L Fusiform Gyrus (335)		YA & OA
R Fusiform Gyrus (336)	YA	YA
L Fusiform Gyrus (337)		YA
R Fusiform Gyrus (338)		YA
L Fusiform Gyrus (339)	YA	YA
R Fusiform Gyrus (340)		YA

Note: AICHA IDX refers to the region labels reported by Joliot et al. (2015).
YA = Young Adult, OA = Older Adult

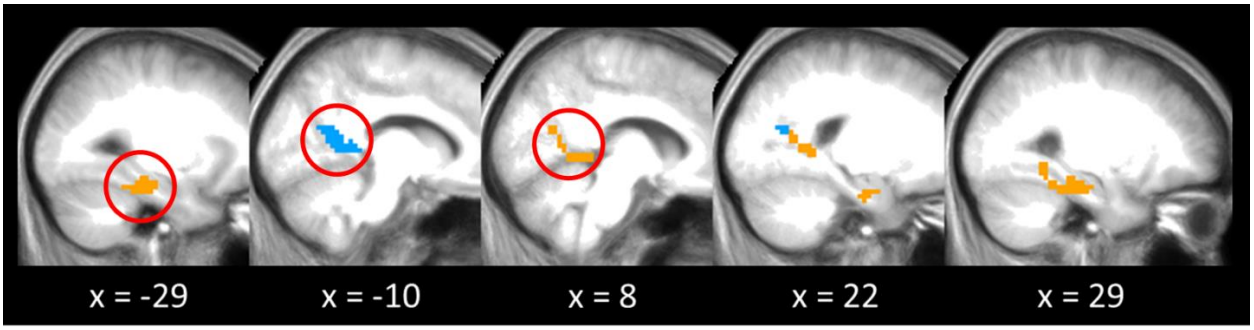

Figure S3. Regions showing a main effect of age on category-level reinstatement. Regions from the whole brain exploratory PSAs showing co-occurring main effects of age and memory on category-level reinstatement of faces (cool colors) and scenes (warm colors). Red circles indicate regions where main effects of age remained significant after controlling for neural selectivity at encoding.

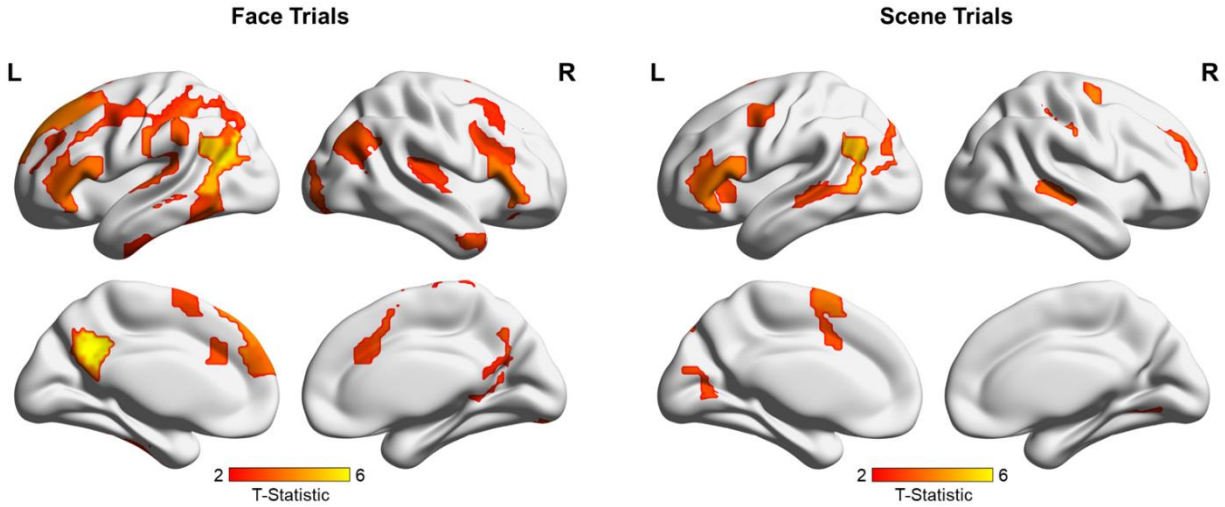

Figure S4. Whole brain item-level pattern similarity. Regions where item-level pattern similarity effects were reliably greater than zero in either or both of the age groups.

Table S4. Labels for regions where whole brain item-level pattern similarity results were significantly greater than zero in either of or both of the age groups.

Region Name (AICHA IDX)	Face Trials	Scene Trials
L Superior Frontal Gyrus (3)	YA	
L Superior Frontal Gyrus (5)	YA	
R Superior Frontal Sulcus (12)		YA
L Superior Frontal Sulcus (13)	YA	
L Superior Frontal Sulcus (15)	YA	
R Superior Frontal Sulcus (16)	YA	
L Middle Frontal Gyrus (21)	YA	
R Middle Frontal Gyrus (26)	YA	
L Middle Frontal Gyrus (27)	YA	
L Inferior Frontal Sulcus (29)	YA	YA
L Inferior Frontal Sulcus (31)	YA	YA
R Inferior Frontal Sulcus (32)	YA	
L Inferior Frontal Gyrus (33)	YA	YA
R Inferior Frontal Gyrus (34)	YA	
R Orbital Sulcus (48)	YA	
R Precentral Sulcus (54)		YA
L Precentral Sulcus (57)	YA	YA
R Precentral Sulcus (62)		YA
L Rolandic Sulcus (65)	YA	
L Postcentral Sulcus (71)	YA	
L Postcentral Sulcus (73)	YA	
L Postcentral Sulcus (75)	YA	
R Postcentral Sulcus (76)		YA
L Supramarginal Gyrus (87)	YA	
L Supramarginal Gyrus (93)	YA	
L Angular Gyrus (103)	YA	
R Angular Gyrus (104)	YA	
L Angular Gyrus (105)	YA	
R Angular Gyrus (106)	YA	
L Intraparietal Sulcus (109)	YA	
L Intraparietal Sulcus (113)	YA	
R Lateral Occipital Gyrus (122)	YA	
L Middle Occipital Gyrus (133)		YA
L Middle Occipital Gyrus (137)	YA	
R Lateral Occipital Gyrus (138)	YA	
L Middle Occipital Gyrus (139)		YA
R Middle Occipital Gyrus (140)	YA	
L Anterior Insula (149)		YA
R Posterior Insula (156)	YA	
L Superior Temporal Gyrus (165)	YA	
R Superior Temporal Gyrus (166)	YA	
L Superior Temporal Sulcus (173)		YA
R Superior Temporal Sulcus (174)		YA

L Superior Temporal Sulcus (177)	YA	YA
L Middle Temporal Gyrus (183)	YA	YA
L Middle Temporal Gyrus (185)	YA	YA
L Inferior Temporal Gyrus (187)	YA	
L Inferior Temporal Gyrus (191)	YA	
L Inferior Temporal Gyrus (193)	YA	
R Mid Temporal Pole (202)	YA	
L Superior Medial Frontal Gyrus (209)	YA	
L SMA (225)	YA	YA
L Cingulate Sulcus (227)	YA	
R Cingulate Sulcus (228)	YA	
R Cingulate Sulcus (230)	YA	
L Cingulate Sulcus (231)		YA
R Paracentral Lobule (264)	YA	
L Precuneus (267)	YA	
R Precuneus (268)	YA	
L Precuneus (269)	YA	
L Precuneus (277)	YA	
R Precuneus (278)	YA	
R Parietooccipital (284)	YA	
R Parietooccipital (286)	YA	
L Calcarine Gyrus (299)		YA
R Lingual Gyrus (308)		YA
L Fusiform Gyrus (337)	YA	
R Caudate (352)	YA	

Note: AICHA IDX refers to the region labels reported by Joliot et al. (2015).
YA = Young Adult