Figure S1

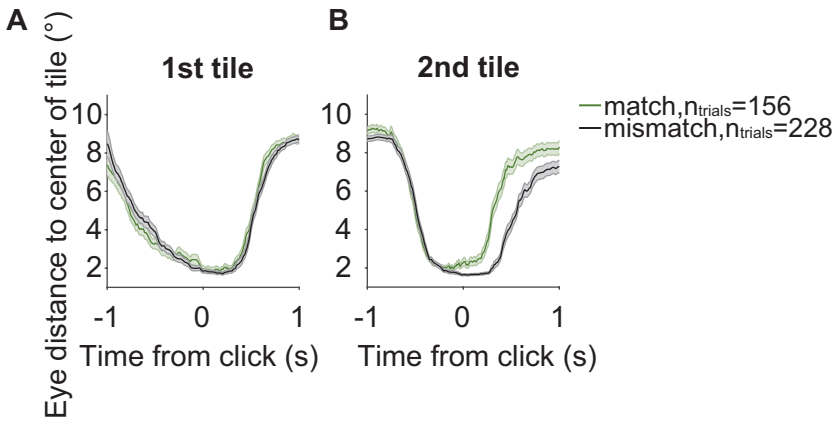

Figure S1. Participants' eye movements tracked the clicked locations.
Eye movements were similar during match and mismatch trials for the 1st tile, and for the 2nd tile before click time, but not for the 2nd tile after click time, when equalizing the reaction time and distances between the 1st and 2nd tiles. Line traces (mean±s.e.m) indicate the average distance in visual angle between gaze and the center of the tile clicked for match (green) and mismatch (black) trials. Reaction times (RT) and distances between the 1st and 2nd tiles were equalized (mean RT ± 200ms; mean distance ± 3°). **A**. No significant difference in eye-movements between match and mismatch was found during clicking the 1st tile. **B**. No significant difference in eye movements between match and mismatch was found before clicking the 2nd tile. Participants' gaze moved faster away from the 2nd tile in match trials than mismatch trials after the click: within the 1 second window after time zero, the distance from the gaze to the center of the tile was on average 1.76 dva (degrees of visual angle) larger for match than mismatch trials.

Figure S2

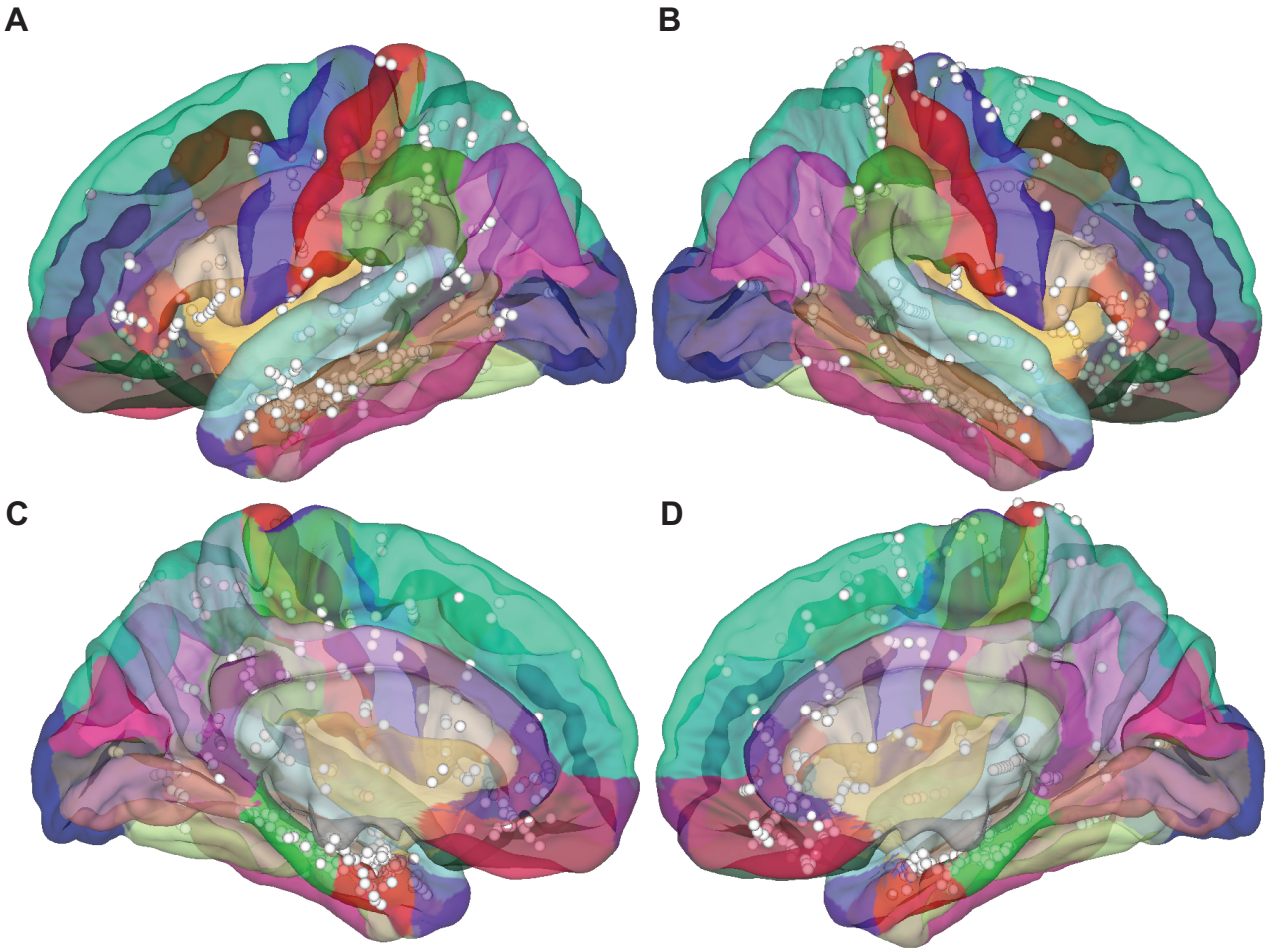

Figure S2. **Locations of electrodes in the gray matter**

Each circle shows a bipolarly referenced electrode (n=676), overlayed on the Desikan-Killiany Atlas with different views: **A**: left lateral; **B**: right lateral; **C**: left medial; **D**: right medial. The colors reflect the Desikan-Killiany parcellation (Desikan et al, 2006). Locations of white matter electrodes are reported in **Figure S3** (see also **Table S2**).

Figure S3

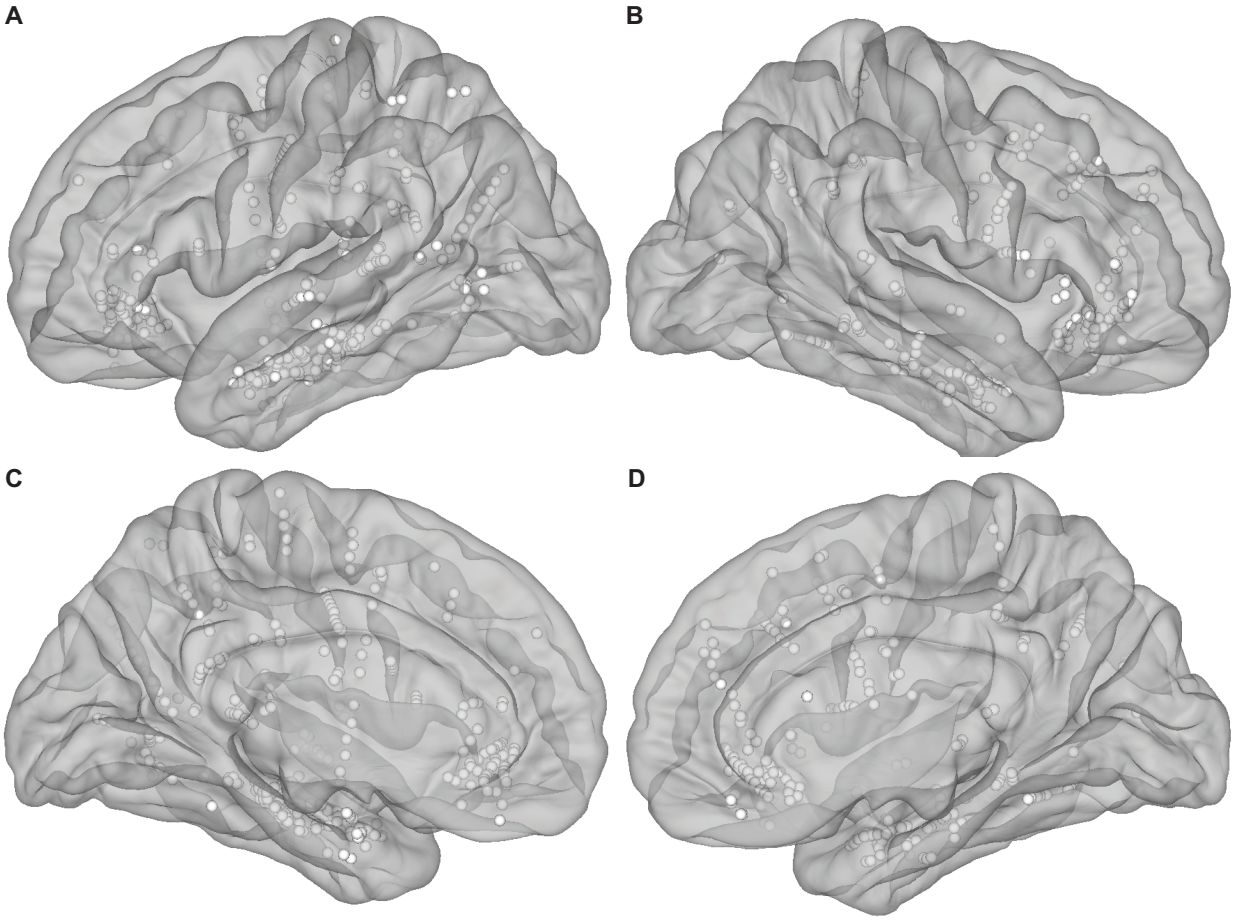

Figure S3. **Locations of all analyzed electrodes in the white matter.** Each sphere reflects one of each pair of nearby electrodes that were bipolarly referenced (n=492, **Table S2**). **A**: left lateral view; **B**: right lateral view; **C**: left medial view; **D**: right medial view. The location of gray matter electrodes is shown in **Figure S2**.

Figure S4

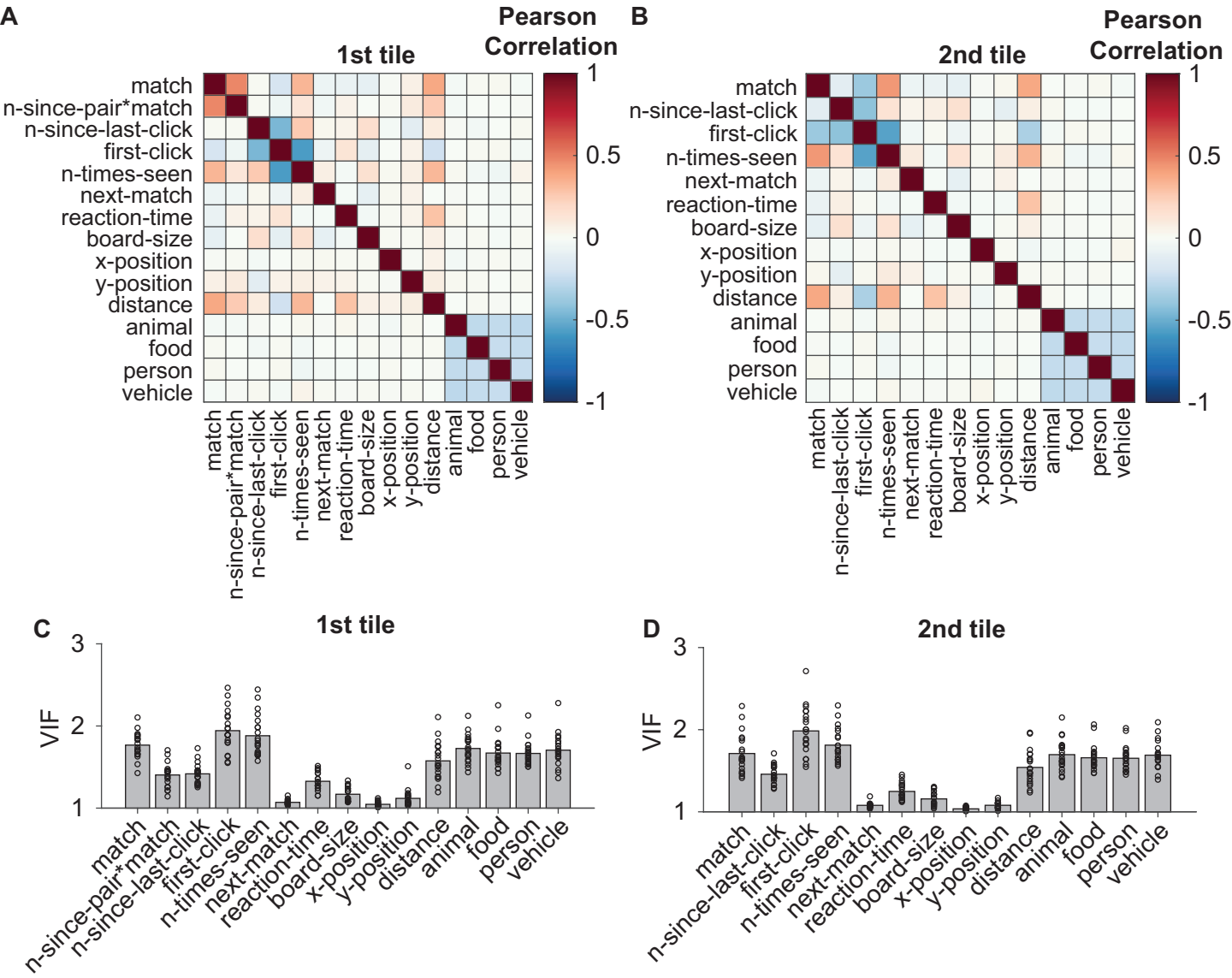

Figure S4. Correlation and collinearity among predictor variables.
A, **B**. Average across subjects of the Pearson correlation between pairs of predictors for the 1st tile (**A**) and the 2nd (**B**) tile. See color scale on the right. This is a symmetric matrix and the diagonal is 1, by definition. **Table 1** describes each of the predictors.
C, **D**. Variation Inflation Factor (VIF) (O'Brien, 2007) of each predictor for the 1st tile (**C**) and the 2nd (**D**) tile. Bar height indicates the average VIF of each predictor across all subjects. Dots represent the VIF of each predictor for each subject.

Figure S5

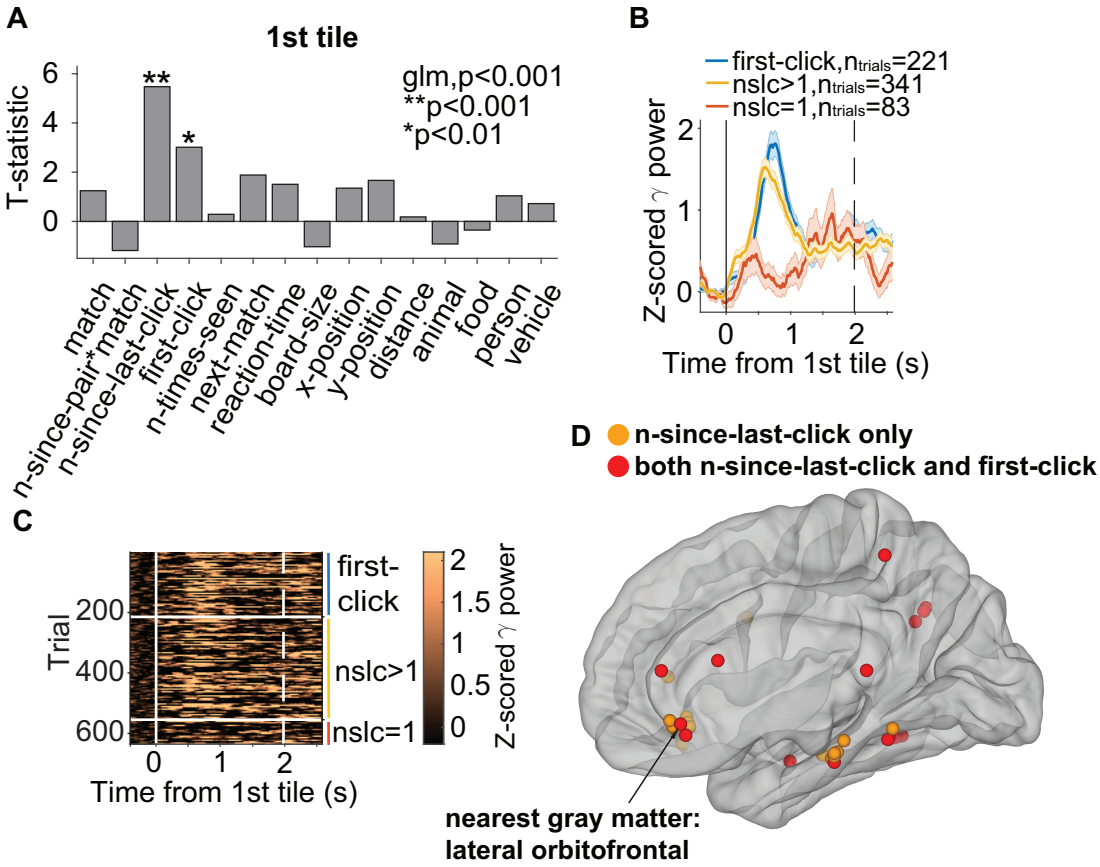

Figure S5. Neural signals in the white matter reflect novelty and familiarity

Panels show an example electrode in the white matter whose closest gray matter region is the left lateral orbitofrontal cortex (arrow in **D**). This figure follows the format of **Figure 3** in the main text.

A. T-statistic of each predictor in the GLM analysis (**Methods**). Asterisks indicate statistically significant predictors for the neural signals.

B. Z-scored gamma band power aligned to the 1st tile onset (solid vertical line) for novel tiles (blue), unfamiliar tiles (n-since-last-click>1, yellow), and more familiar tiles (n-since-last-click=1, red). The vertical dashed line indicates the mean reaction time. The time axis extends from 400 ms before the click to 500 ms after the average reaction time.

C. Raster plot showing the z-scored gamma power in individual trials ordered by first-click and then larger to smaller n-since-last-click; division indicated by white horizontal lines and colored vertical lines.

D. Locations of all white matter electrodes where n-since-last-click was a significant predictor during the 1st tile. Orange: n-since-last-click; red: both n-since-last-click and first-click were significant predictors. All electrodes were reflected on one hemisphere for display purposes.

Figure S6

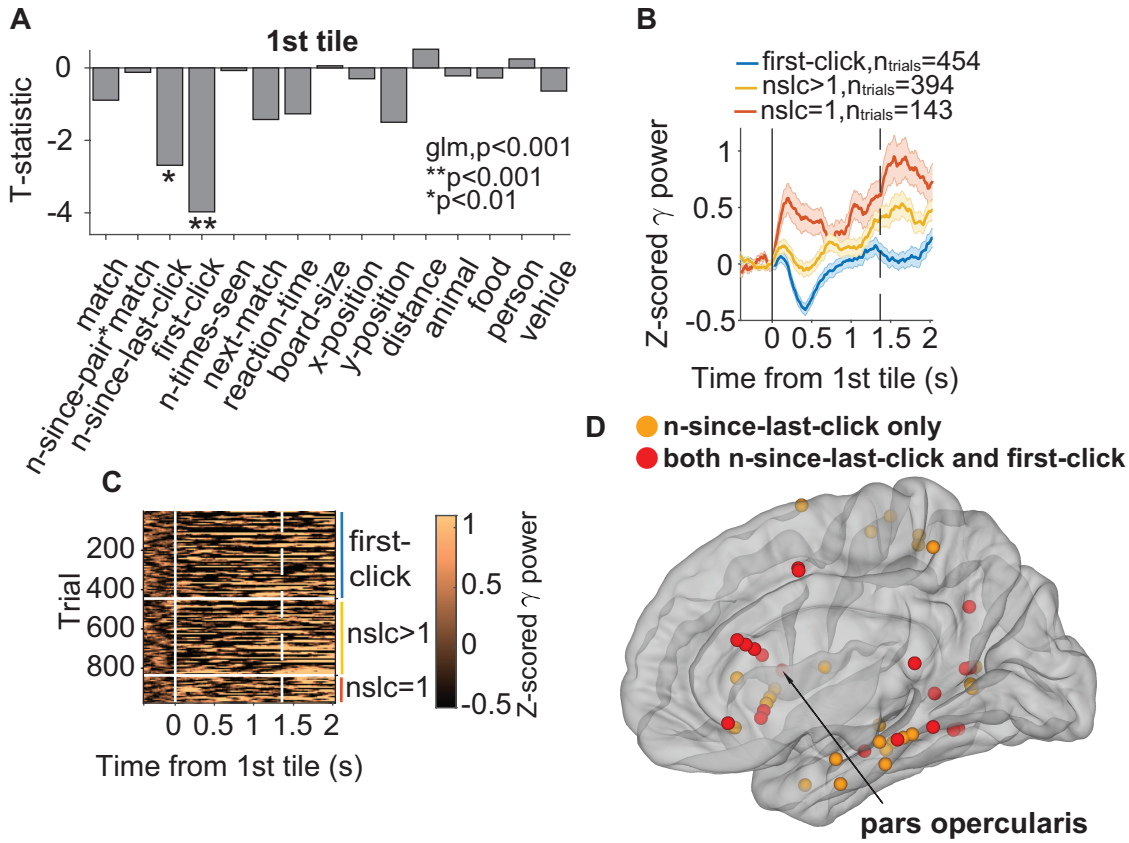

Figure S6. Neural signals reflect novelty and familiarity with a pattern different from that shown in Figure 3E-G.

This figure shows an example electrode in the right pars opercularis (gray matter, arrow in **D**), following the format of **Figure 3** in the main text. In contrast to **Figure 3E-G**, this electrode showed increased activity for more familiar trials.

A. T-statistic of each predictor in the GLM for the 1st tile. Asterisks indicate significant predictors for the gamma power AUC.

B. Z-scored gamma (30-150 Hz) power for first-click (blue), n-since-last-click>1 (yellow), and n-since-last-click=1 (red). Dashed line indicates the mean reaction time.

C. Raster plot showing the z-scored gamma power in individual trials ordered by first-click and then larger to smaller n-since-last-click; division indicated by white horizontal lines and colored vertical lines.

D. Locations of all n-since-last-click electrodes during the 1st tile. Orange: n-since-last-click only; red: both n-since-last-click and first-click were significant predictors. All electrodes were reflected on one hemisphere for display purposes.

Figure S7

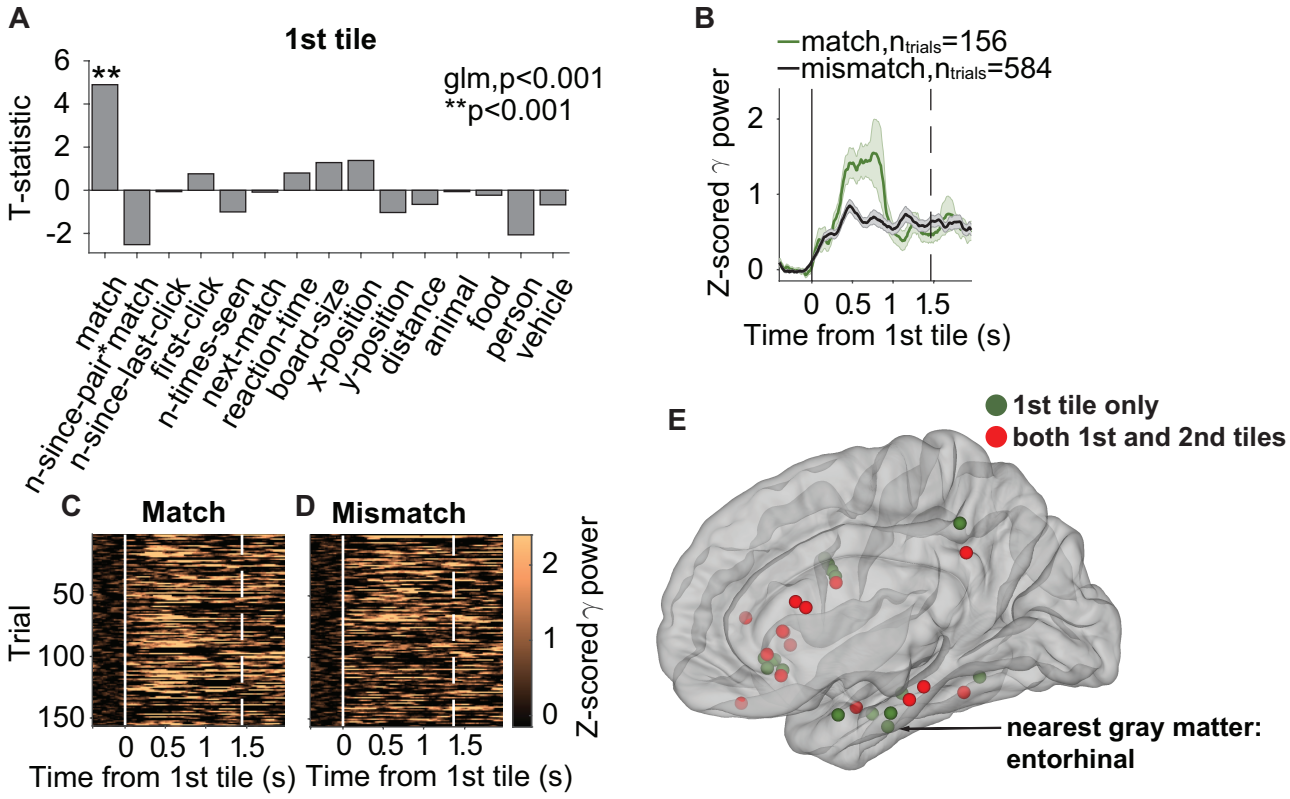

Figure S7. Neural signals in the white matter predict correct retrieval

Panels show an example electrode located in the white matter where the nearest gray matter region is the right entorhinal cortex (see arrow in **E**) as well as population locations in **E**. The format follows **Figure 3**.

A. t-statistic of each predictor in the GLM analysis. Asterisks indicate statistically significant predictors for the neural signals.

B. Z-scored gamma band power aligned to the 1st tile onset (solid vertical line) for match trials (green) and mismatch trials (black). The vertical dashed line indicates the mean reaction time. Shaded error bars indicate s.e.m.

C-D. Raster plots showing the gamma power in individual trials for match (**C**) and mismatch (**D**) trials.

E. Locations of all the white matter electrodes where match was a significant predictor during the 1st tile only (green) and during both tiles (red). All electrodes were reflected on one hemisphere for display purposes.

Figure S8

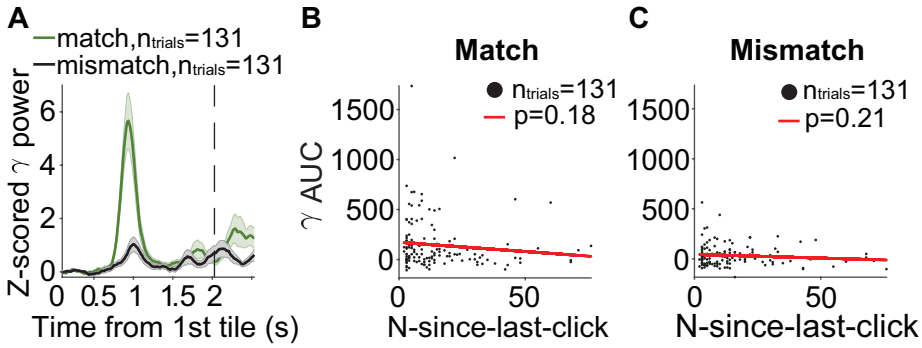

Figure S8. Match is the only predictor that accounts for the neural differences between match and mismatch

Panels shown the neural responses of an example electrode in the right lateral orbitofrontal cortex (same as in **Figure 4**) when equalizing the distribution of n-since-last click in match and mismatch trials.

A. Z-scored gamma (30-150 Hz) power during match (green) and mismatch (black) trials aligned to the 1st tile onset (solid line) after equalizing n-since-last-click values of match and mismatch trials by random subsampling. Dashed line indicates the mean reaction time.

B-C. Scatter plots of AUC of gamma power versus n-since-last-click for match (**B**) and mismatch (**C**) trials. Each dot represents data from one trial. Red lines represent linear fits of the data.

Figure S9

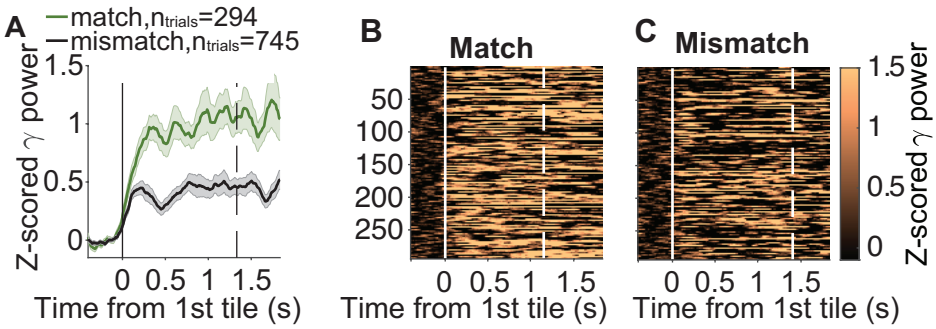

Figure S9. Neural signals predict correct retrieval with a pattern different from that shown in Figure 4

Panels show an example electrode located in the left middle temporal gyrus where "match" was a significant predictor for gamma activity.

A. Z-scored gamma (30-150 Hz) power during match (green) and mismatch (black) trials aligned to the 1st tile onset (solid line). Dashed line indicates the mean reaction time.

B-**C**. Raster plots showing the z-scored gamma power in individual match (**B**) and mismatch (**C**) trials. For display purposes, trial numbers of match and mismatch were equalized (**Methods**).

Figure S10

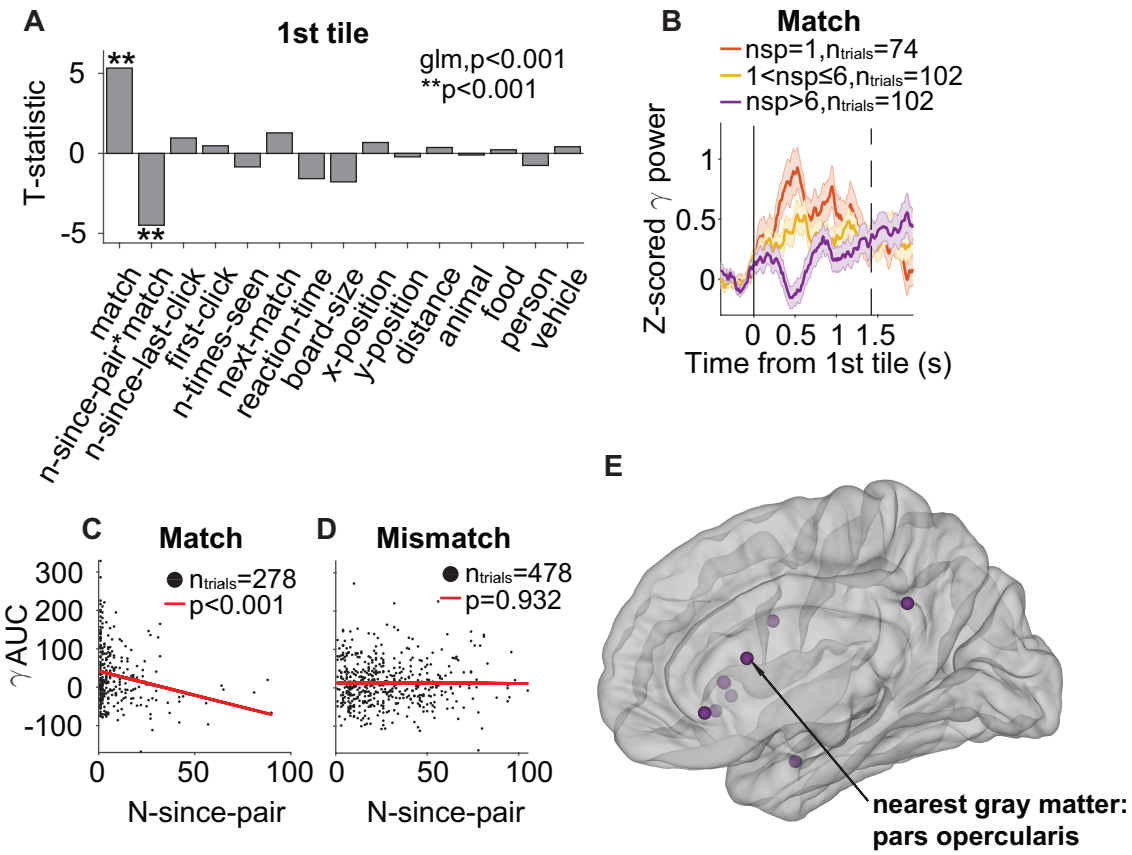

Figure S10. Neural signals in the white matter reflect the strength of memory retrieval
Panels show an example electrode in the white matter where the closest gray matter region is the left pars opercularis (see arrow in part **E**) and population locations in **E**.

A. T-statistic of each predictor in the GLM analysis. Asterisks indicate significant predictors for the neural signals.

B. Z-scored gamma band power aligned to the 1st tile onset (solid vertical line) for match trials with small n-since-pair (red, stronger memories), intermediate nsp (yellow), and large nsp (purple, weaker memories). The vertical dashed line indicates the mean reaction time. Shaded error bars indicate s.e.m.

C-D. Scatter plots of the area under the curve (AUC) of the gamma band power as a function of nsp for match trials (**C**) and mismatch trials (**D**). Each dot represents one trial. Red lines show linear fits to the data.

E. Locations of all white matter electrodes where nsp was a significant predictor. All electrodes were reflected on one hemisphere for display purposes.

Figure S11

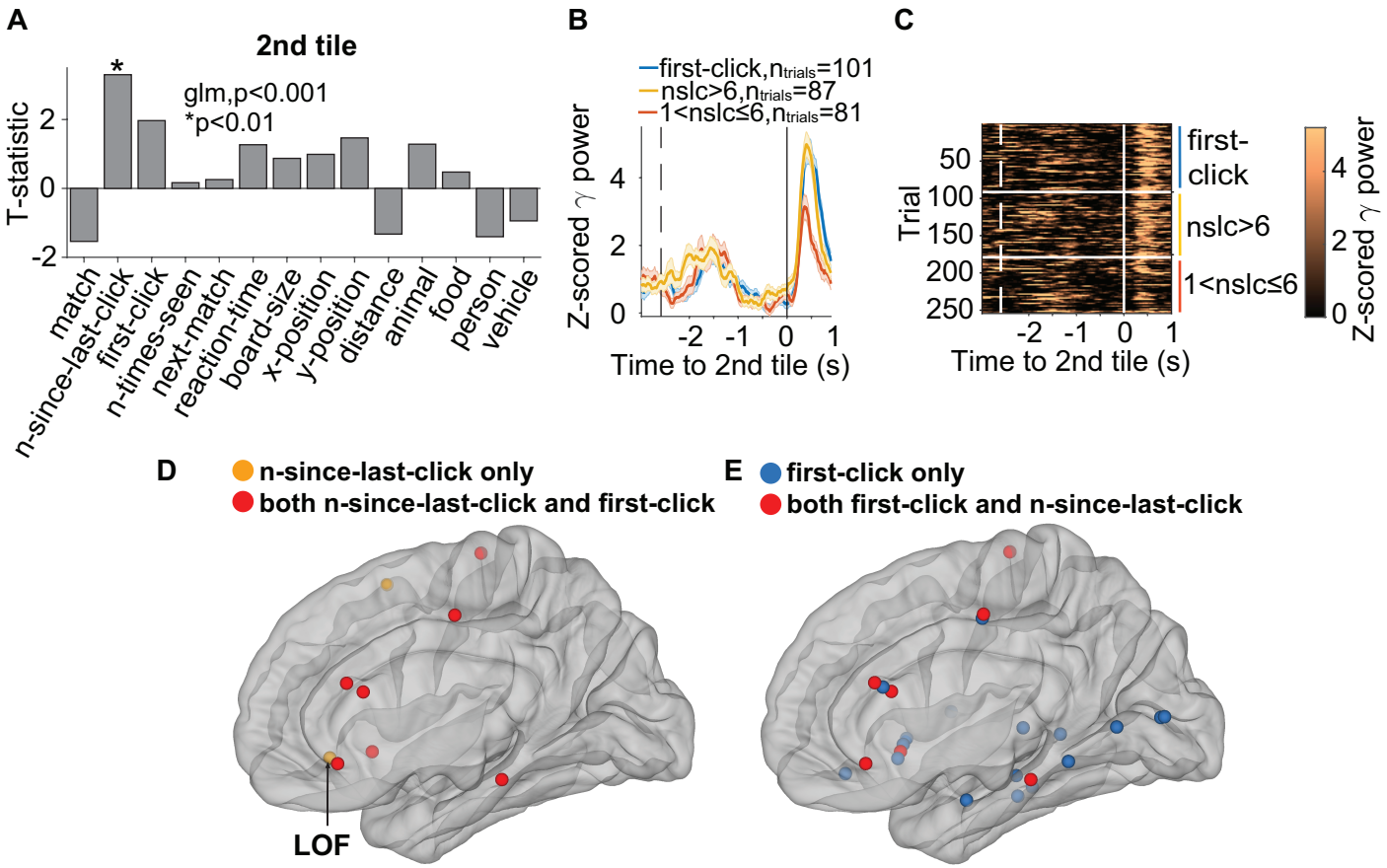

Figure S11. Neural signals after the second tile reflect familiarity and novelty
Panels show an example electrode in the right lateral orbitofrontal (LOF) cortex and population locations in **D**-**E**.

A. T-statistic of each predictor in the GLM analysis (**Methods**). Asterisks indicate statistically significant predictors for the neural signals.

B. Z-scored gamma band power aligned to the 2nd tile onset (solid vertical line) for novel tiles (blue), unfamiliar tiles (n-since-last-click>6, yellow), and familiar tiles (n-since-last-click≤1, red). The vertical dashed line indicates the mean onset of the 1st tile. The time axis extends from 400 ms plus the average reaction time before the click to 1,000 ms after the click.

C. Raster plots showing the z-scored gamma power in individual trials ordered by first-click and then larger to smaller n-since-last-click; division indicated by white horizontal lines/spaces and colored vertical bars.

D. Locations of all electrodes where n-since-last-click was a significant predictor during the 2nd tile. Orange: n-since-last-click only; red: both n-since-last-click and first-click were significant predictors.

E. Locations of all electrodes where first-click was a significant predictor during the 2nd tile. Blue: first-click only; red: both first-click and n-since-last-click were significant predictors. All electrodes were reflected on one hemisphere for display purposes.

Figure S12

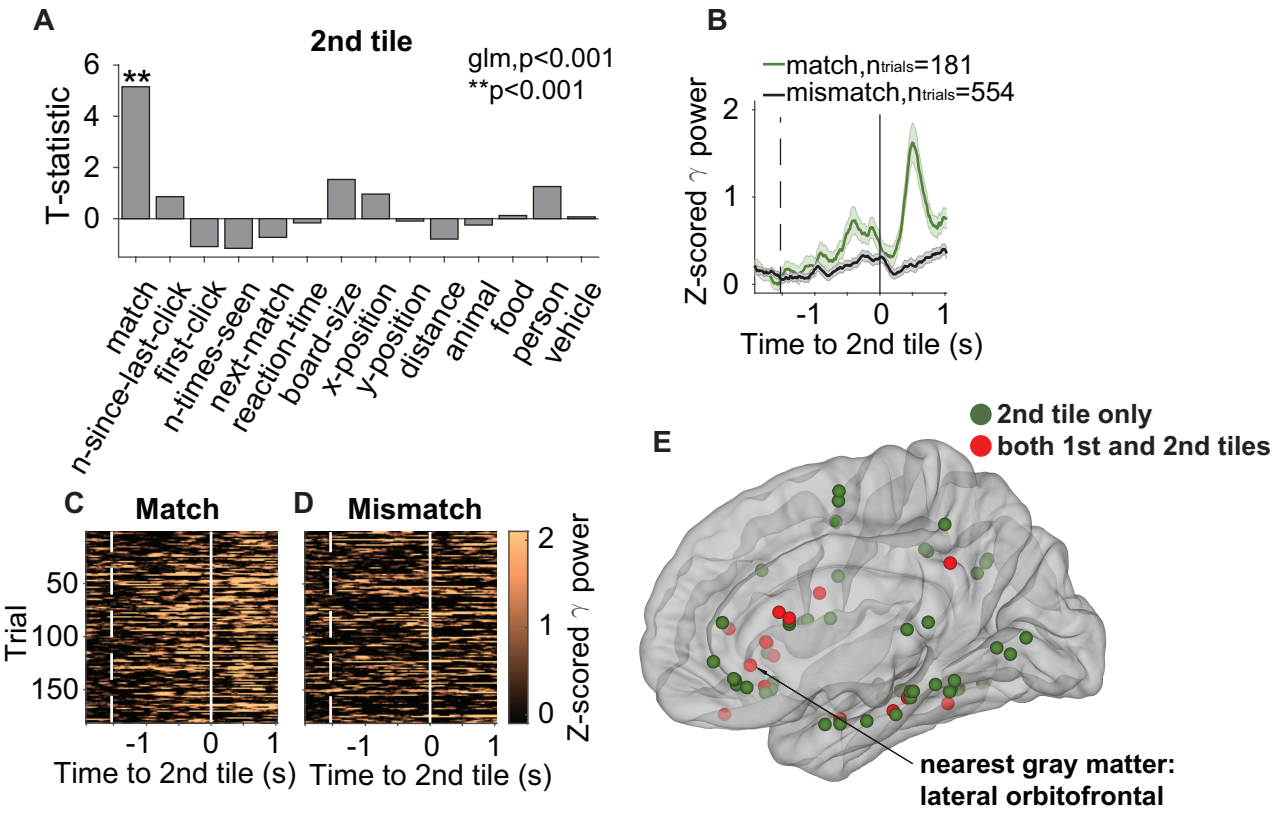

Figure S12. Neural signals in the white matter after the second tile reflect correct retrieval

Panels show an example electrode located in the white matter whose closest gray matter region is the right LOF (see arrow in part **E**).

A. T-statistic of each predictor in the GLM analysis for the responses after the 2nd tile. Asterisks indicate statistically significant predictors of neural signals.

B. Z-scored gamma band power aligned to the onset of the 2nd tile (solid vertical line) for match (green) and mismatch (black) trials. The dashed line indicates the mean onset of the 1st tile.

C-D. Raster plots showing the gamma band power in individual trials for match (left) and mismatch (right) trials.

E. Locations of all the white matter electrodes where match was a significant predictor during the 2nd tile only (green) and during both tiles (red). All electrodes were reflected on one hemisphere for display purposes.

Figure S13

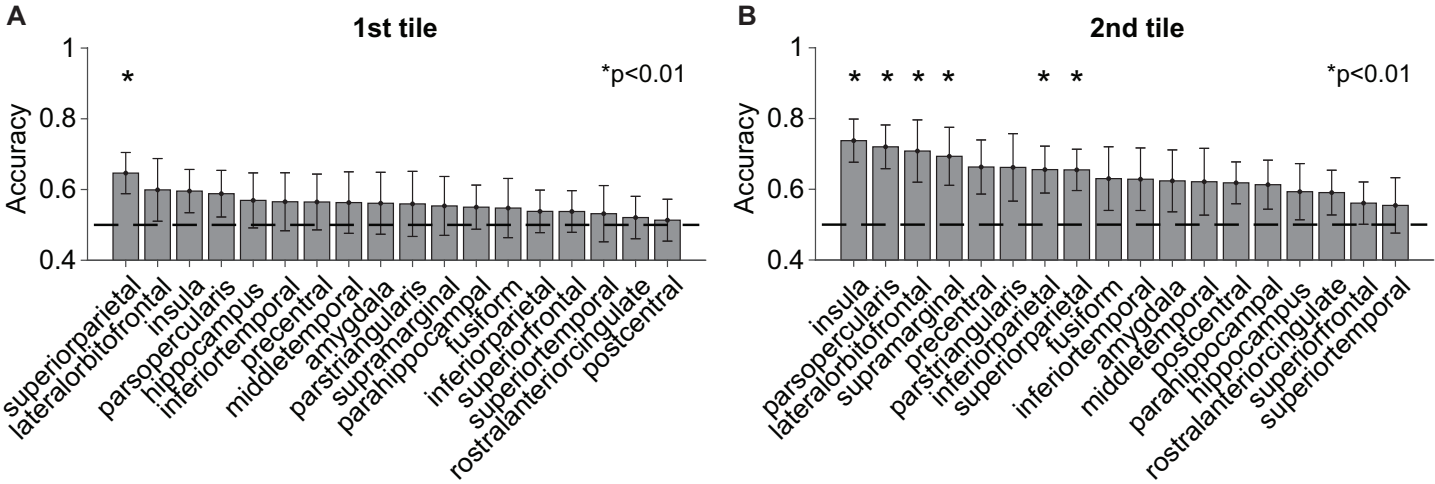

Figure S13. Decoding of match versus mismatch with random subsampling of 12 channels in each brain region.

Average decoding accuracy of each brain region (**Methods**) using neural responses after the 1st tile (**A**) and the 2nd tile (**B)**. The format follows **Figure 7**. Brain regions are ordered from higher to lower average decoding accuracy. Dashed horizontal lines indicate chance accuracy. Asterisks denote significant decoding accuracy above chance (α=0.01). All error bars indicate SD (n=1,000 iterations).

Table 1. Predictors in the generalized linear models, their definitions, and applicable tiles.

Predictor	Description	Which tile
match	Whether the trial was a match or mismatch	both
n-since-pair*match	how many clicks ago the tile's pair was clicked (matched trials only)	1st
n-since-last-click	how many clicks ago the same tile was clicked	both
first-click	Whether a tile was clicked the very first time	both
n-times-seen	number of times the same image had been previously clicked	both
next-match	whether the next trial was a match or mismatch	both
reaction-time	time between the 1st and 2nd tile	both
board-size	Total number of tiles in the current block	both
x-position	x position in pixel	both
y-position	y position in pixel	both
distance	distance between the 2nd tile of the current trial and the 1st tile of the next trial in pixel	both
animal	image belonged to animal category	both
food	image belonged to food category	both
person	image belonged to person category	both
vehicle	image belonged to vehicle category	both

Table S1: Information about each participant: hospital where data were recorded, gender, age, total number of electrodes implanted, number of electrodes analyzed in the gray matter, and number of electrodes analyzed in the white matter. All participants were right-handed.

Subject No.	Hospital	Gender	Age	# electrodes	# gray matter electrodes analyzed	# white matter electrodes analyzed
1	Xuanwu	female	22	85	37	21
2	Xuanwu	male	32	53	21	11
3	Xuanwu	male	19	114	32	68
4	Xuanwu	male	33	61	22	21
5	Xuanwu	male	35	71	28	27
6	Xuanwu	male	21	83	34	28
7	Xuanwu	male	26	86	34	35
8	Xuanwu	male	23	78	23	15
9	Xuanwu	female	47	34	11	4
10	Xuanwu	female	21	61	35	12
11	Xuanwu	female	26	78	17	9
12	BWH	female	32	51	29	0
13	BWH	female	31	74	24	19
14	BWH	female	26	60	15	15
15	BWH	male	22	104	30	21
16	BWH	female	52	98	35	28
17	BWH	male	44	58	20	9
18	BCH	male	18	154	85	26
19	BCH	female	12	188	97	46
20	BCH	male	15	159	47	77

Table S2: Distribution of electrode locations per hemisphere and brain region for the gray matter (left) and white matter (right). The location of any white matter electrode was based on its nearest gray matter region.

Gray matter				White matter (closest gray matter)			
Region	**Left**	**Right**	**Total**	**Region**	**Left**	**Right**	**Total**
amygdala	21	24	45	amygdala	0	0	0
bankssts	0	7	7	bankssts	5	2	7
caudalanteriorcingulate	1	3	4	caudalanteriorcingulate	1	0	1
caudalmiddlefrontal	1	5	6	caudalmiddlefrontal	1	7	8
entorhinal	5	0	5	cuneus	1	1	2
fusiform	15	10	25	entorhinal	2	2	4
hippocampus	36	31	67	fusiform	21	14	35
inferiorparietal	11	8	19	inferiorparietal	7	3	10
inferiortemporal	14	9	23	inferiortemporal	31	16	47
insula	13	15	28	insula	11	12	23
isthmuscingulate	6	0	6	isthmuscingulate	1	0	1
lateraloccipital	3	2	5	lateraloccipital	2	3	5
lateralorbitofrontal	19	32	51	lateralorbitofrontal	23	30	53
lingual	3	2	5	lingual	2	2	4
medialorbitofrontal	4	7	11	medialorbitofrontal	6	8	14
middletemporal	53	38	91	middletemporal	31	21	52
paracentral	4	0	4	paracentral	3	3	6
parahippocampal	10	13	23	parahippocampal	6	5	11
parsopercularis	11	5	16	parsopercularis	5	3	8
parsorbitalis	2	3	5	parsorbitalis	4	7	11
parstriangularis	13	19	32	parstriangularis	10	10	20
pericalcarine	0	1	1	pericalcarine	4	0	4
postcentral	8	12	20	postcentral	6	0	6
posteriorcingulate	4	3	7	posteriorcingulate	10	1	11
precentral	8	21	29	precentral	11	15	26
precuneus	3	0	3	precuneus	12	3	15
rostralanteriorcingulate	7	7	14	rostralanteriorcingulate	3	3	6
rostralmiddlefrontal	1	4	5	rostralmiddlefrontal	2	7	9
superiorfrontal	13	19	32	superiorfrontal	10	18	28
superiorparietal	8	12	20	superiorparietal	10	7	17
superiortemporal	26	21	47	superiortemporal	21	13	34
supramarginal	10	4	14	supramarginal	4	4	8
transversetemporal	6	0	6	transversetemporal	6	0	6
Total	**339**	**337**	**676**	**Total**	**272**	**220**	**492**

Table S3A. First tile GLM analysis for all gray matter electrodes that showed first-click as a significant predictor. Each column (starting from column 4) shows a separate predictor. Yellow rows indicate the example electrodes in **Figure 4** (first and second rows) and **Figure S4** (third row)**.** *: $p<0.01$. **: $p<0.001$. X: most significant predictor.

Region	Sub	Channel	match	n-since-pair* match	n-since-last-click	first-click	n-times-seen	next-match	RT	board-size	x-position	y-position	distance	animal	food	person	vehicle
Amygdala	7	3				* X											
Amygdala	15	81				*										** X	
bankssts	18	131				** X											
caudalmiddlefrontal	12	43				** X											
fusiform	1	42				*				*							** X
fusiform	3	11			*	*			**					** X			
fusiform	6	11			** X	*											*
fusiform	8	63			**	** X											
fusiform	16	92				* X											
inferiorparietal	3	71			** X	**			**							*	
inferiorparietal	18	150			** X	**				**		*					
inferiorparietal	18	151			** X	**					*					*	
inferiortemporal	18	143	*		**	** X											
inferiortemporal	18	144			** X	*											
insula	3	50				* X											
lateraloccipital	20	5				**			** X		*			*		*	
lateralorbitofrontal	3	40				** X			**	*			*				
lateralorbitofrontal	14	32				* X	*										
lateralorbitofrontal	15	22			** X	**		*	*			*					
lateralorbitofrontal	18	5				**				** X							
lateralorbitofrontal	18	6		*		** X				**							
lateralorbitofrontal	18	7				** X				*							
lateralorbitofrontal	18	20				** X	*										
lateralorbitofrontal	18	21				** X											
lateralorbitofrontal	18	22				** X											
lateralorbitofrontal	18	25	*		*	* X				*							
lateralorbitofrontal	18	26	**	**	**	** X				*							
lateralorbitofrontal	19	41				* X											
medialorbitofrontal	18	18				* X				*							
medialorbitofrontal	18	19				** X											
middletemporal	18	108				** X											
middletemporal	18	110	** X	*		*										*	
middletemporal	18	134			*	* X											
middletemporal	18	148				** X											
parahippocampal	9	27				* X											
parsopercularis	8	22			** X	**			**					*			
parsopercularis	8	23			**	** X			**							**	
parsopercularis	11	78			*	** X		*						*			*
parsopercularis	18	30				** X											
parsopercularis	18	32			*	** X											
parstriangularis	18	11				*				*				* X		*	
parstriangularis	18	13				**							** X				
parstriangularis	18	14				** X							*				
precentral	15	15			*	** X			**								
precentral	15	16			**	** X				**							
precentral	18	38				** X											
precentral	12	42				** X											
rostralmiddlefrontal	8	24			**	** X			**							*	
superiortemporal	2	44			*	** X											
supramarginal	2	32	** X	**		*	**		**				*				

Table S3B. First tile GLM analysis for all white matter electrodes that showed first-click as a significant predictor. Each column (starting from column 4) shows a separate predictor. Yellow row indicates the example electrode in **Figure S4**. *: p<0.01. **: p<0.001. X: most significant predictor.

Region	Sub	Channel	match	n-since-pair* match	n-since-last-click	first-click	n-times-seen	next-match	RT	board-size	x-position	y-position	distance	animal	food	person	vehicle
caudalanteriorcingulate	8	21	**		** X	**			**								
fusiform	3	28			** X	**			**				*			**	
fusiform	18	106				* X											
fusiform	18	138			**	** X				**	**					*	
fusiform	18	139			**	** X				*	*						
fusiform	18	140			**	** X			**	**	*						
fusiform	18	141			**	** X				*							
fusiform	18	142	*		**	** X				*							
inferiortemporal	1	43				*											** X
inferiortemporal	1	69				* X		*									
inferiortemporal	1	82				** X		*									
inferiortemporal	6	58				** X	**										
inferiortemporal	7	39			**	*			** X		*						
inferiortemporal	18	107				** X											
lateralorbitofrontal	15	21			** X	**			*								
lateralorbitofrontal	15	23			** X	*											
lateralorbitofrontal	18	4				** X											
lateralorbitofrontal	18	10				** X											
lateralorbitofrontal	18	23				** X											
lateralorbitofrontal	18	24				** X											
parahippocampal	1	10				*			*					** X	**	**	*
parsopercularis	18	31				** X		*									
parstriangularis	16	8				** X							*				
rostralmiddlefrontal	3	80				** X											
rostralmiddlefrontal	15	3			** X	**											
superiorfrontal	15	10				*			** X								
superiorparietal	3	20	*			*				* X							
superiorparietal	3	23			** X	**			*								
superiorparietal	3	70			** X	**											
superiorparietal	3	72			** X	**			*								
superiorparietal	3	73			** X	**			**		*						
superiortemporal	2	40				* X											
superiortemporal	2	43			**	** X											**

Table S4A. First tile GLM analysis for all gray matter electrodes that showed n-since-last-click as a significant predictor. Each column (starting from column 4) shows a separate predictor. Yellow rows indicate the example electrodes in **Figure 4E-H** (first row) and **Figure S5** (second row).*: p<0.01. **: p<0.001. X: most significant predictor.

Region	Sub	Channel	match	n-since-pair* match	n-since-last-click	first-click	n-times-seen	next-match	RT	board-size	x-position	y-position	distance	animal	food	person	vehicle
Hippocampus	6	6			*		* X										
bankssts	16	41			*									*		** X	
bankssts	16	42			*									*	*	** X	
entorhinal	6	27	*		* X												
fusiform	2	13			* X												
fusiform	3	11			*	*			**					** X			
fusiform	6	11			** X	*											*
fusiform	8	63			**	** X											
inferiorparietal	3	71			** X	**			**							*	
inferiorparietal	18	150			** X	**				**		*					
inferiorparietal	18	151			** X	**					*					*	
inferiorparietal	18	152			** X												
inferiortemporal	7	38	*		*				** X		*						
inferiortemporal	18	143	*		**	** X											
inferiortemporal	18	144			** X	*											
insula	18	27	**	**	** X												
insula	18	28	**	**	** X												
insula	18	29	**	**	** X												
insula	18	34			**					** X							
lateralorbitofrontal	15	22			** X	**		*	*			*					
lateralorbitofrontal	15	73			*				**							** X	
lateralorbitofrontal	18	25	*		*	* X				*							
lateralorbitofrontal	18	26	**	**	**	** X				*							
middletemporal	11	45		*	* X			*									
middletemporal	14	48			* X												
middletemporal	16	24			*				*					** X			
middletemporal	18	134			*	* X											
parahippocampal	6	8			**												** X
parahippocampal	6	9			**							**					** X
parahippocampal	10	8			* X												
parsopercularis	8	22			** X	**			**					*			
parsopercularis	8	23			**	** X			**							**	
parsopercularis	11	78			*	** X		*						*			*
parsopercularis	18	32			*	** X											
parstriangularis	10	59			** X												
postcentral	12	39			*				* X			*					
postcentral	12	49			** X												
precentral	15	15			*	** X			**								
precentral	15	16			**	** X				**							
rostralmiddlefrontal	8	24			**	** X			**							*	
superiorfrontal	12	6			**				** X								
superiorparietal	3	111			*				*		** X						
superiorparietal	3	112			*				* X								
superiortemporal	2	44			*	** X											
supramarginal	2	37			*				** X				**				

Table S4B. First tile GLM analysis for all white matter electrodes that showed n-since-last-click as a significant predictor. Each column (starting from column 4) shows a separate predictor. Yellow row indicates the example electrode in **FigureS4**. *: p<0.01. **: p<0.001. X: most significant predictor.

Region	Sub	Channel	match	n-since-pair* match	n-since-last-click	first-click	n-times-seen	next-match	RT	board-size	x-position	y-position	distance	animal	food	person	vehicle
caudalanteriorcingulate	8	21	**		** X	**			**								
fusiform	3	12			**				**					** X		**	
fusiform	3	28			** X	**			**				*			**	
fusiform	6	12			*					*				** X	*	**	
fusiform	6	53			** X											**	**
fusiform	18	138			**	** X				**	**					*	
fusiform	18	139			**	** X				*	*						
fusiform	18	140			**	** X			**	**	*						
fusiform	18	141			**	** X				*							
fusiform	18	142	*		**	** X				*							
inferiortemporal	7	39			**	*			** X		*						
inferiortemporal	7	40			*										**	** X	
inferiortemporal	7	41			*				**					** X	**	**	
lateralorbitofrontal	6	66			* X												
lateralorbitofrontal	6	67			**				** X								
lateralorbitofrontal	6	68			*												** X
lateralorbitofrontal	13	31			* X				*								
lateralorbitofrontal	15	21			** X	**			*								
lateralorbitofrontal	15	23			** X	*											
lateralorbitofrontal	15	74	*		**										*	** X	
lateralorbitofrontal	15	75			* X												
middletemporal	5	66			* X												
parahippocampal	6	50	*		** X												
parsorbitalis	15	76	** X		*												
parstriangularis	4	49	** X		*				*								
precentral	4	59	* X		*												
rostralmiddlefrontal	15	3			** X	**											
superiorparietal	3	23			** X	**			*								
superiorparietal	3	70			** X	**											
superiorparietal	3	72			** X	**			*								
superiorparietal	3	73			** X	**			**		*						
superiortemporal	2	43			**	** X											**

Table S5A. First tile GLM analysis for all gray matter electrodes that showed match as a significant predictor. Each column (starting from column 4) shows a separate predictor. Yellow rows indicate the example electrodes in **Figure 5** (first row), **Figure S7** (first row), and **Figure S8** (second row).*: p<0.01. **: p<0.001. X: most significant predictor.

Region	Subject	Channel	match	n-since-pair* match	n-since-last-click	first-click	n-times-seen	next-match	RT	board-size	x-position	y-position	distance	animal	food	person	vehicle
Hippocampus	2	47	* X														
Hippocampus	16	28	** X														
bankssts	4	36	* X												*		
entorhinal	6	27	*		* X												
fusiform	6	10	*														* X
inferiortemporal	7	18	** X														
inferiortemporal	7	38	*		*				** X		*						
inferiortemporal	18	143	*		**	** X											
insula	18	27	**	**	** X												
insula	18	28	**	**	** X												
insula	18	29	**	**	** X												
insula	19	55	* X														
lateralorbitofrontal	4	39	* X											*			
lateralorbitofrontal	4	42	* X														
lateralorbitofrontal	4	43	** X														
lateralorbitofrontal	4	45	** X								*						
lateralorbitofrontal	10	46	** X														
lateralorbitofrontal	18	25	*		*	* X				*							
lateralorbitofrontal	18	26	**	**	**	** X				*							
middletemporal	2	52	** X	**													
middletemporal	8	37	*				*									** X	
middletemporal	13	45	**						*			*	** X				
middletemporal	18	109	* X														
middletemporal	18	110	** X	*		*										*	
parahippocampal	10	7	** X	*													
parsopercularis	6	82	** X					*	*								
parsopercularis	6	83	** X	*													
parsopercularis	10	57	** X							*							
precentral	19	106	** X	*												*	
precuneus	1	77	** X	*													
rostralanteriorcingulate	9	34	** X														
supramarginal	2	32	** X	**		*	**		**				*				

Table S5B. First tile GLM analysis for all white matter electrodes that showed match as a significant predictor. Each column (starting from column 4) shows a separate predictor. Yellow row indicates the example electrode in **Figure S6**. *: p<0.01. **: p<0.001. X: most significant predictor.

Region	Sub	Channel	match	n-since-pair* match	n-since-last-click	first-click	n-times-seen	next-match	RT	board-size	x-position	y-position	distance	animal	food	person	vehicle
caudalanteriorcingulate	8	21	**		** X	**			**								
entorhinal	10	19	** X														
fusiform	18	142	*		**	** X				*							
inferiortemporal	6	57	** X														
inferiortemporal	7	19	* X														
inferiortemporal	7	63	* X														
lateralorbitofrontal	4	41	** X														
lateralorbitofrontal	4	44	* X														
lateralorbitofrontal	10	55	** X	**			*										
lateralorbitofrontal	14	34	** X														
lateralorbitofrontal	14	36	** X	*			*										*
lateralorbitofrontal	15	74	*		**										*	** X	
lingual	11	60	*								**	*		**		** X	
medialorbitofrontal	11	63	** X					*									
middletemporal	9	24	** X														
middletemporal	13	44	*						*			*	** X				
parahippocampal	6	50	*		** X												
parsopercularis	6	81	** X	**													
parsorbitalis	15	76	** X		*												
parstriangularis	4	49	** X		*				*								
parstriangularis	7	82	** X	*													
parstriangularis	7	84	** X	**													
precentral	4	55	** X														
precentral	4	56	** X														
precentral	4	57	** X	*													
precentral	4	58	** X														
precentral	4	59	* X		*												
superiorparietal	3	20	*			*				* X							
superiortemporal	6	19	*					*			* X		*				
supramarginal	2	31	** X	**					*								

Table S6A. First tile GLM analysis for all gray matter electrodes that showed n-since-pair*match as a significant predictor. Each column (starting from column 4) shows a separate predictor. Yellow row indicates the example electrode in **Figure 6**.*: p<0.01. **: p<0.001. X: most significant predictor.

Region	Sub	Channel	match	n-since-pair* match	n-since-last-click	first-click	n-times-seen	next-match	RT	board-size	x-position	y-position	distance	animal	food	person	vehicle
insula	18	27	**	**	** X												
insula	18	28	**	**	** X												
insula	18	29	**	**	** X												
lateralorbitofrontal	18	3		* X													
lateralorbitofrontal	18	6		*		** X				**							
lateralorbitofrontal	18	26	**	**	**	** X				*							
medialorbitofrontal	18	2		* X													
middletemporal	2	52	** X	**													
middletemporal	11	45		*	* X			*									
middletemporal	18	110	** X	*		*										*	
parahippocampal	10	7	** X	*													
parsopercularis	6	83	** X	*													
precentral	19	106	** X	*												*	
precuneus	1	77	** X	*													
supramarginal	2	32	** X	**		*	**		**				*				

Table S6B. First tile GLM analysis for all white matter electrodes that showed n-since-pair*match as a significant predictor. Each column (starting from column 4) shows a separate predictor. Yellow row indicates the example electrode in **Figure S9**. *: p<0.01. **: p<0.001. X: most significant predictor.

Region	Sub	Channel	match	n-since-pair* match	n-since-last-click	first-click	n-times-seen	next-match	RT	board-size	x-position	y-position	distance	animal	food	person	vehicle
lateralorbitofrontal	10	55	** X	**			*										
lateralorbitofrontal	14	6		** X									*				
lateralorbitofrontal	14	36	** X	*			*										*
middletemporal	18	60		*						* X		*					
parsopercularis	6	81	** X	**													
parstriangularis	7	82	** X	*													
parstriangularis	7	84	** X	**													
precentral	4	57	** X	*													
supramarginal	2	31	** X	**					*								

Table S7A. Second tile GLM analysis for all gray matter electrodes that showed first-click as a significant predictor. Each column (starting from column 4) shows a separate predictor. *: p<0.01. **: p<0.001. X: most significant predictor.

Region	Sub	Channel	match	n-since-last-click	first-click	n-times-seen	next-match	RT	board-size	x-position	y-position	distance	animal	food	person	vehicle
Amygdala	10	10			* X											
Hippocampus	18	104	** X		**											
bankssts	18	131	*		*			** X	*							
fusiform	3	11		*	*								** X			
fusiform	10	37			*											** X
insula	18	27	** X		**	*		*								
insula	18	28	** X		*	*										
lateraloccipital	20	4			* X											
lateraloccipital	20	5			** X											
lateralorbitofrontal	15	22	*	**	**		*							**		** X
lateralorbitofrontal	18	5			* X				*							
lateralorbitofrontal	18	25	**		** X	**		**								
lateralorbitofrontal	18	26	**	*	** X	**		**								
lingual	1	12	*		*						** X			*		
parahippocampal	9	27			*				** X							
parsopercularis	8	22	**	**	**			** X	**				**			
parsopercularis	8	23	**		**			** X	**							
postcentral	20	83			* X					*						
postcentral	20	84		*	* X											
precentral	18	40			* X	*						*				
precentral	12	24	*	*	* X											
precuneus	1	77			*		** X									
rostralmiddlefrontal	8	24	** X	*	**			**								
superiortemporal	18	119			* X						*					

Table S7B. Second tile GLM analysis for all white matter electrodes that showed first-click as a significant predictor. Each column (starting from column 4) shows a separate predictor. *: p<0.01. **: p<0.001. X: most significant predictor.

Region	Sub	Channel	match	n-since-last-click	first-click	n-times-seen	next-match	RT	board-size	x-position	y-position	distance	animal	food	person	vehicle
caudalanteriorcingulate	8	21	**	**	*			** X								
fusiform	18	138	** X	**	*				**	*					*	
inferiorparietal	20	15			** X											
lateralorbitofrontal	6	68		*	** X	*										
lateralorbitofrontal	15	23		*	**											** X
lateralorbitofrontal	18	24	**	*	** X	*										
parstriangularis	16	7			** X											
parstriangularis	16	9			** X											
posteriorcingulate	20	123			** X			*								
precentral	4	54			* X											
precentral	4	57			*		* X									
precentral	4	58			*		** X									

Table S8A. Second tile GLM analysis for all gray matter electrodes that showed n-since-last-click as a significant predictor. Each column (starting from column 4) shows a separate predictor. Yellow row indicates the example electrode in **Figure S10**. *: p<0.01. **: p<0.001. X: most significant predictor.

Region	Sub	Channel	match	n-since-last-click	first-click	n-times-seen	next-match	RT	board-size	x-position	y-position	distance	animal	food	person	vehicle
fusiform	3	11		*	*								** X			
lateralorbitofrontal	122	46		* X												
lateralorbitofrontal	15	22	*	**	**		*							**		** X
lateralorbitofrontal	18	9	** X	*				**	*							
lateralorbitofrontal	18	26	**	*	** X	**		**								
parsopercularis	8	22	**	**	**			** X	**				**			
postcentral	20	84		*	* X											
precentral	12	24	*	*	* X											
rostralmiddlefrontal	8	24	** X	*	**			**								

Table S8B. Second tile GLM analysis for all white matter electrodes that showed n-since-last-click as a significant predictor. Each column (starting from column 4) shows a separate predictor. *: p<0.01. **: p<0.001. X: most significant predictor.

Region	Sub	Channel	match	n-since-last-click	first-click	n-times-seen	next-match	RT	board-size	x-position	y-position	distance	animal	food	person	vehicle
caudalanteriorcingulate	8	21	**	**	*			** X								
caudalmiddlefrontal	3	90		** X			*									
fusiform	3	28		**				*							** X	
fusiform	6	12	**	**									** X	*	*	
fusiform	6	53		*				**							** X	*
fusiform	18	138	** X	**	*				**	*					*	
fusiform	18	139	** X	**				*		*						
fusiform	18	140	** X	*				**		**						
fusiform	18	141	** X	**				**		*						
lateralorbitofrontal	6	68		*	** X	*										
lateralorbitofrontal	15	21	** X	*												
lateralorbitofrontal	15	23		*	**											** X
lateralorbitofrontal	15	74		*				** X							*	
lateralorbitofrontal	18	24	**	*	** X	*										
middletemporal	7	10		* X												
middletemporal	7	66		*										* X	*	
middletemporal	7	67	* X	*							*					
parahippocampal	6	50	*	** X												
parsorbitalis	6	71		* X												
parsorbitalis	15	76		*				*								** X
parstriangularis	2	28		* X												
parstriangularis	2	29		*												* X
parstriangularis	7	83	** X	*			*									
superiorparietal	3	72	** X	*					*						*	

Table S9A. Second tile GLM analysis for all gray matter electrodes that showed match as a significant predictor. Each column (starting from column 4) shows a separate predictor. Yellow row indicates the example electrode in **Figure 7** and **Figure S9**. *: p<0.01. **: p<0.001. X: most significant predictor.

Region	Sub	Channel	match	n-since-last-click	first-click	n-times-seen	next-match	RT	board-size	x-position	y-position	distance	animal	food	person	vehicle
Amygdala	6	16	*				* X									
Amygdala	7	4	** X													
Amygdala	8	51	** X													
Hippocampus	2	47	* X			*										
Hippocampus	16	28	** X													
Hippocampus	18	102	** X													
Hippocampus	18	103	** X													
Hippocampus	18	104	** X		**											
Hippocampus	18	105	** X													
bankssts	16	42	*											* X		
bankssts	18	131	*		*			** X	*							
bankssts	18	132	** X					**	*							
caudalmiddlefrontal	13	69	** X							*						
caudalmiddlefrontal	13	73	** X													
entorhinal	19	2	*									* X				
inferiorparietal	3	60	** X						*							
inferiorparietal	3	71	** X					**					*		**	
inferiorparietal	16	62	** X						*							
inferiorparietal	16	63	** X													
inferiortemporal	1	65	* X													
inferiortemporal	1	66	*					*							*	* X
inferiortemporal	7	21	** X													
inferiortemporal	7	37	* X					*								
inferiortemporal	7	38	** X					**								
insula	3	50	** X													
insula	6	77	** X					*								
insula	7	79	** X													
insula	7	80	** X													
insula	18	27	** X		**	*		*								
insula	18	28	** X		*	*										
insula	18	29	** X													
insula	18	44	** X													
insula	18	45	** X													
insula	19	55	** X													
insula	19	104	* X					*								
insula	20	151	* X													
lateraloccipital	16	81	*					** X								
lateralorbitofrontal	4	39	** X													
lateralorbitofrontal	4	43	** X													
lateralorbitofrontal	4	45	** X													
lateralorbitofrontal	10	40	** X													
lateralorbitofrontal	10	43	** X													
lateralorbitofrontal	10	46	** X													

Table S9A continued...

lateralorbitofrontal	13	28	** X													
lateralorbitofrontal	13	29	** X				*									
lateralorbitofrontal	13	30	** X				**									
lateralorbitofrontal	15	22	*	**	**		*							**		** X
lateralorbitofrontal	18	3	** X					**			*					
lateralorbitofrontal	18	7	** X						**							
lateralorbitofrontal	18	8	** X					**	**							
lateralorbitofrontal	18	9	** X	*				**	*							
lateralorbitofrontal	18	20	** X						*							
lateralorbitofrontal	18	21	** X													
lateralorbitofrontal	18	22	** X											*		
lateralorbitofrontal	18	25	**		** X	**		**								
lateralorbitofrontal	18	26	**	*	** X	**		**								
lateralorbitofrontal	19	41	* X													
lateralorbitofrontal	19	54	* X													
lingual	1	12	*		*						** X			*		
medialorbitofrontal	18	2	** X					**	**							
medialorbitofrontal	18	18	** X													
medialorbitofrontal	18	19	** X						*							
middletemporal	1	60	** X								*					
middletemporal	2	52	** X													
middletemporal	9	32	** X													
middletemporal	13	19	* X													
middletemporal	13	45	** X													
middletemporal	16	22	* X													
middletemporal	16	23	* X													
middletemporal	16	24	* X													
middletemporal	18	108	** X													
middletemporal	18	109	** X													
middletemporal	18	133	** X						**		**					
middletemporal	18	134	** X								**					
middletemporal	18	135	** X						**		**					
middletemporal	18	148	* X													
parahippocampal	6	8	**										*	**	*	** X
parahippocampal	6	9	*										*			** X

Table S9A continued ...

parsopercularis	6	78	** X					*		**		**				
parsopercularis	8	22	**	**	**			** X	**				**			
parsopercularis	8	23	**		**			** X	**							
parsopercularis	18	30	** X			*			*							
parsopercularis	18	32	**					** X	*							
parsopercularis	20	50	* X													
parstriangularis	2	25	** X													
parstriangularis	6	74	** X					**								
parstriangularis	6	75	** X					**								
parstriangularis	10	59	** X													
parstriangularis	18	11	* X													
parstriangularis	18	12	** X					**	*							
parstriangularis	18	13	** X									*				
parstriangularis	18	14	** X					**	*							
postcentral	18	35	** X													
postcentral	12	39	* X													
posteriorcingulate	20	73	* X			*										
precentral	122	32	* X			*										
precentral	122	33	** X													
precentral	15	16	** X							*						
precentral	16	50	** X													
precentral	16	53	** X													
precentral	18	36	** X										*			
precentral	12	24	*	*	* X											
rostralanteriorcingulate	9	34	** X													
rostralmiddlefrontal	8	24	** X	*	**			**								
superiorfrontal	19	175	** X					*								
superiorfrontal	12	6	*					** X								
superiorparietal	16	61	** X					*	*							
superiorparietal	20	129	** X													
superiorparietal	20	130	** X													*
supramarginal	2	37	* X													
supramarginal	16	64	** X													
supramarginal	16	65	** X													

Table S9B. Second tile GLM analysis for all white matter electrodes that showed match as a significant predictor. Each column (starting from column 4) shows a separate predictor. Yellow row indicates the example electrode in **Figure S11**. *: p<0.01. **: p<0.001. X: most significant predictor.

Region	Sub	Channel	match	n-since-last-click	first-click	n-times-seen	next-match	RT	board-size	x-position	y-position	distance	animal	food	person	vehicle
caudalanteriorcingulate	8	21	**	**	*			** X								
fusiform	6	12	**	**									** X	*	*	
fusiform	7	5	** X													
fusiform	7	6	* X													
fusiform	18	106	** X													
fusiform	18	138	** X	**	*				**	*					*	
fusiform	18	139	** X	**				*		*						
fusiform	18	140	** X	*				**		**						
fusiform	18	141	** X	**				**		*						
inferiorparietal	3	59	** X													
inferiortemporal	1	69	** X				*					*				
inferiortemporal	1	81	** X													
inferiortemporal	6	42	** X				*	**								
inferiortemporal	6	57	** X													
inferiortemporal	6	58	** X													
inferiortemporal	6	59	* X													
inferiortemporal	6	60	*					* X								
inferiortemporal	7	39	** X					**								
inferiortemporal	18	107	** X													
inferiortemporal	18	147	* X						*							
insula	3	49	** X													
lateralorbitofrontal	4	40	** X													
lateralorbitofrontal	4	41	** X													
lateralorbitofrontal	4	44	** X													
lateralorbitofrontal	6	64	** X								*					
lateralorbitofrontal	6	66	** X													
lateralorbitofrontal	6	67	** X													
lateralorbitofrontal	10	55	** X				**									
lateralorbitofrontal	13	32	*					** X				*				
lateralorbitofrontal	15	21	** X	*												
lateralorbitofrontal	18	23	** X													
lateralorbitofrontal	18	24	**	*	** X	*										
lingual	11	60	*										** X	**	**	
medialorbitofrontal	11	63	** X													
middletemporal	5	9	* X													
middletemporal	7	65	*					*					*	* X		
middletemporal	7	67	* X	*							*					
middletemporal	13	44	** X													
paracentral	3	106	*					*	** X							
parahippocampal	1	10	**										** X	**	**	
parahippocampal	6	50	*	** X												
parsopercularis	6	79	** X									*				
parsopercularis	6	80	** X					*		*						
parsopercularis	6	81	** X					*								
parsopercularis	13	67	** X													
parsorbitalis	5	54	** X													
parstriangularis	4	49	* X													
parstriangularis	7	82	** X				*				*					
parstriangularis	7	83	** X	*			*									
parstriangularis	7	84	** X									*				
pericalcarine	20	1	* X													
precentral	3	54	* X				*									
precentral	3	55	** X				*						*	**		
precentral	4	55	** X					*								
rostralmiddlefrontal	3	80	* X													
rostralmiddlefrontal	15	3	** X													
superiorfrontal	19	173	** X													
superiorfrontal	19	174	** X													
superiorfrontal	19	183	** X													
superiorparietal	3	21	*					** X								
superiorparietal	3	70	* X				*									
superiorparietal	3	72	** X	*					*						*	
superiorparietal	3	73	* X													
superiortemporal	2	43	* X													
supramarginal	2	31	** X				*	**								
transversetemporal	8	10	** X					*								

Supplementary Video 1

This video shows the sequence of events in the task for boards of different size for one of the participants in the experiment. In each trial, participants click on two tiles. If they match, the tiles turn green, otherwise, the tiles turn black again. The goal is to find all matching pairs. See **Methods** for an expanded description of the task.