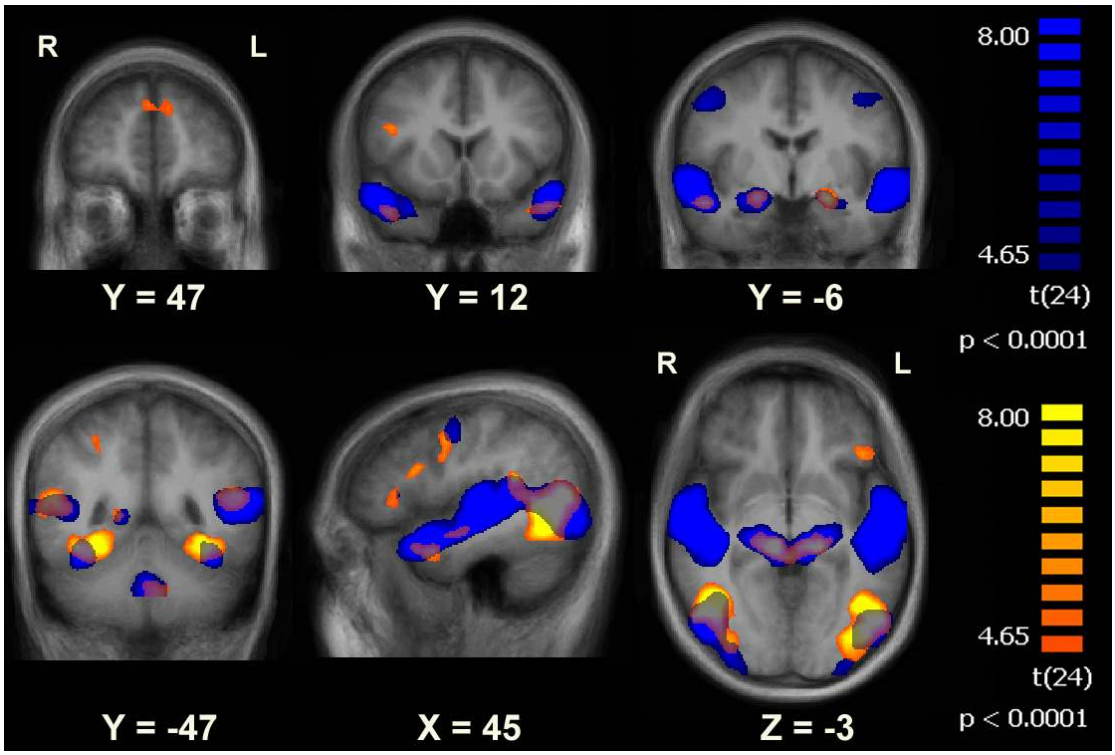
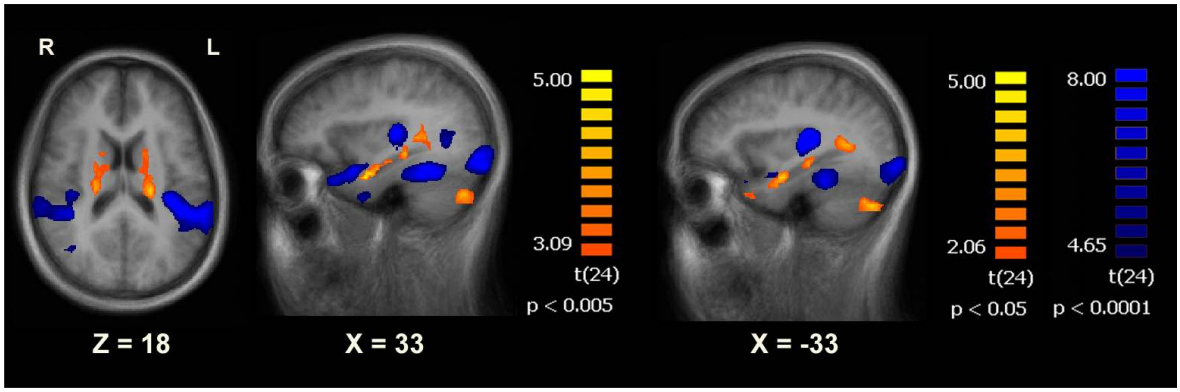
Contrast of Movie>Scrambled clips

In addition to the subsequent memory contrasts (Remembered>Forgotten and R-Blank>F-Blank), we contrasted the narrative movie clips with the scrambled clips, which contain very little "encodable" information (Movie>Scrambled). A comparison of the Movie>Scrambled contrast with the Remembered>Forgotten contrast (below) revealed a large overlap between the two contrasts. Note that the Movie>Scrambled contrast results in further activations in the temporal lobe, not present in the Remembered>Forgotten contrast.



Supplementary Figure 1. Contrast of Movie>Scrambled clips overlaid on the contrast of Remembered>Forgotten (Figure 2. of the manuscript). In yellow-orange: regions showing significantly stronger BOLD activity for Remembered clips when compared to Forgotten clips (Early ROIs; $p<0.0001$, uncorrected, minimal cluster size 5 contiguous functional voxels, GLM with a random effects group analysis, n=25). In blue: regions showing significantly stronger BOLD activity for Movie clips when compared to Scrambled clips ($p<0.0001$, uncorrected, minimal cluster size 5 contiguous functional voxels, GLM with a random effects group analysis, n=25). Data are shown on coronal, sagittal and axial slices of the group-average brain.

When contrasting the online activity of Remembered>Forgotten clips, we found no evidence of online hippocampal activation. As an additional measure, we examined whether the hippocampus would be identified when comparing Movie>Scrambled clips. Below is the contrast of Movie>Scrambled (in blue), overlaid on the R-Blank>F-Blank (in yellow-orange) contrast from which the Delayed ROIs were derived.

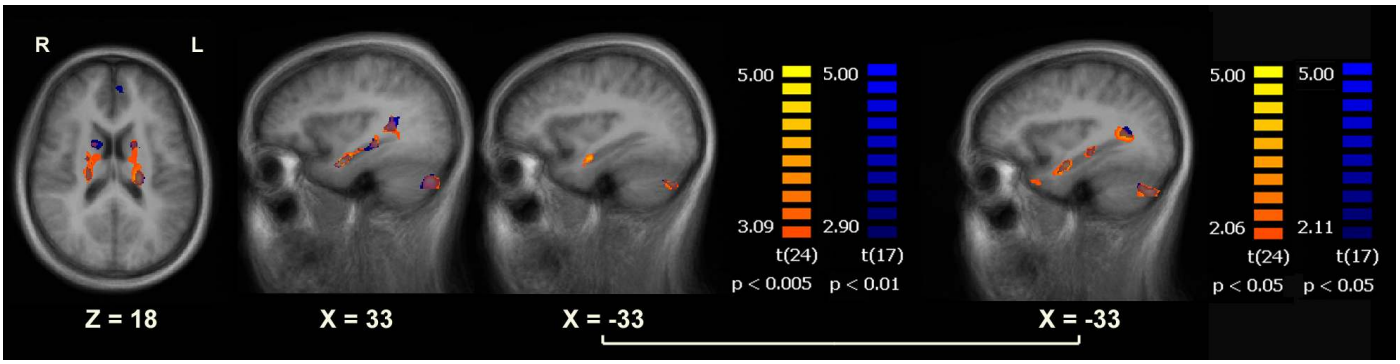


Supplementary Figure 2. Contrast of Movie>Scrambled clips overlaid on the contrast of R-Blank>F-Blank (Figure 3a. of the manuscript). In yellow-orange: regions in Experiment 1 showing a significant difference in BOLD activity between blank screens following Remembered clips (R-Blank) and blank screens following Forgotten clips (F-Blank) in conjunction with F-Blank>baseline (Delayed ROIs; $p<0.005$ for each contrast, uncorrected, minimal cluster size 5 contiguous functional voxels, GLM with a random effects group analysis, n=25). In blue: regions showing significantly stronger BOLD activity for Movie clips when compared to Scrambled clips ($p<0.0001$, uncorrected, minimal cluster size 5 contiguous functional voxels, GLM with a random effects group analysis, n=25). Data are shown on coronal, sagittal and axial slices of the group-average brain. On the right, a slice including the left hippocampus is shown with the same contrast at a more relaxed threshold ($p<0.05$).

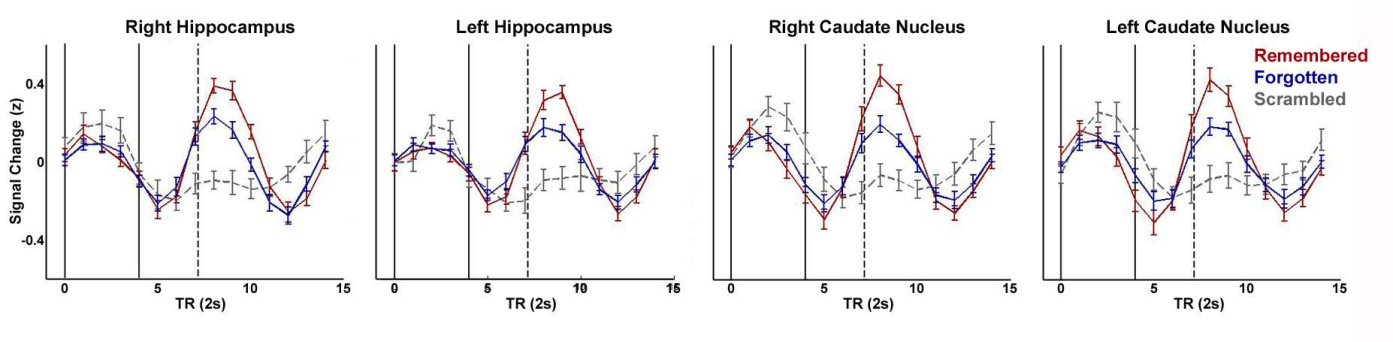
Offline Encoding in the No-Rehearsal Group

A small number of participants reported they engaged in rehearsal of the clips during the blank screens following the clips. In order to verify that our results do not reflect active rehearsal, we re-ran the analysis used to identify offline regions (the contrast of R-Blank>F-Blank) using only participants that did not report significant rehearsal (No-Rehearsal). In the No-Rehearsal analysis a more relaxed threshold was used as there were fewer participants in the analysis. The figure below demonstrates that the same activity is observed when limiting participants to the No-Rehearsal group, indicating our results do not reflect active rehearsal.

a



b

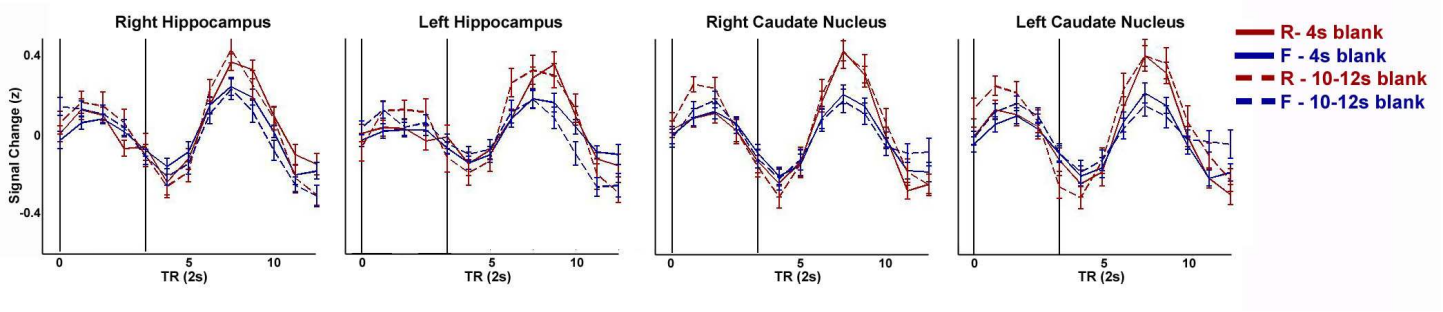


Supplementary Figure 3. Contrast of R-Blank>F-Blank in the No-Rehearsal group (Experiment 1) overlaid on Figure 3a of the manuscript (the same contrast with all participants). (a) In yellow-orange: regions showing a significant difference in BOLD activity in Experiment 1 between blank screens following Remembered clips (R-Blank) and blank screens following Forgotten clips (F-Blank) in conjunction with F-Blank>baseline (Delayed ROIs; $p<0.005$ for each contrast, uncorrected, minimal cluster size 5 contiguous functional voxels, GLM with a random effects group analysis, n=25). Data are shown on axial and sagittal slices of the group-average brain. In blue: the same contrast when run only on participants that reported no significant rehearsal during the blank screens ($p<0.01$ for each contrast, uncorrected, minimal cluster size 5 contiguous functional voxels, GLM with a random effects group analysis, n=18). On the right, a slice including the left hippocampus is shown with the same contrasts at a more relaxed threshold ($p<0.05$). (b) Mean group BOLD signal of the No-Rehearsal group (after z-scoring each time-course) during and following Remembered, Forgotten and Scrambled clips. Error bars show standard error of the mean. The black lines indicate the onset (left line) and offset (right line)

of clip presentation, while the dashed line indicates the mean onset of the following clip. Results are shown for the bilateral hippocampus bodies and bilateral dorsal striatum (dorsal caudate nucleus) derived from the R-Blank>F-Blank contrast of the No-Rehearsal group.

Offline Encoding of Clips Preceding Long vs. Short Blanks

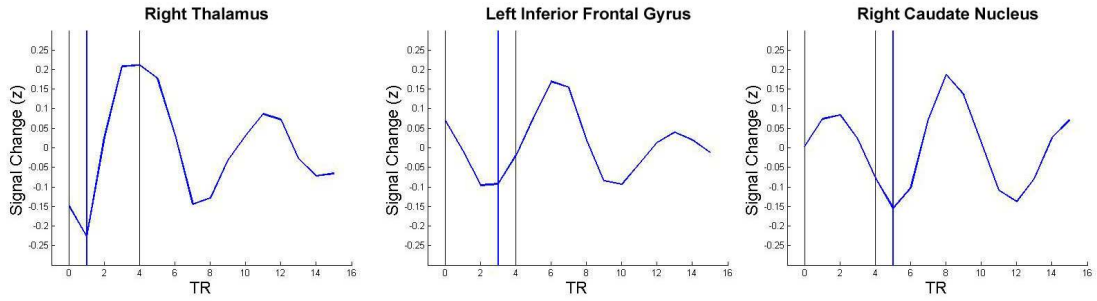
Due to the delay of the hemodynamic response, the peaks of the observed offline activity occurred during the following clips. In order to demonstrate that this activity is truly related to the clip offsets, and not to the following clips, we present below the average BOLD response to Remembered/Forgotten clips when they preceded short/long blank screens.



Supplementary Figure 4. BOLD Response to Remembered and Forgotten clips, separated by the length of the following blank screen. Mean group BOLD signal (after z-scoring each time-course) during and following Remembered, Forgotten and Scrambled clips. Error bars show standard error of the mean. The black lines indicate the onset (left line) and offset (right line) of clip presentation. Clips preceding short (4s) blank screens are plotted against clips preceding long (10-12s) blank screens. Results are shown for the bilateral hippocampus bodies and bilateral dorsal striatum (dorsal caudate nucleus).

Demonstration of Onset Calculation in Representative Regions

In order to demonstrate the results of the onset calculation, below is an estimation of response onset in three representative regions.



Supplementary Figure 5. Response onset estimation in three representative regions. Mean group BOLD signal (after z-scoring each time-course) during clip presentation (regardless of memory performance). The black lines indicate the onset (left line) and offset (right line) of clip presentation, while the blue line indicates the response onset as estimated by the onset calculation method. Results are shown for the right thalamus, left inferior frontal gyrus and right caudate nucleus.

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Supplementary Table 1. T-values of ROI-specific contrasts in Experiments 2&3

Lat	Region	R-Blank > F-Blank		F-Blank baseline		>F-Blank > S-Blank/U-Blank	
Experiment 2 (df=19)		t-value	p-value	t-value	p-value	t-value	p-value
R	Optic Radiations*	2.47	0.01	7.83	$1.1x10^{-7}$	4.65	0.0001
R	Hippocampus Head**	5.02	$3.8x10^{-5}$	7.55	$2x10^{-7}$	8.02	$1x10^{-7}$
R	Hippocampus Body	3.19	0.002	5.60	$1.1x10^{-5}$	4.15	0.0003
R	Posterior Cerebellum	2.94	0.004	3.63	0.0009	5.26	$2.2x10^{-5}$
R	Caudate Nucleus	2.68	0.007	5.01	$3.9x10^{-5}$	4.30	0.0002
L	Caudate Nucleus	2.81	0.006	4.25	0.0002	3.04	0.003
L	Posterior Cerebellum	3.78	0.0006	2.19	0.02	3.74	0.0007
L	Hippocampus Head**	9.48	$1x10^{-8}$	5.38	$1.7x10^{-5}$	4.59	0.0001
L	Hippocampus Body	2.71	0.007	4.42	0.0001	2.73	0.007
Experiment 3 (df=20)							
R	Optic Radiations*	3.78	0.0006	1.72	0.05	3.31	0.002
R	Hippocampus Head**	3.02	0.003	2.54	0.01	3.66	0.0008
R	Hippocampus Body	3.08	0.003	3.02	0.003	5.24	$2x10^{-5}$
R	Posterior Cerebellum	4.21	0.0002	5.51	$1.1x10^{-5}$	3.66	0.0008
R	Caudate Nucleus	2.37	0.014	1.93	0.034	3.83	0.0005
L	Caudate Nucleus	1.67	0.055	1.4	0.09	1.96	0.03
L	Posterior Cerebellum	5.6	$9x10^{-6}$	3.53	0.001	2.24	0.02
L	Hippocampus Head**	2.41	0.013	0.32	0.38	2.98	0.004
L	Hippocampus Body	2.45	0.012	1.2	0.12	3.69	0.0007

* Adjacent to the posterior hippocampus
** Extending to the amygdala-hippocampal junction

Results of contrasting R-Blank>F-Blank, F-Blank>baseline and F-Blank>S-Blank (in Experiment 2) and F-Blank>U-Blank (in Experiment 3). The contrasts were calculated using a one-tailed t-test, corrected for multiple comparisons using Holm-Bonferroni. Above are the t-values and p-values for these contrasts in Experiments 2&3, in the Delayed ROIs (derived from Experiment 1).

Supplementary Table 2. Relation between clip group and response onset in Experiment 2 vs. Experiment 1

Lat	Region	ROI type	Exp1 slope	Exp2 slope	t-value	p-value
R	Optic Radiations*	Delayed	-0.08	1.13	9.4	2.8×10^{-12}
R	Hippocampus Head**	Delayed	-0.08	1	6.86	1×10^{-8}
R	Hippocampus Body	Delayed	-0.09	1.15	6.88	9.5×10^{-9}
R	Posterior Cerebellum	Delayed	-0.06	0.81	3.52	0.0005
R	Caudate Nucleus	Delayed	-0.04	0.85	4.41	3.4×10^{-5}
L	Caudate Nucleus	Delayed	0.1	0.88	3.86	0.0002
L	Hippocampus Head**	Delayed	-0.01	0.96	5.13	3.3×10^{-6}
L	Hippocampus Body	Delayed	-0.09	1.01	4.64	1.6×10^{-5}
R	Temporal Pole	Early	-0.1	0.58	3.6	0.0004
R	Amygdala	Early	-0.09	0.81	5.16	3×10^{-6}
R	Anterior Calcarine Sulcus	Early	-0.18	0.54	2.95	0.003
L	Dorsomedial Prefrontal Cortex	Early	-0.18	0.36	3.12	0.0016
L	Amygdala	Early	-0.14	0.73	4.97	5.5×10^{-6}

* Adjacent to the posterior hippocampus
** Extending to the amygdala-hippocampal junction

The slope of the regression line (of response onset to clip group) in Experiment 2 compared to the slope in Experiment 1 (one-tailed t-test, corrected for multiple comparisons), in all statistically significant ROIs (Delayed ROIs and Early ROIs). In 8/9 Delayed Regions and 5/20 Early Regions the response onset increased linearly with clip length (corresponding to clip group).

Supplementary Table 3. Effect of clip length on response onset in Experiment 3

Lat	Region	ROI type	F(2,205)		12s>8s		16s>12s	
			F-value	p-value	t-value	p-value	t-value	p-value
R	Optic Radiations*	Delayed	29.95	$4x10^{-12}$	2.34	0.01	5.95	$2x10^{-8}$
R	Hippocampus Head**	Delayed	24.44	$3x10^{-10}$	3.73	0.0002	4.65	$4.7x10^{-6}$
R	Hippocampus Body	Delayed	29.3	$6x10^{-12}$	3.28	0.0007	5.41	$1.8x10^{-7}$
R	Posterior Cerebellum	Delayed	21.19	$4.3x10^{-9}$	4.88	$2.1x10^{-6}$	3.20	0.0009
R	Caudate Nucleus	Delayed	29.69	$5x10^{-12}$	3.72	0.0002	5.97	$1x10^{-8}$
L	Caudate Nucleus	Delayed	33.16	$3.3x10^{-13}$	4.53	$8.7x10^{-6}$	5.17	$5.3x10^{-7}$
L	Posterior Cerebellum	Delayed	20.16	$1x10^{-8}$	5.25	$5x10^{-7}$	2.70	0.004
L	Hippocampus Head**	Delayed	10.44	$4.8x10^{-5}$	2.81	0.003	3.04	0.001
L	Hippocampus Body	Delayed	11.99	$1.2x10^{-5}$	2.97	0.002	3.05	0.001
R	Inferior Frontal Sulcus	Early	9.66	$9.8x10^{-5}$	-4.31	1	1.56	0.06

* Adjacent to the posterior hippocampus
** Extending to the amygdala-hippocampal junction

Regions showing a significant effect (one-way ANOVA) of clip length on response onset ($p<0.05$, corrected for multiple comparisons), indicating that the onset of the BOLD response was later for longer clips. For each such region, a-priori determined t-tests were subsequently performed (one-tailed, corrected), comparing the response onset to different clip lengths.