Science Advances
AAAS

advances.sciencemag.org/cgi/content/full/5/4/eaav1695/DC1

Supplementary Materials for

Rehearsal initiates systems memory consolidation, sleep makes it last

L. Himmer*, M. Schönauer*, D. P. J. Heib, M. Schabus, S. Gais

*Corresponding author. Email: monika.schoenauer@uni-tuebingen.de (M. Schönauer); lea.himmer@uni.tuebingen.de (L.H.)

Published 24 April 2019, *Sci. Adv.* **5**, eaav1695 (2019)
DOI: 10.1126/sciadv.aav1695

This PDF file includes:

Supplementary Figure

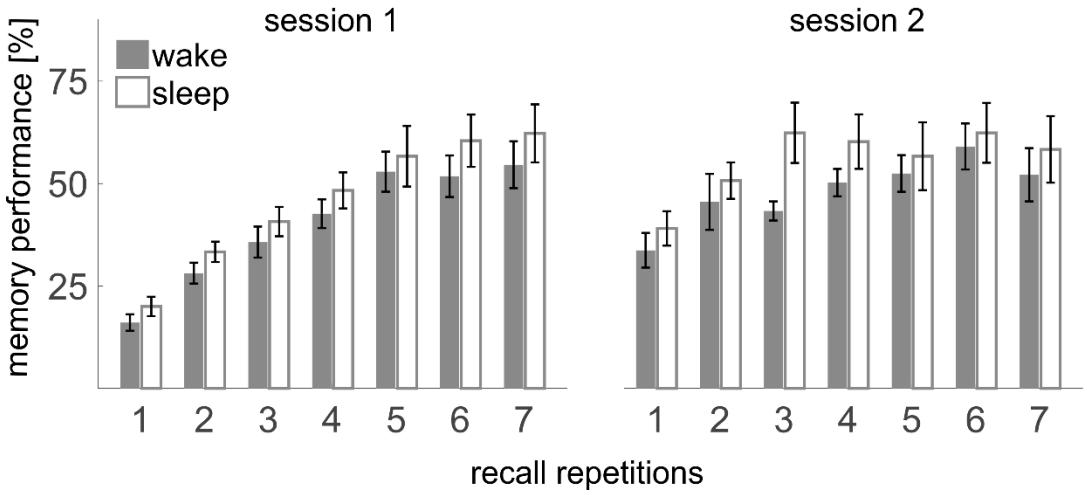

Fig. S1. Memory performance. Participants showed increasing memory performance within each session (repeated measures ANOVA, main effect of repetition, session 1: $F_{1,3.45} = 39.99$, $p < 0.001$; session 2: $F_{1,2.98} = 7.40$, $p < 0.001$). Learning slopes were steeper in session 1, whereas memory performance was generally higher in session 2 (repeated measures ANOVA, main effect of session: $F_{1,1} = 18.412$, $p < 0.001$; interaction session × repetition: $F_{1,2.537} = 5.032$, $p = 0.005$). Sleep and wake groups did not differ significantly within sessions (repeated measures ANOVA, main effect sleep/wake, session 1: $F_{1,27} = 1.489$, $p = 0.233$; session 2: $F_{1,28} = 1.389$, $p = 0.248$; interaction repetition × sleep/wake, session 1: $F_{1,3.45} = 0.097$, $p = 0.974$; session 2: $F_{1,2.98} = 0.991$, $p = 0.401$) nor did memory retention across sessions differ between both groups (repeated measures ANOVA, interaction last recall session 1 / first recall session 2 × sleep/wake: $F_{1,29} = 0.014$, $p = 0.908$).

Supplementary Tables

Table S1. List of regions with decreasing activity over repeated learning (session 1). Table denotes clusters with a minimal extent of 20 voxels at a whole-brain family wise error correction of $p_{FWE} \leq 0.05$. Coordinates are given in Montreal Neurological Institute space. Region labels were obtained using the Anatomy toolbox implemented in SPM8. Clusters marked with a * were extracted to serve as regions of interests for subsequent analyses.

		MNI coordinates (mm)				
anatomical region		**x**	**y**	**z**	**T**	**p_{FWE}**
right	rolandic operculum	40	-16	20	7.136	< 0.001
		38	-30	28	5.250	0.014
left	Medial prefrontal cortex	0	40	6	6.836	< 0.001
	& anterior cingulate cortex*	-6	50	2	6.793	< 0.001
		-14	0	28	6.214	< 0.001
left	hippocampus*	-16	-42	8	6.435	< 0.001
		-26	-36	0	5.585	0.005
		-30	-28	-10	5.428	0.008
left	inferior frontal gyrus	-38	32	-12	6.292	< 0.001
left	superior temporal gyrus	-54	-10	-2	6.043	< 0.001
left	insular lobe	-38	-14	26	5.634	0.004
left	paracentral lobule	-12	-34	70	5.530	0.006
left	superior frontal gyrus	-20	34	48	5.442	0.007
		-12	48	44	5.100	0.022
		-22	46	40	5.046	0.026
right	postcentral gyrus	12	-32	76	5.309	0.011
right	calcarine gyrus	30	-52	14	5.257	0.014
right	superior frontal gyrus	18	34	50	5.063	0.025

Table S2. List of regions with increasing activity over repeated learning (session 1). Table denotes clusters with a minimal extent of 20 voxels at a whole-brain family wise error correction of $p_{FWE} \leq 0.05$. Clusters marked with a * were extracted to serve as regions of interests for subsequent analyses.

		MNI coordinates (mm)				
anatomical region		**x**	**y**	**z**	**T**	**p_{FWE}**
right	superior & inferior	48	-38	58	6.898	< 0.001
	parietal lobule*	34	-52	64	6.379	< 0.001
		42	-46	62	6.313	< 0.001
right	Inferior temporal gyrus	60	-42	-18	5.851	0.002
left	cerebellum	-8	-74	-48	5.553	0.005
right	Precuneus*	12	-70	52	5.318	0.011

Table S3. List of regions with activity changes over repeated recall (session 1). Table denotes clusters at a whole-brain family wise error correction of $p_{FWE} \leq 0.05$.

anatomical region		MNI coordinates (mm) x	y	z	T	p_{FWE}
Increases over repetitions						
right	cuneus	16	-90	42	5.867	0.008
right	precuneus	12	-66	30	5.083	0.023
right	Superior occipital gyrus	28	-86	32	4.918	0.039
		28	-88	24	4.883	0.043
Decreases over repetitions						
Left	Supramarginal gyrus	-60	-50	24	5.174	0.002
		-58	-50	32	5.122	0.003
right	Medial temporal pole	54	18	-28	5.779	0.002
right	Medial prefrontal cortex	4	56	36	4.734	0.014
right	Medial prefrontal cortex	-10	60	28	4.541	0.031
left	Medial prefrontal cortex	0	54	20	4.458	0.043
right	Superior medial gyrus	4	48	6	4.456	0.044

Table S4. List of regions with decreasing activity over repeated learning of new words (session 2). Table denotes clusters with a minimal extent of 20 voxels at a whole-brain family wise error correction of $p_{FWE} \leq 0.05$.

anatomical region		MNI coordinates (mm) x	y	z	T	p_{FWE}
left	hippocampus	-28	-18	-16	5.138	0.007

Table S5. List of regions with increasing activity over repeated learning of new words (session 2). Table denotes clusters with a minimal extent of 20 voxels at $p \leq 0.001$ that survived small-volume FWE correction at $p \leq 0.05$ within the given volume. Small-volume correction was applied to precuneus and IPL ROIs (see Table S2), but resulted in no significant voxels in the case of the precuneus. All areas can also be considered significant after applying an additional Bonferroni correction for testing two ROIs ($p_{SVC} \leq 0.025$).

anatomical region		MNI coordinates (mm) x	y	z	T	p_{SVC}
small-volume correction: IPL						
right	Superior parietal lobule	28	-52	70	3.742	0.008
right	Postcentral gyrus	40	-40	64	3.625	0.012
		54	-28	58	3.568	0.014
		52	-30	62	3.465	0.019

Table S6. List of regions with a stronger response to old compared to new words (session 2). Table denotes clusters with a minimal extent of 20 voxels at $p \leq 0.001$ that survived small-volume FWE correction at $p \leq 0.05$ within the given volume. Small-volume correction was applied to precuneus and IPL ROIs (see Table S2). All areas can also be considered significant after applying an additional Bonferroni correction for testing two ROIs ($p_{SVC} \leq 0.025$).

		MNI coordinates (mm)				
anatomical region		**x**	**y**	**z**	**T**	**p_{SVC}**
small-volume correction: IPL						
right	angular gyrus	42	-58	52	3.835	0.006
right	inferior parietal lobule	44	-58	48	3.828	0.006
right	superior parietal lobule	40	-48	64	3.713	0.009
right	superior parietal lobule	42	-52	58	3.596	0.013
small-volume correction: precuneus						
right	precuneus	42	-70	54	3.385	0.002

Table S7. List of regions with a stronger response to new compared to old words (session 2). Table denotes clusters with a minimal extent of 20 voxels at $p \leq 0.001$ that survived small-volume FWE correction at $p \leq 0.05$ within the given volume. Small-volume correction was applied to hippocampus and mPFC ROIs (see Table S1), but resulted in no suprathreshold voxels in the case of the mPFC. All areas can also be considered significant after applying an additional Bonferroni correction for testing two ROIs ($p_{SVC} \leq 0.025$).

		MNI coordinates (mm)				
anatomical region		**x**	**y**	**z**	**T**	**p_{SVC}**
small-volume correction: hippocampus						
left	hippocampus	-32	-26	-16	3.565	0.007
left	hippocampus	-26	-40	2	3.434	0.010
left	hippocampus	-28	-38	-2	3.295	0.015