Supporting Information

Suthana et al. 10.1073/pnas.1423036112

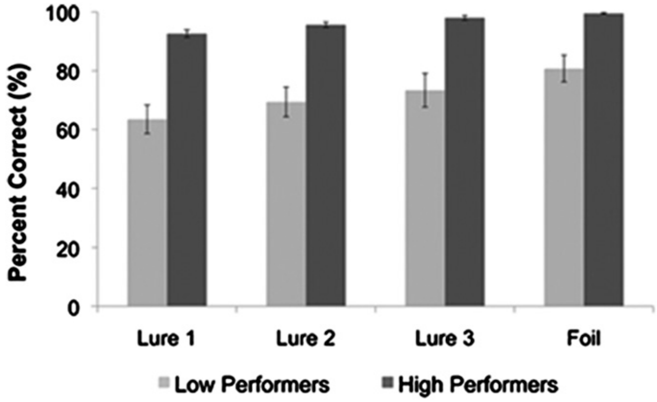

Fig. S1. Shown is percentage correct for the 40 sessions from 25 patients ($n = 40$) split into low and high performers. Lure 1 is the most similar and lure 3 is the least similar photograph to the target photograph, and the foil image is a novel photograph of an unstudied face.

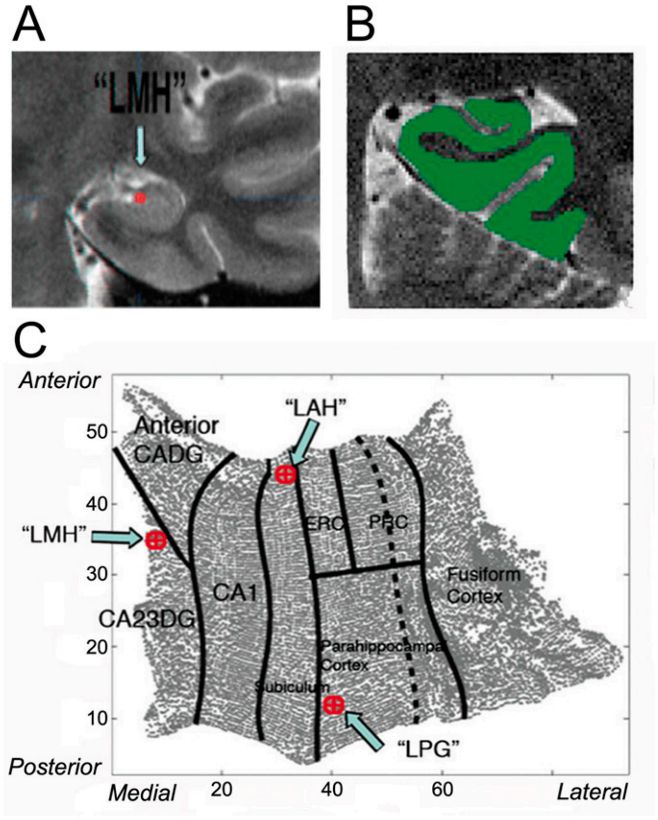

Fig. S2. (*A*) High-resolution MRI showing a left medial hippocampal (LMH) electrode location. (*B*) The 3D gray matter of the medial temporal lobe was created by manual segmentation of the gray matter on the high-resolution MRI. (*C*) An example patient's 2D flat map was created by unfolding the 3D gray matter and projecting electrode locations (shown in red). Regions shown are CA2, CA3, and dentate gyrus (CA23DG), anterior CA fields and dentate gyrus (CADG), CA1, subiculum, entorhinal cortex (ERC), parahippocampal cortex, perirhinal cortex (PRC), and fusiform cortex.

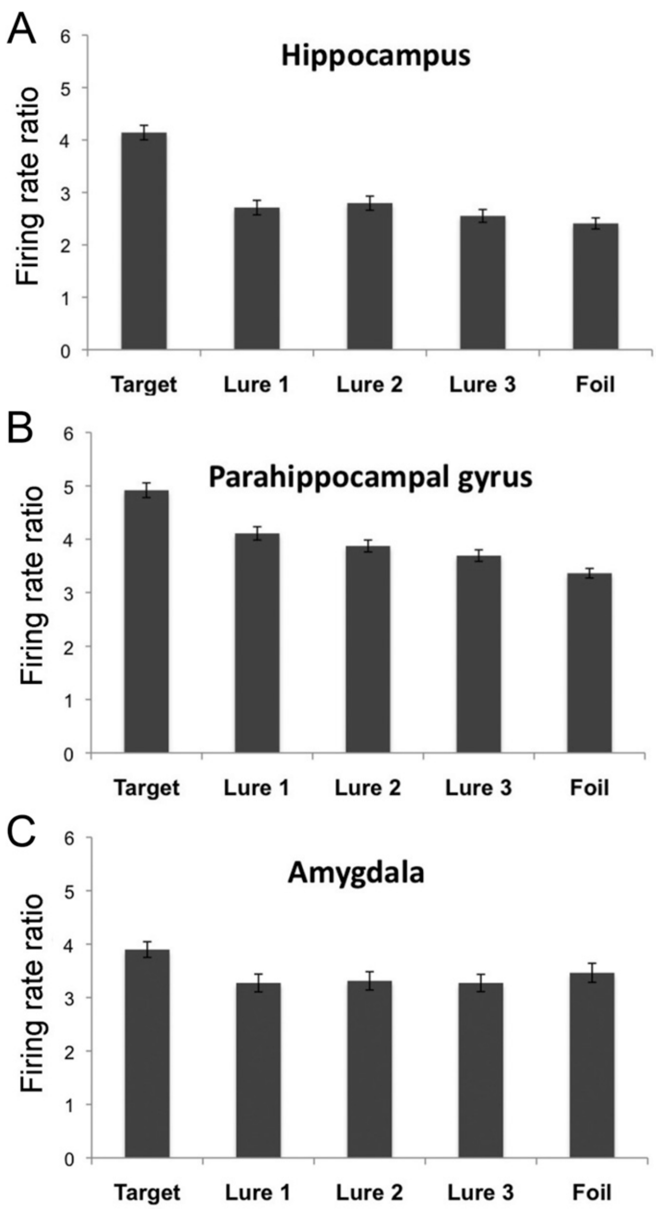

Fig. S3. Increase in average firing rate ratio (poststimulus compared with baseline) across all sessions (n = 40) during recognition of the target, lures, and foil images in regions hippocampus (*A*), parahippocampal gyrus (combined entorhinal and parahippocampal cortex) (*B*), and amygdala (*C*). Error bars show the SEM.

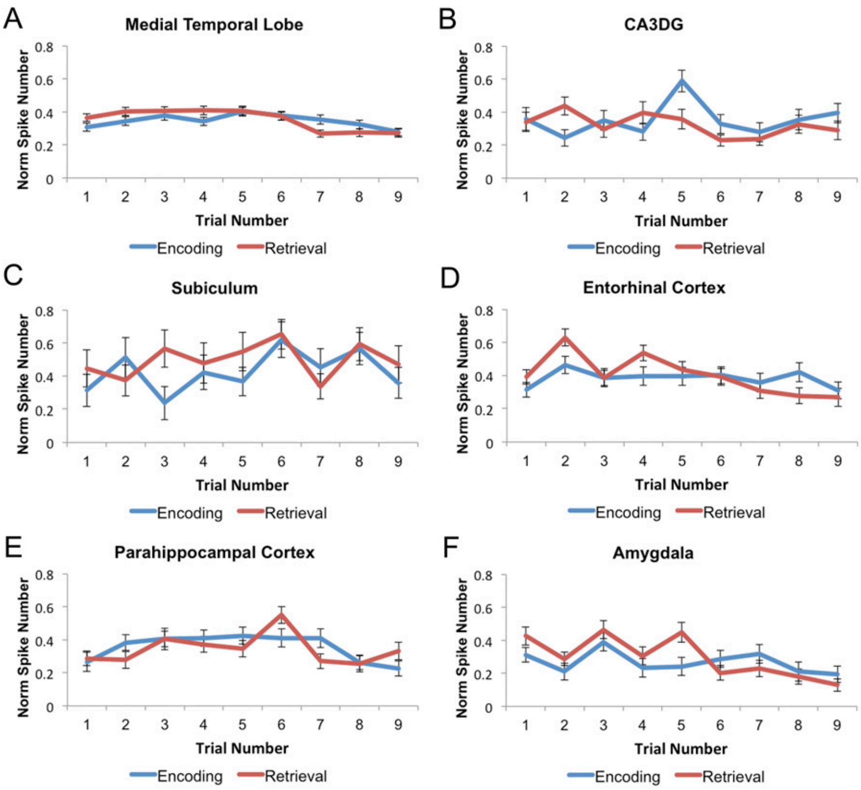

Fig. S4. Normalized average number of spikes for each trial during encoding and retrieval. Shown is the average spike counts for all units within the MTL regions (*A*) as well as within individual MTL areas including the CA3DG (*B*), subiculum (*C*), entorhinal cortex (*D*), parahippocampal cortex (*E*), and amygdala (*F*). Error bars reflect SEM.

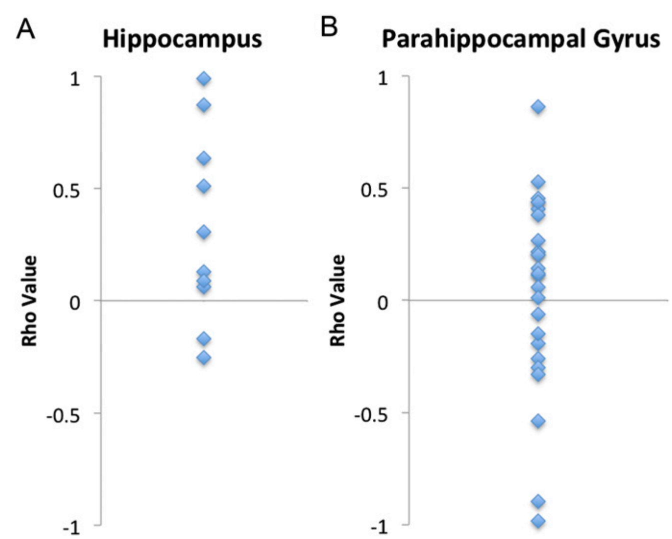

Fig. S5. Spearman correlation coefficient values between behavioral discrimination indices and target-lure 1 firing rate changes for specific learned target items within each individual subject. Rho values across subjects were significantly above zero within the (*A*) hippocampus (average $\rho = 0.32$; $P < 0.05$) but not within the (*B*) parahippocampal gyrus (average $\rho = 0.05$; $P > 0.05$).

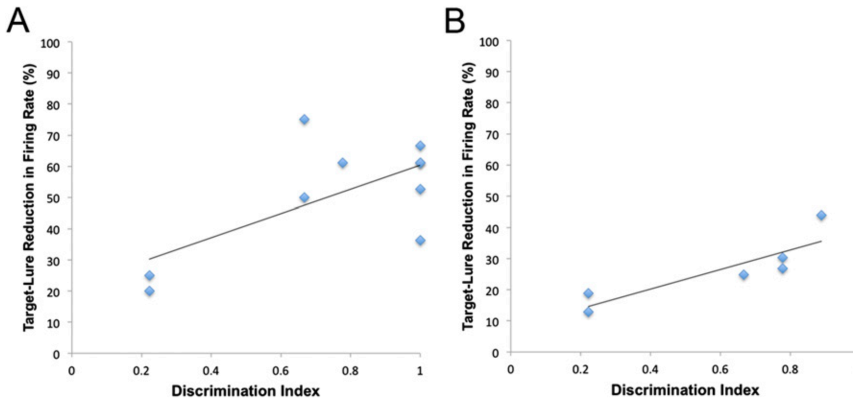

Fig. S6. Two example subjects (*A* and *B*) scatterplots of behavioral discrimination indices and hippocampal target-lure 1 firing rate changes for specific learned target items.

Table S1. Patient electrode localizations

Patient	Placement	Localization	Patient	Placement	Localization
#1	RAH	CA3DG	#12	RAH	Subiculum
	LAH	Subiculum		LAH	CA3DG
	LPG	LPHC		REC	REC
	RPG	RPHC		LEC	LEC
	RA	Amygdala		RA	Amygdala
	LA	Amygdala		LA	Amygdala
#2	RAH	RAH	#13	RMH	Subiculum
	LAH	LAH		LMH	CA3DG
	LEC	LEC		REC	Not in gray matter
	LPG	LPHC1		LEC	ERC
		LPHC2		RA	Amygdala
	RPG	RPHC		LA	Amygdala
	RA	Amygdala	#14	RAH	CA3DG
	LA	Amygdala		LAH	CA1
#3, #6	RAH	CA3DG		REC	REC
	LAH	CA3DG		LEC	LEC
	RPG	RPHC		RPG	RPG
	LPG	LPHC		LPG	Fusiform gyrus
	RA	Amygdala		RA	Amygdala
	LA	Amygdala		LA	Amygdala
#4	RAH	RAH	#15	RAH	CA3DG
	LAH	LAH		LAH	CA1
	REC	REC		RA	Amygdala
	LEC	LEC		LA	Amygdala
	RPG	RPHC	#16	RAH	Subiculum
	LPG	LPHC		LAH	Subiculum
	RA	Amygdala		REC	REC
	LA	Amygdala		LEC	LEC
#5	RAH	CA3DG		RPG	RPHC
	LAH	CA3DG		LPG	LPHC
	REC	REC		RA	Amygdala
	LEC	LEC		LA	Amygdala
	RPG	RPHC	#17	LMH	Subiculum
	LPG	LPHC		REC	REC
	RA	Amygdala		LEC	LEC
	LA	Amygdala		RA	Amygdala
#7	RAH	CA3DG		LA	Amygdala
	LAH	CA3DG	#18	LMH	CA3DG
	RPH	CA1		REC	Fusiform gyrus
	REC	REC		LEC	LEC
	LEC	LEC	#19, #25	RAH	CA3DG
	RPG	RPHC		LAH	CA3DG
	LPG	LPHC	#20	REC	REC
	RA	Amygdala		LEC	LEC
	LA	Amygdala	#21	RAH	CA3DG
#8	RAH	CA3DG		LAH	CA3DG
	LAH	CA3DG		REC	REC
	RPG	RPHC		LEC	Subiculum
	LPG	LPHC		LPG	LPHC
	LEC	LEC	#22	RMH	CA3DG
	RA	Amygdala		LMH	CA3DG
	LA	Amygdala		REC	REC
#9	RAH	RAH		LEC	LEC
	LAH	LAH		RA	Amygdala
	LEC	LEC		LA	Amygdala
	RPG	RPHC	#23	RAH	CA3DG
	LPG	LPHC		LAH	CA3DG
	RA	Amygdala		REC	REC
	LA	Amygdala		LEC	Subiculum
#10	RAH	Subiculum		RPG	RPHC
	REC	REC		LPG	LPG
	LEC	LEC	#24	RAH	CA3DG
	RPG	RPHC		LAH	Not in gray matter

Table S1. Cont.

Patient	Placement	Localization	Patient	Placement	Localization
	LPG	LPHC		REC	REC
	RA	Amygdala		LEC	LEC
	LA	Amygdala		RPG	RPHC
#11	RAH	CA3DG		LPG	LPHC
	LAH	CA3DG		LA	Amygdala
	REC	REC			
	LEC	Subiculum			
	RPG	RPHC			
	LPG	LPHC			
	RA	Amygdala			
	LA	Amygdala			

Region placements shown are right and left anterior, medial, or posterior hippocampus (RAH, LAH, RMH, LMH, RPH, LPH), right and left parahippocampal cortex (RPHC and LPHC), right and left entorhinal cortex (REC and LEC), and right and left amygdala (RA and LA). Electrodes from 22 of 25 subjects were further localized to the encompassing hippocampal subregions CA3 and dentate gyrus (CA3DG), CA1, or subiculum.

Table S2. Demographics and clinical characteristics of low and high performers

	Age	Sex	WAIS VIQ	WAIS digit span	WMS verbal memory	CVLT verbal memory	Rey–Osterrieth visual memory	Trails B executive
LP (mean)	**31.75**	**7 (5)**	**90.1**	**27.17**	**18.17***	**14.33***	**9**	**29.2**
SEM	3.23		4.27	9.05	4.16	5.96	7.67	10.08
HP (mean)	**34.62**	**6 (5)**	**98.09**	**44.17**	**59.82***	**53.82***	**29.3**	**20.18**
SEM	3.23		5.24	9.97	7.89	6.88	7.71	8.32

Shown are the average (bolded) and SE (SEM) of the ages and neuropsychological test scores in both groups. Under sex, is shown the number of male and female (in parentheses) participants within each group. Verbal IQ (VIQ) and digit span (attention) scores (percentiles shown) were calculated by using the Wechsler Adult Intelligence Scale (WAIS). Long-term verbal memory percentiles were calculated by using the Wechsler Memory Scale (WMS) and California Verbal Learning Test (CVLT) and executive function by means of the Trail Making Test. The asterisks (*) indicate significant differences between low performers (LP) and high performers (HP).

Table S3. Number of recorded units

Region	Multi-units	Single-units	Total units
Hippocampus	105	180	285
CA3DG	(62)	(117)	(179)
CA1	(9)	(7)	(16)
Subiculum	(34)	(56)	(90)
Entorhinal cortex	111	141	252
Parahippocampal cortex	88	138	226
Amygdala	176	237	413
Total	480	696	1,176

A total of 1,176 units were recorded from, with 285 in the hippocampus (179 in CA3 and dentate gyrus, 16 in CA1, and 90 in the subiculum), 252 in the entorhinal cortex, 226 in the parahippocampal cortex, and 413 in the amygdala. All performers (n = 40 sessions).

Table S4. Number of units in hippocampal CA3DG and subiculum regions, entorhinal cortex, parahippocampal cortex, and amygdala recorded from low performers

Region	Multi-units	Single-units	Total units
Hippocampus	47	82	129
CA3DG	(28)	(55)	(83)
CA1	(3)	(1)	(4)
Subiculum	(7)	(16)	(23)
Entorhinal cortex	50	83	133
Parahippocampal cortex	43	66	109
Amygdala	79	136	215
Total	204	343	586

Low performers (n = 20).

Table S5. Number of units in hippocampal CA3DG and subiculum regions, entorhinal cortex, parahippocampal cortex, and amygdala recorded from high performers

Region	Multi-units	Single-units	Total units
Hippocampus	58	98	156
CA3DG	(32)	(55)	(87)
CA1	(4)	(3)	(7)
Subiculum	(20)	(26)	(46)
Entorhinal cortex	61	58	119
Parahippocampal cortex	45	72	117
Amygdala	97	101	198
Total	251	298	590

High performers (n = 20).