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Supplemental materials

David E. Warren
University of Iowa

Mellissa C. Duff
University of Iowa

Daniel Tranel
University of Iowa

Please see article for additional authors.

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Comments

This item supplements the article "Observing Degradation of Visual Representations over Short Intervals When Medial-temporal Lobe Is Damaged" J Cogn Neurosci. December 2011, Vol. 23, No. 12, Pages 3862-3873. PMID: 21736458. http://dx.doi.org/10.1162/jocn_a_00089

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Supplemental Methods

Statistical Analyses and Plotting

All statistical analyses were conducted in the R (version 2.12.2), SAS (version 9.2), and Python (version 2.7) programming languages. R's lattice library was used to generate all figures except Figures 1 and S1, which were created using Inkscape software.

Evaluating patient search

Our patients were all severely amnesic, and since our task was complex enough to require tens of seconds of concentrated attention, patients might have been unable to remember what portions of the array they had already searched, resulting in uneven or incomplete sampling. This concern was addressed using eye-tracking data both qualitatively through visual inspection of fixation locations and quantitatively by examining a number of eye-movement variables.

Qualitatively, MTL patients did not exhibit gross differences in their sampling of lure items, generally exhibiting the same left-to-right, top-to-bottom search exhibited by comparison subjects (Fig. S1a). One notable exception was a single trial by patient 2308, who began searching a target-absent array by examining an item close to the center, then proceeding to search the remainder of the array from that point, eventually indicating that no target was found without returning to the remaining items (Fig. S1b). No other MTL patient or comparison subject searched any array in this fashion. Quantitative measures of the number of fixations made to search arrays, the number of regions searched by MTL patients and comparison subjects, the number of regions searched by MTL patients in correct rejection and

miss trials, and the number of fixations made to each lure are presented later in this supplemental section

Eye Movement

Number of fixations

The number of fixations made to each lure by each group was analyzed using a t-test of per-subject averages of the number of fixations made to each lure across all correct-rejection trials. Additionally, patient fixations were compared across correct rejection and miss trials using a paired t-test.

Number of regions sampled

The number of regions sampled by the two groups was analyzed using a t-test of per-subject averages of the number of regions sampled across all correct-rejection trials. Additionally, patient sampling of regions in correction rejection and miss trials was compared using a paired t-test.

Number of fixations per item

The number of fixations made to any given lure by the two groups was analyzed using a t-test of per-subject averages of the number of fixations made to lures across all correct-rejection trials. Additionally, patient sampling of regions in correction rejection and miss trials was compared using a paired t-test.

Fixation duration

In the main text, we report an analysis of fixation duration by lure-sample similarity that employed a binary fixation latency factor to index whether a fixation was made early or late in search (i.e., 6 or fewer vs. 7 or more fixations since the sample item was last fixated). This distinction was motivated by visual inspection of group-level averages of fixation durations to lure items of varying similarity to the sample at different latencies since the sample item was last fixated. For this qualitative inspection, the latency variable used was simply the ordinal value of the fixation since the last fixation to the sample (e.g., 1, 2, …, n). Examination of the plotted differences between fixation durations to 2- and 0-match lures revealed an interesting and fairly consistent group-level decrease at longer latencies for patients, especially at latencies of 7 or more (see Fig. S2b).

In a preliminary analysis, we considered the influence of latency as a continuous predictor in a HLM analysis that also included binary predictors for MTL status and lure-sample similarity at match levels 2 and 0 along with a random intercept term to reflect variation between patients (which was assumed to be normally distributed). We also conducted an additional analysis of fixation duration that employed the differences between fixation durations to 2- and 0-match lures as an outcome measure by using a similar HLM without the (now obviated) similarity predictor. Notably, both analyses include fixations made with latency values of 10 or less because instances of fixation latencies greater than 10 were relatively rare in patients. Specifically, some patients made fewer than 20 fixations at latency 11 (and greater), making derived estimates of central tendency potentially invalid. Predictors and outcomes were aggregated across all trials for each subject.

Lure type and fixation of sample

If eye movements were driven by ongoing comparisons between a maintained version of the sample item and a currently fixated lure, then it would be reasonable to expect that lure items more closely resembling the sample would be more likely to prompt another fixation of the sample item. We investigated this possibility using a repeated measures ANOVA to analyze a dataset composed of predictors including MTL status and lure-sample match and an outcome measure of the proportion of fixated lures that generated a transition to the sample.

Supplemental Results

Eye-Movement Measures

Number of fixations

Patients and comparison subjects did not differ in the number of fixations made during correction-rejection trials (125.726 ± 13.552 vs. 104.174 ± 8.997 fixations [mean ± SE], respectively;T_8 = 1.325, p = 0.2218), and patients did not make fewer fixations in trials where they missed the target item than in correct-rejection trials (126.213 ± 14.294 vs. 125.726 ± 13.552 fixations [mean ± SE], respectively; paired T_4 = 0.075, p = 0.945).

Number of regions sampled

Patients and comparison subjects did not differ in the number of regions sampled (44.278 ± 2.561 vs. 51.934 ± 4.479 regions [mean ± SE], respectively; T_8 = 1.484, p = 0.176), and patients did not sample fewer regions in trials where they missed the target item rather than

those that were correctly rejected (45.158 ± 3.199 vs. 44.278 ± 2.561 regions [mean ± SE], respectively; paired $T_4 = 0.6416$, $p = 0.556$).

Number of fixations per lure

On average, patients made more fixations per fixated region than comparison subjects (2.785 ± 0.193 vs. 2.005 ± 0.106 fixations per region [mean ± SE], respectively; $T_8 = 3.542$, $p = 0.008$), but patients made the same number of fixations per item in both correct-rejection and miss trials (2.785 ± 0.193 vs. 2.749 ± 0.154 fixations per region [mean ± SE], respectively; paired $T_4 = 0.414$, $p = 0.700$).

Fixation durations

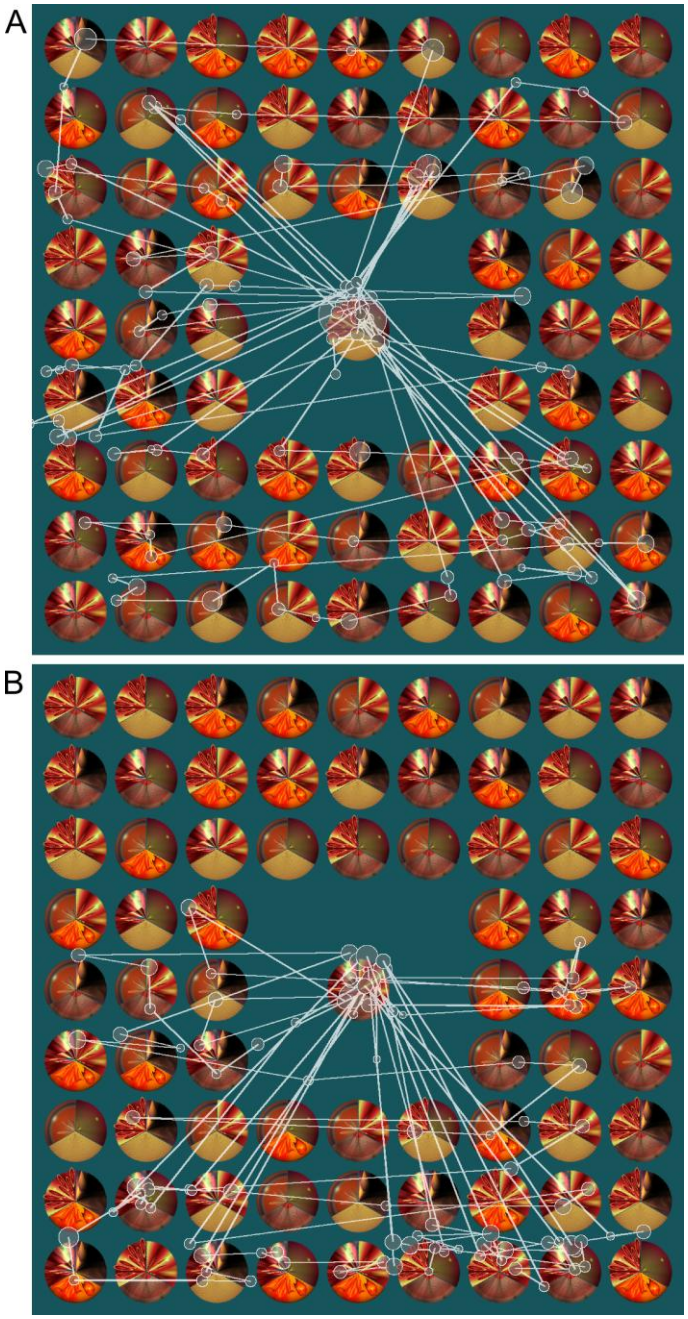
Fixation duration was influenced by lure-sample similarity and the interaction of latency, similarity, and MTL status (Fig. S2a). According to an ANOVA test of our best-fit model, 2-match lures were fixated for longer than 0-match lures irrespective of latency ($F_{1,184} = 89.640$, $p < 0.0001$), and latency exerted a distinct effect on fixation durations for patients and comparison subjects for the two types of lures ($F_{1,184} = 7.060$, $p = 0.00860$). Overall, patients tended to fixate 2-match lures more briefly and 0-match lures for longer at greater latencies, while comparison subjects showed the opposite pattern. Notably, only the interaction term was reliable; neither group showed any other reliable relation between predictors and outcomes.

Similarly, our model of the difference between fixation durations to 2- and 0-match lures contained one reliable term, the interaction between latency and MTL status ($F_{1,88} =$

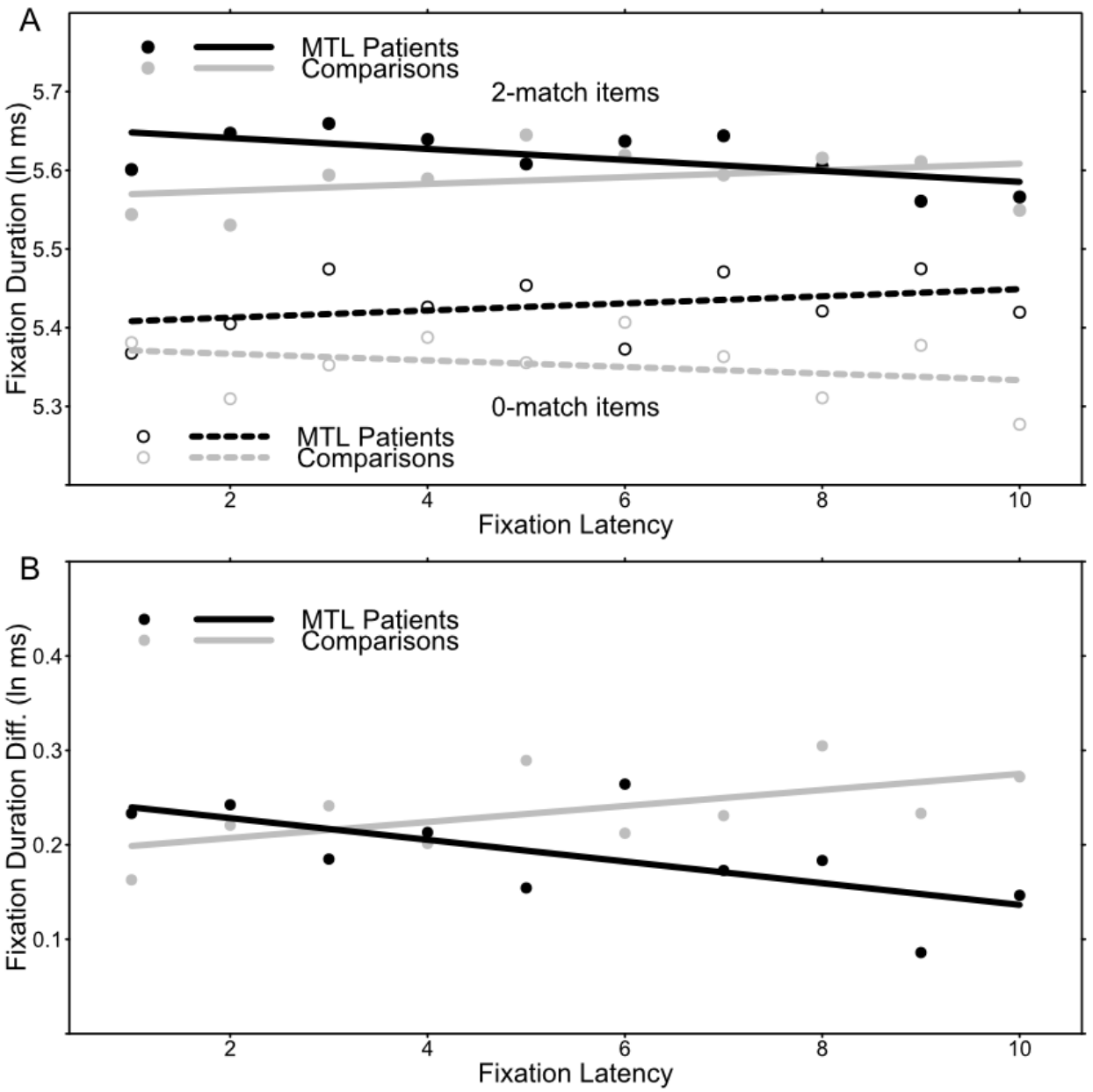
10.420, $p = 0.00170$). Overall, the two groups showed different trends in fixation durations related to latency, but neither was reliable in isolation (Fig. S2b).

Similarity and transitions to sample

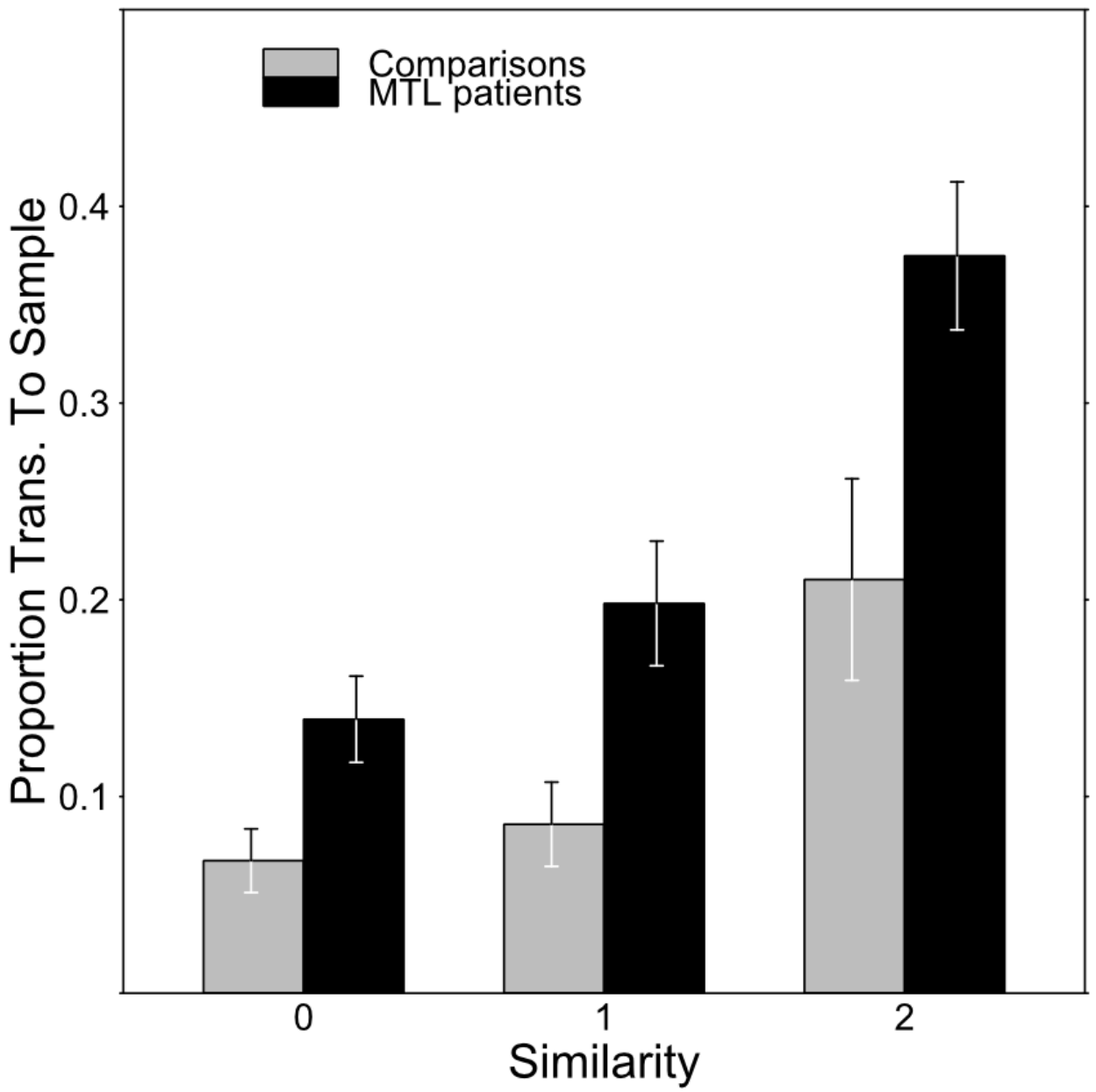
The proportion of fixated lures that provoked a fixation of the sample item varied by lure-sample similarity and by MTL status, and also by the interaction of those factors (Fig. S3). Overall, patients were more likely to fixate the sample after fixating lures ($F_{1,8} = 7.925$, $p = 0.0227$; see also Fig. 4a), and lures that resembled the sample item more were more likely to evoke an immediate fixation of the sample ($F_{1,18} = 73.998$, $p < 0.0001$). Additionally, these two effects interacted, and patients fixated the sample item even more frequently when leaving a lure item that with a greater resemblance to the sample ($F_{1,18} = 4.435$, $p = 0.0495$).



Supplemental Figure 1: Plots of eye movements for patient 2308 overlaid on search arrays. Circles indicate points of fixation, diameters of circles reflect duration of fixation, and lines indicate saccades. (a) An example of a complete search of a target-absent display performed by 2308. The scanning pattern shown here was typical of 2308's searches, and similar to that exhibited by other subjects. (b) Unique among all trials across all subjects, patient 2308 performed a partial search of one array during his session. Although subjects sometimes fixated arrays sparsely, this trial was the only example of a subject completely ignoring a large portion of the array.



Supplemental Figure 2: Changes in fixation duration since last fixation of sample item. (a) Group-mean values for MTL patients and comparisons viewing 2-match (top, solid lines and closed points) and 0-match (bottom, dashed lines and open points) lures with points for each latency and regression lines reflecting the underlying trend. 2-match items received longer fixations overall, and fixation durations across latency differed between groups for 2-match and 0-match lures; put another way, patients fixated 0-match lures for longer and 2-match lures more briefly as latency increased, and this differed from comparison behavior. (b) plots group-mean values for the difference between 2- and 0-match lure fixation durations for patients and comparisons with points for each latency and regression lines indicating trends. The latency-by-MTL status interaction was reliable, but the unique group-level slopes were not.



Supplemental Figure 3: The proportion of fixated regions that caused at least one transition to the sample item aggregated for both groups across the three levels of lure match. MTL patients were more likely to transition to the sample item overall, but both groups were more likely to transition to the sample from lures that matched the sample to a greater degree. Bars indicate group-by-condition means and whiskers indicate standard error of the mean.

Patient ID	Etiology	Sex	Hand	Onset	Age	Ed.	WAIS	WMS	
							FSIQ	GMI	DRI
0002	CHI	F	R	1985	53	23	126	49	58
1606	Anoxic	M	R	1990	61	12	91	66	61
1846	Anoxia	F	R	1993	45	14	84	57	62
1951	HSE	M	R	1980	56	16	121	75	53
2144	Anoxia	F	R	1997	59	12	99	56	57
2308	HSE	M	L	1999	52	16	87	45	48
2363	Anoxia	M	R	1998	52	16	98	73	74
2563	Anoxia	M	L	2000	53	16	102	75	80

Table S1: Details of participating neurological patients. WAIS, Wechsler adult intelligence scale-III; FIQ, full-scale IQ; WMS, Wechsler memory scale-III; GMI, general memory index; DRI, delayed recall index. For the WMS-III, the DRI is an average of the auditory delayed index and visual delayed index. All tests yield mean scores in the normal population of 100 with an SD of 15.

		Hits		CRs	
ID	**Group**	**Rate**	**RT (s)**	**Rate**	**RT (s)**
1606	MTL	0.56	19.59	0.76	30.96
1846	MTL	0.74	25.23	0.98	50.87
1951	MTL	0.70	27.52	0.98	59.87
2308	MTL	0.67	46.61	0.96	57.93
2363	MTL	0.63	29.39	0.96	60.13
1606c	Comp	0.96	29.04	1.00	40.53
1846c	Comp	1.00	25.71	1.00	43.50
1951c	Comp	0.78	19.50	1.00	28.14
2308c	Comp	0.93	28.59	1.00	44.87
2363c	Comp	0.74	19.56	1.00	33.28

Table S2: Per-participant hit and correction-rejection rates and response times. Patients were much more likely to miss stimuli than comparisons, but both groups correctly rejected most target-absent displays.