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The impact of right temporal lobe epilepsy on nonverbal memory: Meta-regression of stimulus- and task-related moderators

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Abstract. Nonverbal memory tests have great potential value for detecting the impact of lateralized pathology and predicting the risk of memory loss following right temporal lobe resection (TLR) for temporal lobe epilepsy (TLE) patients, but this potential has not been realized. Previous reviews suggest that stimulus type moderates the capacity of nonverbal memory tests to detect right-lateralized pathology (i.e., faces > designs), but the roles of other task-related factors have not been systematically explored. We address these limitations using mixed model meta-regression (k = 158) of right-lateralization effects (right worse than left TLE) testing the moderating effects of: 1) stimulus type (designs, faces, spatial), 2) learning format (single trial, repeated trials), 3) testing delay (immediate or long delay), and 4) testing format (recall, recognition) for three patient scenarios: 1) presurgical, 2) postsurgical, and 3) postsurgical change. Stimulus type significantly moderated the size of the right-lateralization effect (faces > designs) for postsurgical patients, test format moderated the size of the right-lateralization effect for presurgical-postsurgical change (recognition > recall) but learning format and test delay had no right-lateralization effect for either sample. For presurgical patients, none of the task-related factors significantly increased right-lateralization effects. This comprehensive review reveals the value of recognition testing in gauging the risk of nonverbal memory decline.

Introduction

Based on seminal neuropsychological observations following unilateral temporal lobe surgery (Milner, 1970), the *material specificity* view of memory function has long dominated our conceptualisation of the differing roles of the left temporal lobe, associated with verbal memory, and the right temporal lobe, associated with nonverbal memory. However, over time it has become clear that material specificity, at least when tested using the major standardized neuropsychological instruments, has critical limitations for characterizing patients with right TLE (RTLE). Unlike the strong association between performance on verbal memory tests and left temporal lobe pathology (e.g., Alpherts et al., 2006; Rausch et al., 2003), performance on nonverbal memory tests does not reliably enable the detection of right temporal lobe pathology (Sherman et al., 2011; Vaz, 2004). Previous large-scale studies (e.g., Barr et al., 1997) and meta-analytic reviews involving TLE patients (Kessels et al., 2001; Lee, Yip, & Jones-Gotman, 2002; Sherman et al., 2011; Vaz, 2004) have suggested that the type of nonverbal stimulus may mediate their relative specificity to right versus left temporal lobe pathology, with tests of memory for faces or spatial information outperforming tests of design memory for this purpose. Experimental neuroimaging studies with healthy participants additionally suggest that the lower verbalisability of faces and spatial information versus designs may explain their greater specificity to right temporal lobe integrity (Golby et al., 2001; Kelley et al., 1998; Kuhn & Gallinat, 2014). However, while some of the failure of the material specificity framework may be attributed to flaws of the tests themselves (e.g., the verbalisability of putatively “nonverbal” material), the low prevalence of TLE patients that show material-specific lateralization profiles (Castro et al., 2013) indicates that the material specificity framework itself has clear limitations and requires re-examination (e.g., Saling, 2009).

One alternative approach has suggested that *task specificity* may be a more sensitive and parsimonious approach (Saling, 2009). Broadly, this view proposes that different types of associative memory task (i.e., semantic versus arbitrary association) are associated with different respective neuroanatomical substrates (i.e., lateral versus medial temporal regions) that operate across both hemispheres, and that this dissociation interacts with, but limits the value of, a material specific hemispheric dichotomy (Saling, 2009). Similarly to material specificity, however, this view maintains a focus on cognitive dissociations as markers of anatomical localisation. More broadly, recent work has characterized the cognitive profiles of TLE patients as varying considerably beyond the traditional phenotype of language and memory, a group with primarily verbal memory and/or language deficits, to include additional phenotypes such as a global or generalized cognitive impairment phenotype for which there is impairment in all or in the majority of cognitive domains (that may include memory or language), a no impairment phenotype for which there is minimal or no evidence of cognitive reduction (Elverman et al., 2019; Reyes et al., 2020), and potentially an additional phenotype with reduced executive functioning and speed (Elverman et al., 2019). Taken together, this evidence strongly suggests the benefits of a broader and more detailed conceptualisation of the cognitive correlates of unilateral TLE than that offered by the material specificity view.

Yet despite the substantial scientific progress made using largely experimental associative memory paradigms, and the benefits and nuances of cognitive phenotyping, from the perspective of a clinician there remains a compelling need for neuropsychological measures that assist with determining the presence of lateralized epilepsy. One possible means of investigation includes broadening the notion of *task specificity* to allow comparisons of different types of measures from standardized instruments that relate to different task requirements. This approach could help disambiguate the observed unreliability of nonverbal memory tests, as the design of most studies does not necessarily produce results that clearly distinguish a material specificity explanation from alternatives. For example, the use of a recall format to test memory for nonverbal stimuli could be prone to interference from impairments in non-memory neuropsychological domains such as attention or higher order executive functions that prevent successful retrieval (Lowndes & Savage, 2007; Mayes et al., 2007). By providing the to-be-retrieved stimulus in the test, a recognition format eliminates these factors and therefore more directly tests memory consolidation and storage functions linked to the medial temporal lobe (Lowndes & Savage, 2007; Mayes et al 2007). Furthermore, popular tests using design stimuli such as Visual Reproduction (Wechsler, 2009) or the Rey Complex Figure Test (Rey, 1941) predominantly test recall, while tests of facial memory (such as the Warrington Recognition Memory Test for Faces; Warrington, 1984) exclusively use recognition. It is therefore possible that interpretation of the superior discriminative capacity of facial over design stimuli may be confounded by differences in the testing format.

The use of repeated learning trials may also impact on the capacity of nonverbal memory tests to detect right temporal lobe pathology. A previous meta-analytis suggested that tests with repeated learning trials (e.g., the Nonverbal Selective Reminding Task; Fletcher, 1985) may outperform tests with single trials (e.g., Visual Reproduction and Rey Complex Figure Test) in detecting clinically significant postsurgical memory changes following TLR (Sherman et al., 2011). Similarly to a recognition test format, repeated learning trials may reduce the impact of transient attentional or executive factors unrelated to memory storage processes and therefore provide a more specific test of medial temporal lobe functioning (e.g., Jones-Gotman, Harnadek, & Kubu, 2000).

It is also unclear whether testing learning of nonverbal material after a short or long delay period moderates the capacity of nonverbal memory tests to detect right-lateralized temporal lobe pathology. Some studies show that testing during (or immediately following) initial learning is more sensitive than following a longer delay such as 30 minutes (Jones-Gotman, Smith, Frisk, & Routhier, 1996; Jones-Gotman et al., 1997; Majdan, Sziklas, & Jones-Gotman, 1996; Trennery et al., 1993), while others suggest the opposite pattern (Pigott & Milner, 1993; Hampstead et al., 2010; Kuhn & Gallinat, 2014; Smith, Bigel, & Miller, 2010). A meta-analysis of neuroimaging evidence in healthy participants suggests a division of labour within the hippocampus (i.e., anterior region for delayed recall versus posterior region for immediate recall) when learning spatially navigated routes (Kuhn & Gallinat, 2014). Therefore in neurobiological terms, given that standard anterior temporal lobectomy—the most common temporal lobe surgery—resects anterior hippocampal tissue while preserving some posterior hippocampal tissue, it is possible that nonverbal memory tested following a long delay may be more sensitive to discriminating memory decline associated with right- versus left-sided surgery than testing after a minimal or short delay.

In summary, the impact of differences in convenient and standardized measures of test format, learning format, and testing delay have not been systematically examined using meta-analysis but may have important implications for understanding right temporal lobe function. Previous meta-analyses have also not accounted for patient-level variables such as age at assessment and age at epilepsy onset, when findings suggest that postsurgical deficits of cognition and language tend to be more severe when seizure onset is later (Baxendale, Thompson, Harkness, & Duncan, 2006; Herman, Seidenberg, Haltiner, & Wyler, 1995; Hermann, Davies, Foley, & Bell, 1999; Lespinet et al., 2002). Existing reviews have also either not permitted or not statistically accounted for the use of multiple tests per study and/or multiple measures per test, which may have lead to biased conclusions. Furthermore, previous meta-analyses have not included presurgical TLE patients, despite the potential value of presurgical neuropsychological assessment for detecting lateralized pathology prior to surgery and for predicting the risk of decline following surgery.

In this context, the aim of this review was to determine whether test-related factors affect the capacity of nonverbal memory tests to detect right temporal lobe pathology. We grouped nonverbal memory test measures into categories by 1) stimulus type, 2) learning format, 3) testing delay, and 4) testing format and compared the difference between the performance of persons with left and right temporal lobe pathology by each category and interactions between these categories. As additional novel features, we used presurgical patients in addition to postsurgical and pre-post samples, explored the effects of age-related variables on identification of RTLE pathology, and used hierarchical meta-analytic methods to statistically account for multiple measures per study.

Methods

This study was conducted in accordance with the Preferred Reporting Items for Systematic

Review and Meta-Analysis (PRISMA; Moher et al., 2009) guidelines.

Inclusion of studies

Studies were selected by means of a literature search in Medline, ProQuest, Web of Science, and Scopus (January 1990 to February 2019) using the following search terms: 1) *epilepsy* AND *neuropsych** AND *temporal lobe*; and 2) *epilepsy* AND *memory* AND *temporal lobe*. Additional studies were identified by examining reference lists of the identified studies, from neuropsychological texts (Lezak, 2012; Strauss, Sherman, & Spreen, 2006), and from published manuals for neuropsychological tests and batteries (e.g., Wechsler, 2009). Table 1 presents inclusion and exclusion criteria.

Table 1. Inclusion and exclusion criteria for the meta-analysis.

	Inclusion criteria
1	Full-text peer reviewed publications
2	Participant population with a diagnosis of medically refractory unilateral temporal lobe epilepsy (TLE), with lateralization exclusively to a unilateral temporal lobe region having been confirmed via standard clinical investigations including video-EEG monitoring, intracranial EEG recordings in the temporal lobe region, results from the Wada test, identification of pathology as determined by magnetic resonance imaging (MRI), neuropsychological testing, or a combination of these methods. Multiple TLE aetiologies were permitted (e.g., medial temporal sclerosis, low-grade tumors, cortical dysgenesis, or unknown)
3	Original data reported from neuropsychological tests of nonverbal memory for both the left and right TLE patients in order to calculate an effect size, with data included for raw test scores (i.e., means and standard deviations), standardized scores (i.e., mean of 100 and standard deviation of 15) and scaled scores (i.e., mean of 10 and standard deviation of 3)
4	Nonverbal memory tests were included if they had published manuals or appeared in journal articles containing some form of validation data, for example, normative data, psychometric or clinical validation data including test-retest reliability, convergent validity, factor structure, diagnostic efficiency statistics, etc.
	Exclusion criteria
1	Tests containing explicitly verbal material or demands to name otherwise “nonverbal” elements[a]
2	Experimental and computerized tests[b]
3	Patients with other major medical and/or psychiatric conditions known to affect neuropsychological function, except depression[c]
4	Studies (or within-paper samples) with: patients younger than 14 or older than 65 years; estimated intellectual functioning (i.e., an IQ measure) less than 70; greater than 20% of patients with bilateral and/or right-lateralization of speech/language functions[d]; a majority (i.e., greater than 50%) with poor postsurgical seizure control as defined by the study[e].
5	For studies presented as a case series, individual cases were removed if any exclusion criteria applied.

[a] Tests with elements that may be nameable were included if the material itself was not explicitly verbal (e.g., the simple designs in Visual Reproduction or the colours in the design-colour stimuli in Visual Paired Associates from the WMS-R; Wechsler, 1987).

[b] While computerized tests have become more popular in clinical practice, we wished to keep the inclusion criteria of this review as close as possible to previous reviews for clearer comparability of results, and additionally believed that the difference between computerized and paper-and-pencil formats could make interpretation of any moderating effects more challenging.

[c] Depression is the most common psychiatric comorbidity in TLE patients (Fuller-Thomson & Brennenstuhl, 2009) and therefore included to accurately reflect this population. While a specific TLE subgroup with lesions in left lateral temporal region has been found to show an association between depressed mood and verbal and figural memory performance (Helmstaedter, Sonntag-Dillender, Hoppe & Elger, 2004), overall group-level data from that study and others (e.g., Tracy et al., 2007) does not suggest a general confounding association between depression and cognitive performance, nor an overall mediation by side of TLE

pathology.

[d] Based on estimates of the prevalence of non-dominant language lateralization in temporal lobe epilepsy patients (Gaillard et al., 2002; Janszky et al., 2003; Springer et al., 1999).

[e] For consistency with previous reviews, and as assumed to have more diffuse and less lateralized pathology.

For studies with postsurgical patients who were tested multiple times following surgery ($k = 4$), the follow-up closest to one year was selected as one year was the most common follow-up time among these four studies (i.e., $k = 3$), and this was further supported by our observation that across the 60 studies where follow-up time was reported as a discrete, unique, average value (i.e., not merely ranges or medians), the average, median and most frequent time to follow-up following surgery was close to one year ($M = 16.27$ months, $SD = 17.66$, range: 0.75 to 75.72; median= 11.21, *mode* = 12).

For studies that featured subgroups of TLE patients (e.g., those with vs. without hippocampal sclerosis), only subgroups that satisfied our selection criteria were included. If multiple within-study subgroups satisfied inclusion criteria but were not reported as an overall group, these data were pooled into one group (see Appendix for formulae and rules). Patient samples in the presurgical, postsurgical, and postsurgical change groups were meta-analysed separately but not exclusively as many papers reported data from one or more of these patient groups.

Categorisation of data by stimulus type, test format, learning format, and testing delay

Included nonverbal memory test measures were categorized according to four main (not mutually exclusive) factors with example categories chosen for their anticipated prevalence based on previous meta-analyses: 1) stimulus type (e.g., design, facial, spatial, scene, object), 2) testing format (e.g., recall, recognition), 3) learning format (i.e., single trial, repeated trials, associative), and 4) testing delay (e.g., immediately after exposure, after a delay of longer than 3 minutes). Tests of memory for designs typically involve remembering lined figures with a novel geometric pattern, tests of spatial memory require learning of specific spatial positions or how to navigate a route, tests of memory for scenes may involve some representation of a realistic environment, while tests of memory for objects involve memory for the specific configuration and identity of elements within a real object (e.g., doors) or a novel object. Tests that could not be categorized unambiguously into all four categories or were index measures that spanned multiple categories (such as those from thse Wechsler scales) were meta-analysed separately as individual test measures (e.g., WMS-IV Visual Memory Index).

Statistical analysis

All analyses were conducted using *R* (version 3.6.1; R Core Team, 2013) using the metafor package (Viechtbauer, 2010). For each included nonverbal memory test measure, pooled standardized mean differences (Cohen's *d*; Cohen, 1977) and pooled variance were calculated separately for: 1) left

TLE (LTLE) versus right TLE (RTLE) presurgical patients, 2) left TLR versus right TLR postsurgical patients, 3) presurgical versus postsurgical left TLR patients, and 4) presurgical versus postsurgical right TLR patients. For presurgical and postsurgical patient groups, the effect size was negative if the right hemisphere patients performed worse than the left hemisphere patients, and for postsurgical change groups the effect size was negative if performance declined following surgery.

For each meta-analysis we calculated descriptive statistics (i.e., means, standard deviations) of pooled Cohen's *d*, test statistics (i.e., 95% confidence intervals, z-scores, and *p*-values), number of studies (*k*) and sample size (*n*). The magnitude of effect sizes was appraised according to the Cochrane review of Lipsey and Wilson (2001; i.e., small: less than 0.3, medium: 0.3 to 0.7, large: > 0.7).

Overall meta-analyses by patient type and age-related variables Meta-analyses were performed for the combination of all nonverbal memory test measures separately for all three patient groups (i.e., presurgical, postsurgical, postsurgical change). To account for the correlation between tests when there was more than one test reported within the same paper (for example, Visual Reproduction and Rey Complex Figure Test), and/or when more than one measure within a test was reported within the same paper (for example, VR I and II), the pooled *d* value weighted by sample size was calculated using a multilevel mixed model design with "k/row" as a random factor, where "k" indexed the paper and "row" indexed the individual row of the datapoint. The "k/row" random factor allowed for multiple datapoints within papers by calculating variance at the k level (variance between the papers) and the k/row level (variance between the measures within papers; see Viechtbauer, 2010 and Kostopoulous et al., 2011, for more details). Differences between the overall effect sizes for the presurgical and postsurgical groups, and between the left and right postsurgical change groups were examined using *t*-tests.

We also collected data on mean patient age at testing and epilepsy onset from each paper (where reported) to determine whether these moderated the overall meta-analyses. When epilepsy duration was reported instead of age of epilepsy onset, age of epilepsy onset was estimated by subtraction of patient age at testing from epilepsy duration. As we expected that papers typically aimed to control for these potential age-related moderators between LTLE and RTLE patients, we averaged across left and right-hemispheric patients within each paper to explore effects at the paper level, rather than testing within-paper differences between LTLE and RTLE patients. Both age-related moderators were mean-corrected to account for possible multi-collinearity between the age-related variables and with test-related moderators.

Meta-regression with test-related variables as moderators To test whether stimulus type, testing format, learning format, or test delay moderated the effect size (hereafter respectively refered to by variable names: Stimulus, Format, Learning, Delay), all included papers with tests that could be categorized into each of the four categories were included as dummy-coded moderators in meta-regressions with an additive design (i.e., Stimulus + Format + Learning + Delay). To increase the validity and generalisability of findings we only ran meta-regression models for which there were at least five papers for each level of each moderator. To test for potential interactions between the factors (i.e., from two-way to four-way interactions) we expanded the validity criteria to at least five papers within each possible factor combination and ran additional meta-analyses adding any eligible interaction terms (i.e., Stimulus + Format + Learning + Delay + (Interaction 1) + (Interaction 2), etc.).

As for the overall analyses, these meta-regressions were carried out with all three samples separately (i.e., presurgical; postsurgical; postsurgical change: left TLR, right TLR) and using the multilevel mixed-model design. Differences between the left and right TLR postsurgical change groups were examined using *t*-tests. Statistically significant differences were explored using contrasts, using Bonferroni corrections for multiple comparisons.

Supplementary analysis – individual test measures Supplementary analyses were also run for each individual test measure that included different measures within the same tests (e.g., VR I and II from the WMS-III; Wechsler, 1997) and index score measures (e.g., the Visual Delayed Index from the WMS-IIII) for each of the presurgical, postsurgical, and postsurgical change samples. For individual test measure analyses without a nested paper/measure structure we used a random-effects design (that includes paper as the random factor to model between-paper variation), and when there was only a single measure within a single paper, we used a fixed-effects model to calculate a paper-specific *d* (as by definition a random-effects model cannot be employed due to zero between-study variation).

Heterogeneity and publication bias Heterogeneity was estimated using the chi-square homogenity test (Q) for all analyses. In addition, for meta-analyses which used the random-effects or mixed-effects method, we also calculated the inconsistency statistic I^2 (the percentage of the total variability in the effect size estimates, which is composed of heterogeneity and sampling variability), that can be attributed to heterogeneity among the true effects, using restricted maximum-likelihood estimation (see Viechtbauer, 2005 for details; Higgins & Thompson, 2002).To examine their relative contribution to the total heterogeneity, for multi-level, mixed-effects analyses, we also calculated the inconsistency statistic for between-paper heterogeneity (I^2_B) and for within-paper heterogeneity (I^2_W). I^2 was interpreted according to the Cochrane Collaboration (i.e., low: less than 40%; medium: 40 to 60%; large: 60%; Deeks, Higgins, Altman, & Green, 2011).).

To determine the impact of publication bias, fail-safe N values were calculated for each analysis using the following formula: $N_{fs} = k(d - d_c) / d_c$, where k = the number of studies in the meta-analysis, d = the average effect size for the studies synthesized, and d_c = the criterion value selected that d would equal when some knowable number of hypothetical studies N_{fs} were added to the meta-analysis (Orwin, 1983). The value of d_c was set at 0.01 as, based on previous reviews (e.g., Vaz, 2004), effect sizes were expected to range from small to medium for most analyses. The resulting measure N_{fs} therefore represents the number of additional unpublished studies with effect sizes of 0.01 to make the significant effect nonsignificant.

Results

Figure 1 shows the PRISMA flowchart of the literature search that resulted in 158 included articles. Table 2 shows the total number of participants and the sample types tested in each included paper (i.e., presurgical, postsurgical or both). Further details of all included samples are in Supplementary Table 1, including the nonverbal memory tests and measures used in each paper, the average age at testing and epilepsy onset (where applicable) and the type of surgery used in postsurgical samples.

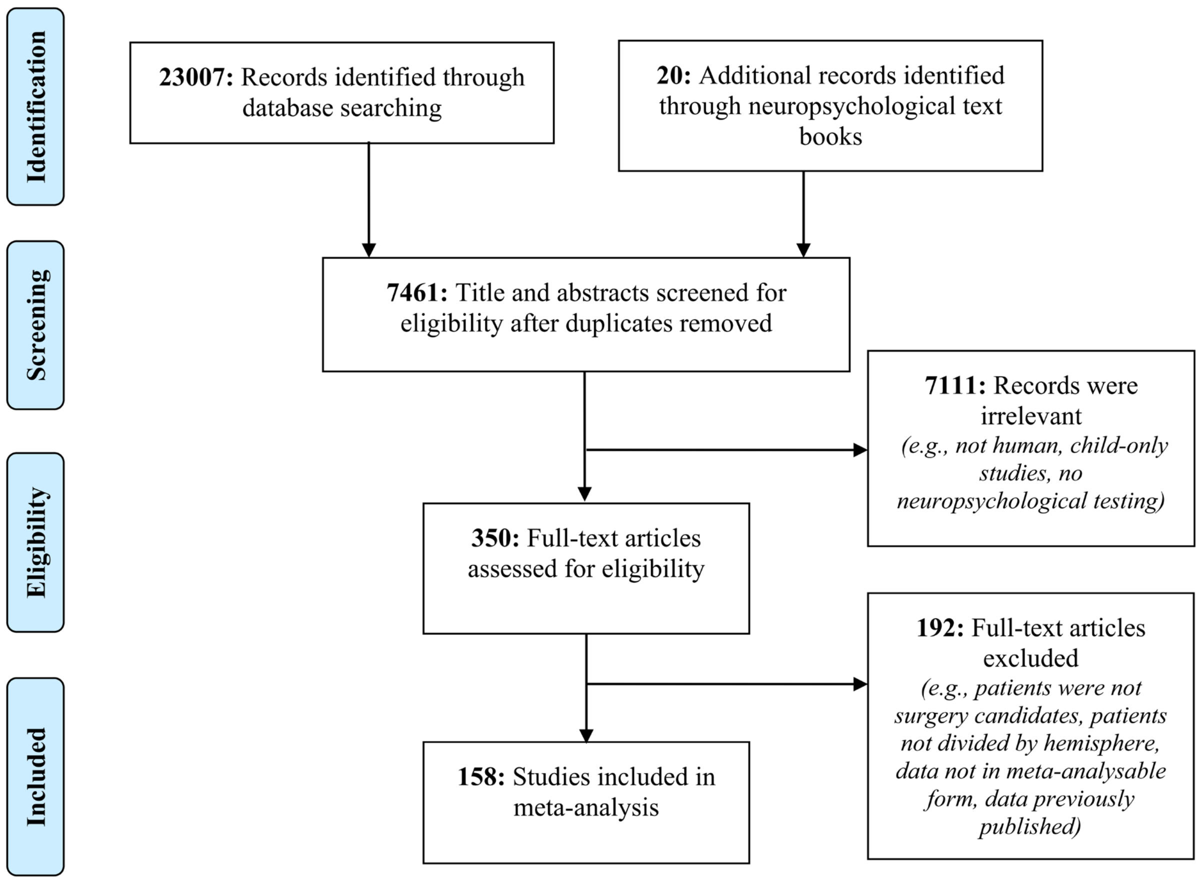


Fig. 1. Summary of the literature search and process of inclusion and exclusion of studies (numbers of records in bold).

Table 2 shows the breakdown of numbers of papers (*k*) and patients (*n*) by each of the test moderators. This shows that for some stimulus types there were too few papers to be included in all analyses (e.g., k = 4 studies using spatial stimuli with postsurgical patients). Furthermore, tests of scene memory (stimulus type) almost exclusively involved the Family Pictures subtest of the WMS-III, the only test employing explicit association (learning format) was the Visual Paired Associates test from the WMS-R, and the only test of object memory (stimulus type) was the Doors test from the Doors and People battery. It was therefore considered misleading to refer to these tests as moderators per se and they were therefore excluded from the moderator analyses. However, as for all memory tests, measures from these excluded tests were analysed individually and reported in summary form in the corresponding section below with full results reported in Supplementary Tables 2 to 5.

Table 2. Counts of papers, rows of data and participants by moderator variables and patient group.

		Presurgical				Postsurgical				Postsurgical change			
Moderators	Moderator Level	*k*	*rows*	*n_L*	*n_R*	*k*	*rows*	*n_L*	*n_R*	*k*	*rows*	*n_L*	*n_R*
Stimulus	Designs	103	243	3581	3345	63	133	2066	2046	49	98	1735	1719
	Faces	26	37	737	665	15	21	338	341	10	15	227	233
	Spatial[a]	7	15	217	213	4	10	109	127	2	3	92	103
	Scene	6	10	185	129	3	6	78	74	1	2	7	8
	Associative	3	6	148	128	-	-	-	-	-	-	-	-
	Object	-	-	-	-	1	1	24	23	-	-	-	-
Learning format	Single	104	243	3612	3397	63	144	2005	2002	44	94	1592	1591
	Repeated	44	84	1632	1525	22	41	975	928	21	29	966	919
Test delay	Learning	114	166	3762	3505	70	94	2129	2095	52	64	1731	1700
	Delayed	101	158	3623	3383	56	89	1979	1964	41	58	1610	1603
Test format	Recall	121	238	4305	3957	69	133	2309	2288	49	92	1821	1803
	Recognition	59	77	1975	1837	31	37	860	880	21	27	644	659
Index[b]		26	33	1001	899	15	22	606	567	9	11	483	463

k: number of papers
r: number of rows/datapoints (exceeds k when multiple measures within the same category are nes-ted within same paper)
n: number of patients, divided by side of temporal lobe epilepsy/surgery (left: *n_L*; right: *n_R*)
[a] spatial category of materials also includes navigational or route-finding tests
[b] index measures are composites of other individual tests, usually involving the Wechsler Memory Scale index scores, and are mixtures of different kinds of moderator levels (i.e., stimulus types, learn-ing formats, testing dela ys and testing formats)

Supplementary Table 6 shows the number of papers with data for all combinations of moderators (i.e., Stimulus by Repetition by Delay by Format combinations). Some combinations of moderators did not reach the threshold of five papers, therefore associated interaction terms were not analysed. Supplementary Table 7 shows the moderator analyses that were run by each patient type.

Overall pooled meta-analytic results and association with age-related moderators

Figure 2 shows mean pooled *d* values, confidence intervals and *p*-values for lateralization effects (left minus right hemisphere) of nonverbal memory tests for a) presurgical patients, b) postsurgical patients, and c) postsurgical change.

Presurgical patients Figure 2A shows that for presurgical patients there was a small-sized effect of lateralization on nonverbal memory performance, with RTLE presurgical patients performing worse than LTLE patients. For papers where the moderators patient age and age of epilepsy onset were reported (k = 101, M_{age} = 34.42; M_{ons} = 14.08), there was no significant effect of these moderators in combination (Q_M = 1.38, p = .50) or in isolation (*ds* < .011, *ps* = .87 and .27, respectively).

Postsurgical patients Figure 2A shows that for the entire sample of 82 papers with data from postsurgical patients, right TLR patients performed worse than left TLR patients. There was no significant effect of patient age or age of epilepsy onset in combination (Q_M = 0.67, p = .71) or in isolation (*ds* < .01, *ps* = .86 and .41, respectively) for postsurgical patients (k = 56; M_{age} = 33.56; M_{ons} = 13.39). The difference between right and left TLR patients was significantly larger for postsurgical patients than presurgical patients, M_{diff} = -0.11 [-0.19, -0.02], t = 2.52, p = .01.

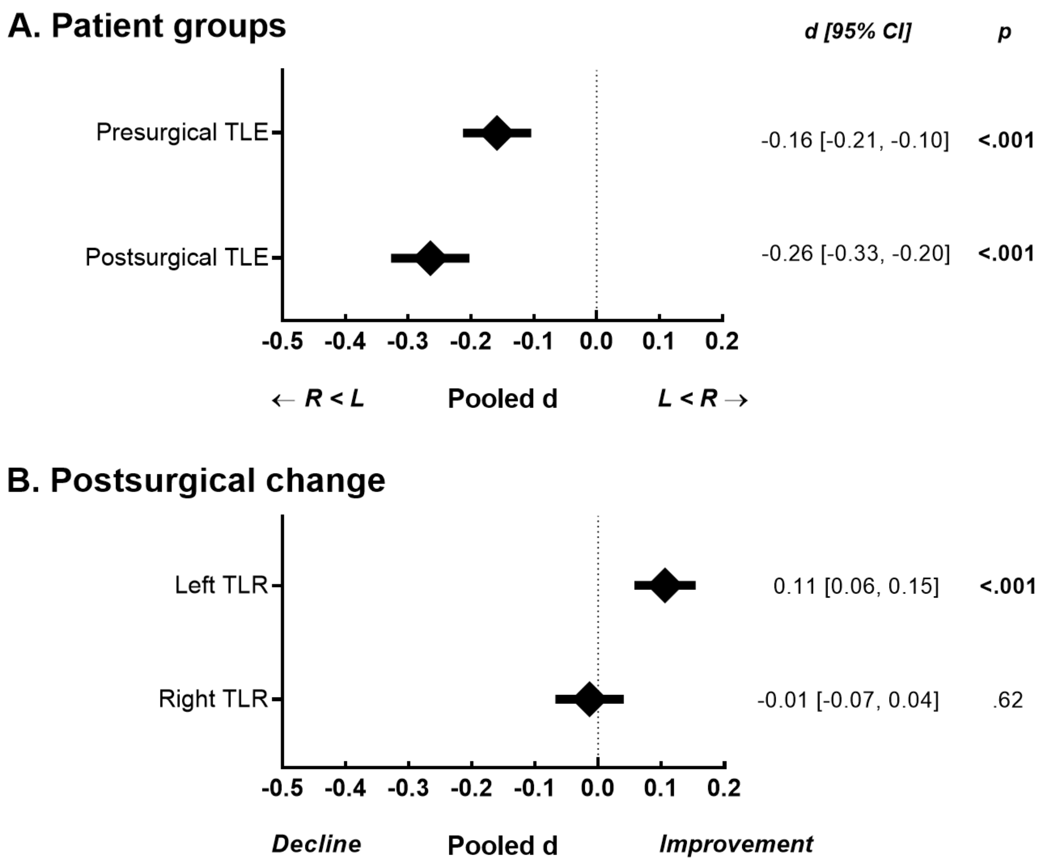


Fig. 2. Standardized effect sizes (Cohen's *d*) and 95% confidence intervals of lateralization (left minus right TLE performance) for all nonverbal memory tests. A: LTLE minus RTLE performance in presurgical and postsurgical patients. Negative effect sizes indicate worse performance for RTLE than LTLE patients. B: postsurgical change (presurgical minus postsurgical performance) divided by hemisphere of TLR. Negative effect sizes indicate worse postsurgical than presurgical performance. Sample size (*k*, studies) inferential statistics, heterogeneity and fail-safe N measures are in Supplementary Table 8.

Postsurgical change Figure 2B shows pooled effect sizes for postsurgical changes in memory performance for left and right TLR patients, respectively ($k = 60$). For left TLR patients the overall pattern indicated a small but significant improvement in nonverbal memory following surgery. For right-resected patients the effect size was negligible and nonsignificant, and there was a signficant difference between the left and right TLR groups, $M_{diff} = -0.12$ [-0.19, -0.05], $t = 3.18$, $p = .002$. In papers reporting both patient age and age of epilepsy onset for postsurgical change patients ($k = 43$), the age-related moderators reached significance in combination for left TLR patients ($Q_M = 6.01$, $p = .049$), but not for right TLR patients ($Q_M = 0.14$, $p = .93$). For left TLR patients, patient age was not significant in isolation ($d = -0.01$, $p = .17$), but age of epilepsy onset was significant ($d = 0.02$, 95% CI [0.003, 0.04], $p = .02$), showing that left TLR patients with an earlier age of epilepsy onset had greater decline in nonverbal memory than those with a later age of epilepsy onset. However, this effect size is so small as to be considered negligible. For right TLR patients neither patient age or age of epilepsy onset reached significance in isolation, *ds* < .001, *ps* = .77 and .78, respectively.

Meta-regression of lateralization effects by stimulus type and test-related moderators

Presurgical patients Figure 3A shows that, for the additive meta-regression model, the moderators collectively did not have a significant effect on lateralization in presurgical patients ($Q_M = 4.12$, $p = .53$), and were not significant as individual moderators, *ds* < 0.14, *ps* < .21. Figure 3B shows the interactive model that was not significant, $Q_M = 9.56$, $p = .57$, along with all of its main effect and interaction terms. There was a statistical trend for a Learning x Delay interaction ($d = 0.16$, $p = .07$). Figure 3C shows the results for specific moderator levels. Taken together, for presurgical patients, the small-sized performance decrement on nonverbal memory tests for RTLE versus LTLE patients was not significantly affected by simulus or task-based factors of the nonverbal memory tests.

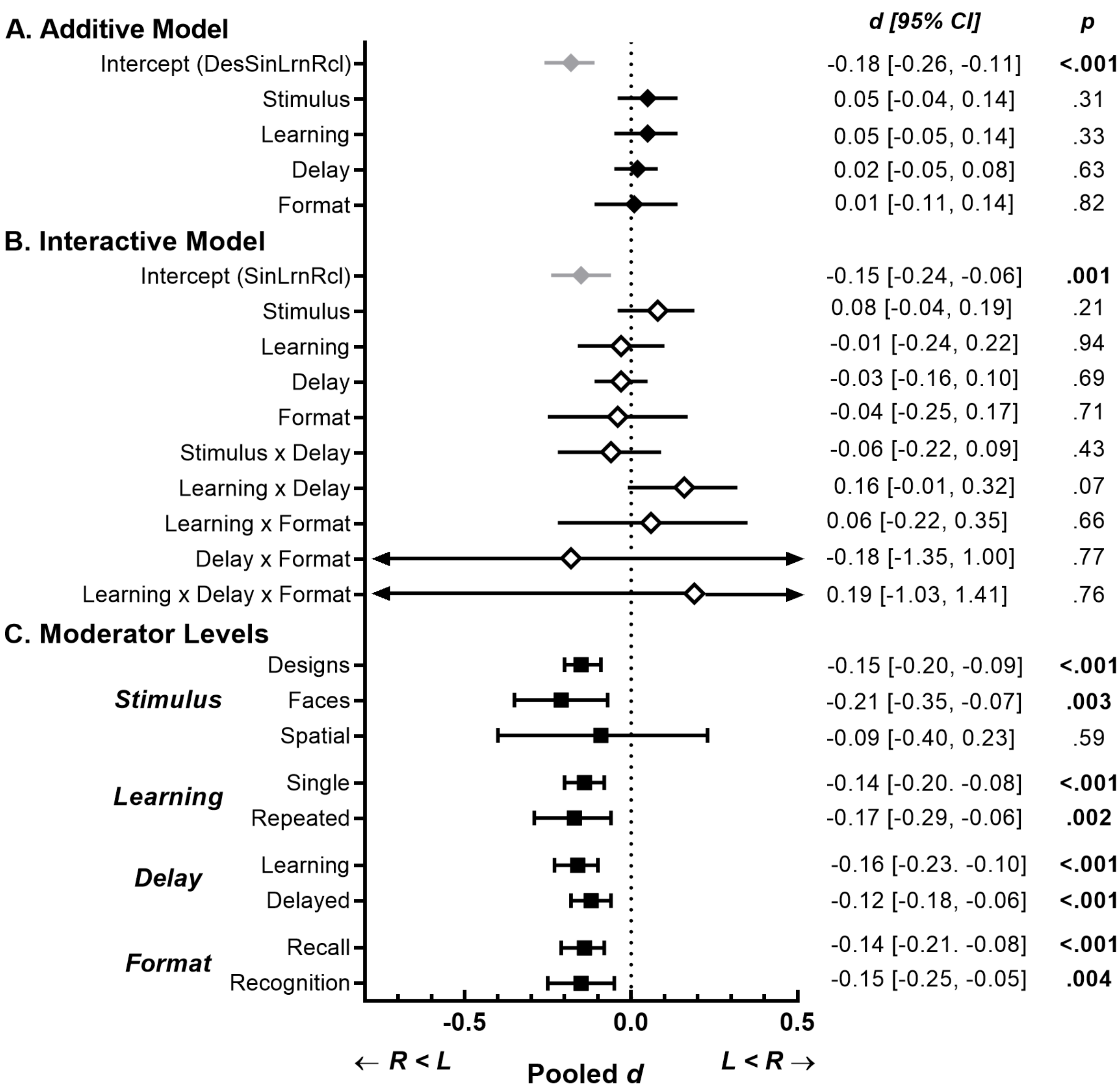


Fig. 3. Standardized effect sizes (Cohen's *d*) and 95% confidence intervals of lateralization (left minus right TLE performance) for presurgical patients, by type of moderator analysis and individual moderator levels. Negative effect sizes indicate poorer performance for right than left TLE patients. Arrows indicate that the confidence intervals exceed the scale. Sample size (*k*, studies) inferential statistics, heterogeneity and fail-safe N measures are in Supplementary Table 9.

Postsurgical patients Figure 4A shows that for the additive meta-regression model, the moderators were significant as a group, $Q_M = 19.44$, $p = < .001$, with a significant Stimulus effect on right-lateralization (Faces > Designs, $d = -0.33$, $p = .003$). No other moderators were significant. Figure 4B shows the moderators were not collectively significant for the interactive model, $Q_M = 10.45$, $p = .11$, but there was a significant effect of Format (Recognition > Recall, $d = -0.23$, $p = .01$).

The latter result seemed notable as Format was not significant in the additive model when the Stimulus factor was present (note that a Stimulus x Format interaction could not by definition be included in the interactive model as there were no Faces-Recall tests to complete all cross-combinations of Stimulus x Format). We therefore considered it possible that tests with facial stimuli may be disproportionately explaining the Recognition effect. Contrasts with Bonferroni-correction to account for multiple comparisons (i.e., $p = .05/2 = .025$) showed that the effect size for Faces-Recognition was significantly larger than for Designs-Recognition, while the effect size for Designs-Recognition was not significantly larger than Designs-Recall (see Figure 4D). Therefore, when taken together, for postsurgical patients the lateralization effects (right < left performance) were affected by stimulus type (faces > designs) that appeared to overshadow and explain the effects of testing format (recognition > recall).

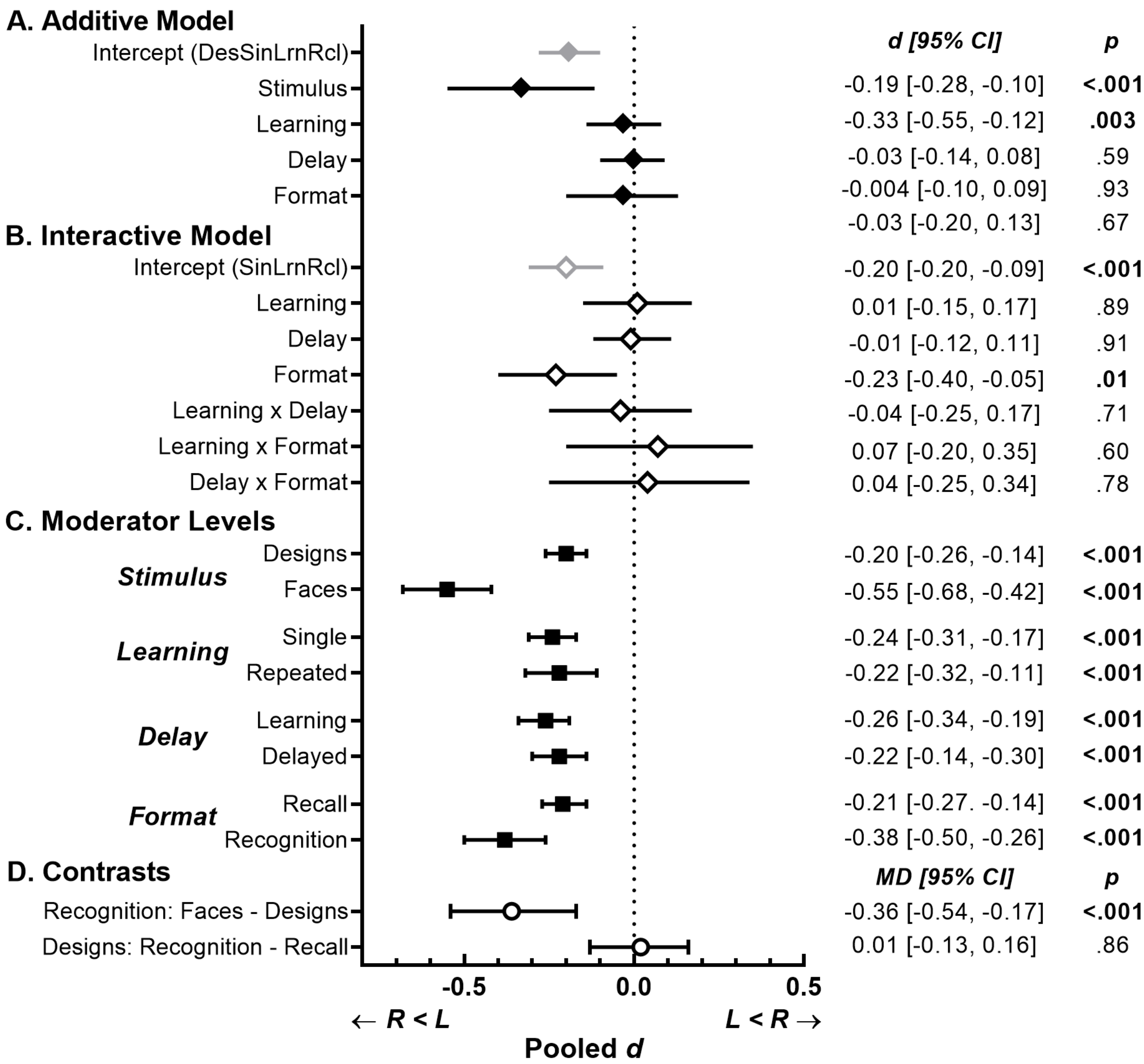
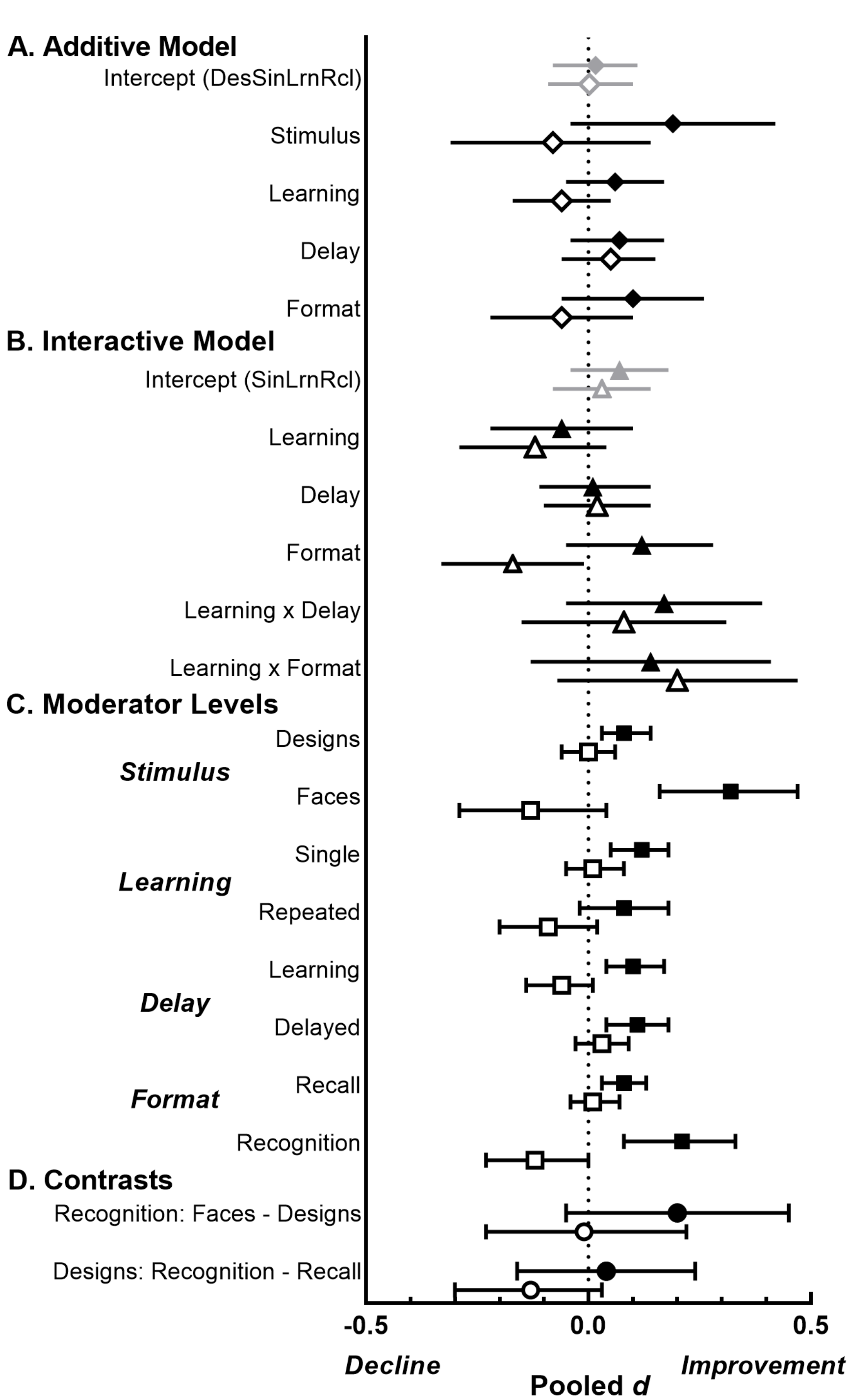


Fig. 4. Standardized effect sizes (Cohen's d) and 95% confidence intervals of lateralization (left minus right TLR performance) for postsurgical patients, by type of moderator analysis and individual moderator levels. Negative effect sizes indicate poorer performance for right than left TLR patients. Sample size (*k*, studies) inferential statistics, heterogeneity and fail-safe N measures are in Supplementary Table 10. Contrasts used mean differences and t-statistic.

Postsurgical change For postsurgical change, the additive meta-regression model showed no significant effects of any of the moderators for either left TLR or right TLR patients (see Figure 5A). The interactive model (Figure 5B) showed no significant main effects or interactions for left TLR patients, but for right TLR patients it showed a significant effect of Format (Recognition > Recall). To determine whether this Format effect for the right TLR group was influenced by Stimulus (for the same reasons as described in the section above for the postsurgical sample, see Figure 5D), we used Bonferroni-corrected contrasts. These showed no significant differences between Faces-Recognition and Designs-Recognition or between Designs-Recognition and Designs-Recall, suggesting that Stimulus did not confound the Format



effect.

Fig. 5. Standardized effect sizes (Cohen's *d*) and 95% confidence intervals of postsurgical change in performance (postsurgical minus presurgical) by hemisphere of TLR (left: black markers; right: white), type of moderator analysis and individual moderator levels. Negative effect sizes indicate poorer postsurgical than presurgical performance. Sample size (*k*, studies) inferential statistics, heterogeneity and fail-safe N measures are in Supplementary Tables 11 (left TLR) and 12 (right TLR). Contrasts used mean differences and *t*-statistic.

Postsurgical change: left versus right TLR Figure 6 shows postsurgical change for left TLR versus right TLR patients. The only significant moderator was Format (Recognition > Recall) for the interactive model only. Additional contrasts showed no significant differences between Faces-Recognition and Designs-Recognition or between Designs-Recognition and Designs-Recall (see Figure 6D). All within-moderator groups showed statistical sensitivity to TLR lateralization (right < left) except for Delayed and Recall, with Faces showing the largest effect, M_{diff} = -0.44, p = .001, followed by Recognition, M_{diff} = -0.33, p < .001.

In summary, for postsurgical change, there was a small effect of testing format in favor of recognition over recall for right TLR patients, and a difference between left and right TLR patients that emerged only when accounting for other test-related moderators and their interactions.

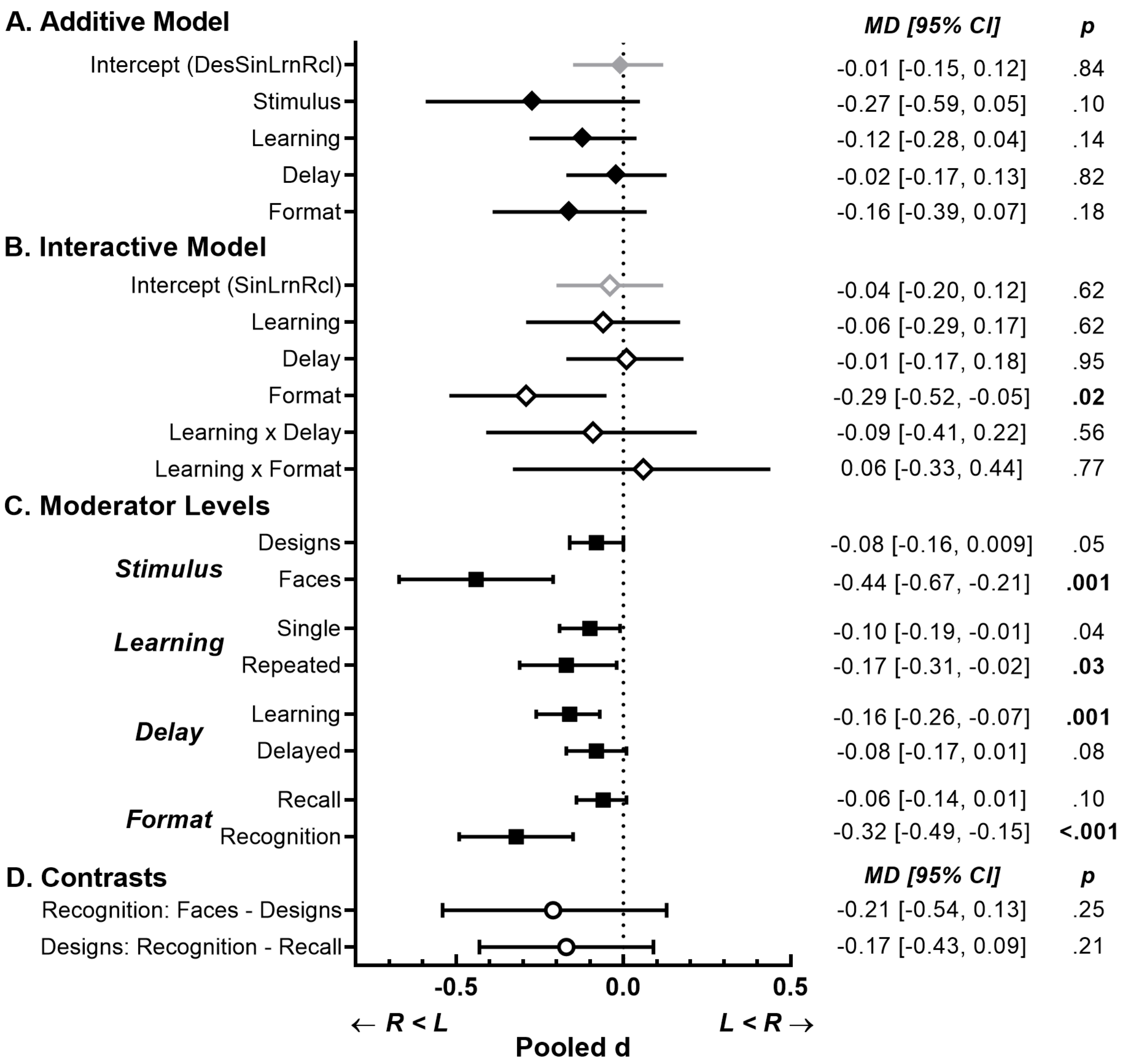


Fig. 6. Standardized effect sizes (Cohen's *d*) and 95% confidence intervals for lateralization of postsurgical change (i.e., difference between postsurgical minus presurgical change in performance for left minus right TLR patients), by type of moderator analysis and individual moderator levels. Negative effect sizes indicate poorer postsurgical than presurgical performance, positive values indicate better postsurgical than presurgical performance. Sample size (*k*, studies) inferential statistics, heterogeneity and fail-safe N measures are in Supplementary Table 13. Contrasts used *t*-statistic.

Supplemental analyses - Results by individual tests

Due to their prohibitive numbers, a full summary of meta-analysis results from individual test measures is too exhaustive to include here but has been included in the Supplementary Material (see Supplementary Tables 2 to 5 for complete results for presurgical, postsurgical, and postsurgical change results, respectively). Very briefly, the most important outcomes were:

- that only one measure, from the Design Learning test from the Adult Memory and Information

Processing (AMIPB) showed significant right-lateralization (R < L) of presurgical patients with evidence from 5 or more studies (Total Learning Score Trials 1 to 5: d = -0.51, p < .001, k = 8),

- the WRMTF was the sole test to significantly distinguish postsurgical change between left and right TLR patients, d = -0.55, p = .004, where left TLR patients showed a significant improvement following surgery, d = 0.23, p = .03, and right TLR patients showed a significant decline, d = -0.30, p = .007 (k = 7).

Heterogeneity

Supplementary Tables 8 to 13 show full statistics for Figures 2 to 6 including heterogeneity. For the overall analyses, heterogeneity was high for the presurgical and postsurgical patient groups as shown by highly significant Q values, but was not significant for the left TLR and right TLR postsurgical change groups. Heterogeneity as a percentage of overall variance (I^2) was in the medium range for presurgical patients and in the low range for postsurgical and postsurgical change groups. The pattern of I^2 values indicated that the majority of the heterogeneity was explained by true variation in the effect size, relative to variability between the study samples. The large size of I^2_B values, relative to negligible I^2_W values, indicates that most of this true variation in effect sizes can be attributed to between-paper rather than within-paper heterogeneity.

This general pattern was also shown for the meta-regression analyses of moderators. There were minor exceptions including the Delayed moderator level in the presurgical group that showed relatively high within-paper heterogeneity (i.e., I^2_W = 16% versus I^2_B = 24%). In the postsurgical group, Faces did not exhibit significant heterogeneity, suggesting comparative uniformity in the medium-to-large effect sizes that could be associated with shared similarities in test design, such as the use of a recognition format and predominantly single stimulus exposure, in addition to the predominance of one test, the WRMTF, in this group. Again within the postsurgical group, Repeated trials and Learning each showed greater within-paper than between-paper heterogeneity, potentially reflecting the wide variety of memory measures available for these tests that feature in these categories (e.g., measures for the RVDLT include Total Learning, Immediate Recall, Delayed Recall and Recognition measures). Heterogeneity statistics for individual tests must be interpreted with caution as estimates of become highly imprecise with small sample size (Viechtbauer, 2005).

Publication bias

For each significant effect size, the calculated fail-safe N required to reverse the significant effects was well in excess of the number of unpublished studies with an effect size of 0.01 that were reasonably hypothesized to exist (see Figures 3 to 6 and Supplementary Tables 2 to 4). This indicates that it is highly unlikely that each of the observed significant effects are explained by publication bias.

Discussion

This is the most comprehensive meta-analysis to date of the lateralizing capabilities of nonverbal memory tests in patients with unilateral TLE. A large sample of papers representing more than four thousand patients was gathered and, unlike previous reviews (e.g., Lee et al. 2002; Sherman et al., 2011; Vaz, 2004), we considered presurgical patients and systematically examined the moderating effects of test characteristics and age differences on the size of lateralization effects. To our knowledge, this is also the first meta-analysis on nonverbal memory tests to statistically account for the impact of multiple test measures within papers.

This study revealed several novel findings. Taking all nonverbal memory tests together, patients with RTLE performed slightly worse than patients with LTLE, in both the presurgical and postsurgical patient groups, with larger differences for the postsurgical group compared to the presurgical groups. For presurgical patients, lateralization effects (right < left) were consistently small and did not differ by stimulus type, learning format, duration of testing delay, or testing format. For postsurgical patients, tests using facial stimuli showed larger right-lateralization effects than tests using design stimuli, and further analysis showed this effect of stimulus type (faces > designs) appeared to overshadow and explain an apparent effect of testing format (recognition > recall). Change in nonverbal memory performance following TLR showed an overall pattern of mild improvement in left TLR patients and no change in right TLR patients. In right TLR patients only, the effect size for postsurgical change was moderated by testing format (recognition > recall), that emerged when accounting for other test-related factors (Repetition and Delay) and their interactions. This advantage for recognition over recall was maintained when comparing postsurgical change for left and right TLR patients and did not appear to differ by the type of stimulus. Patient age at the time of the assessment had no significant effect on nonverbal memory performance in any patient sample, while patients with left TLR performed worse on nonverbal memory tests following surgery when the age of epilepsy onset was younger.

Our meta-analysis shows that the testing format moderates the capacity of nonverbal memory tests to reveal memory decline following surgery (i.e., recognition > recall) for right TLR patients and that they better discriminate postsurgical change of left and right TLR patients. This suggests that a recognition format may more specifically test memory consolidation and storage functions linked to the medial temporal lobe than a recall format (Lowndes & Savage, 2007; Mayes et al. 2007). In contrast, other test attributes including stimulus type, learning format and test delay did not impact the right-lateralization effect for the postsurgical change group (cf. Jones-Gotman, Harnadek, & Kubu, 2000; Majdan et al., 1996). Our findings support the recommendations of the International League Against Epilepsy (ILAE; Wilson et al., 2015) report regarding the use of recognition testing alongside recall measures for comparison, from the same tests where applicable.

This study additionally updates previous reviews that suggested face memory tests were more sensitive to postsurgical right TLR than design memory (Sherman et al., 2011; Vaz, 2004), and expands this to a systematic level accounting for other task-related factors. This advantage of faces over other types of nonverbal stimuli could be related to their lower verbalisability (e.g., Kelley et al., 1998) and is supported by evidence of a strongly right-lateralized network, including the right hippocampus, for perceptual encoding processes of the configural elements of faces (e.g., Crane & Milner, 2002). Our finding of stimulus-related effects similarly supports ILAE recommendations to include different nonverbal memory tests with different types of stimuli. Taken together, these key results highlight the value of considering the multi-factorial nature of testing nonverbal memory when comparing between different types of tests and their attributes.

We found mild improvements in nonverbal memory following left TLR, complementing previous findings and those showing improvement in verbal memory function after right TLR (Baxendale, Thompson, & Duncan, 2008). This may be due to increased reserve capacity of the contralateral right side to process nonverbal material following the elimination of uncontrolled seizures that spread from the left to the right hemisphere (e.g., see Novelly et al., 2004), and/or to increased functional adequacy of the resected left side to process nonverbal material using left-lateralized processes (Chelune, 1995).

While we replicated previous findings that age-related moderators—specifically age of epilepsy onset—affected the degree of improvement following left TLR surgery in TLE patients (Baxendale et al., 2006; Herman, Seidenberg, Haltiner, & Wyler, 1995; Hermann, Davies, Foley, & Bell, 1999; Lespinet et al., 2002), our results were in the opposite direction to previous studies that showed worse performance with older age of epilepsy onset. This discrepancy may be due to our use of the meta-analytic method which measures the effect of variation in age between groups at the between-paper level (where for any given paper, age is typically statistically matched between left and right TLE patients), rather than the variation between individuals at the within-paper level. As our finding had a small effect size (d = 0.02) and was not replicated in any other sample it probably has unclear theoretical or clinical implications and should be interpreted with caution when compared to previous findings of an opposing effect.

Limitations and further research

Our meta-analysis grouped together test measures that may have otherwise varied considerably, for example, different types of design stimuli of tests within the designs category, and tests with different number of repeated learning trials in the repeated category. This likely affected the heterogeneity statistics which were larger for designs than for faces, for example. We aimed to reduce these effects by using a mixed-model design that better accounts for between-study variance than does an analysis using a fixed or random effects model.

Our results lack generalizability to several groups of TLE patients who were excluded from analysis, including non-surgical patients, those with bilateral TLE, or poor post-surgical seizure control, children and adolescents or older adults, and patients with atypical (bilateral or right) lateralization of speech and language functions. A comparison of patients following standard anterior temporal lobectomy, which typically removes some ventrolateral structures, with those following selective amygdalohippocampectomy (SAH) techniques was not pursued here due to insufficient studies indicating the latter, but future work of this type could do so to cast more light on anatomical factors that may interact with test-related contributions. Further research could extend our meta-analysis to predict TLE laterality via a combination of nonverbal and verbal tests, potentially increasing disciminative capacity. Such work would also greatly benefit from examining the multi-domain cognitive phenotypes of TLE patients, beyond the traditional focus on lateralization of language and memory to better account for variations and impairments in intelligence, visuoperception, speed and executive functioning, as this may increase the precision and parsimonious interpretation of the findings (Elverman et al., 2019; Reyes et al., 2020).

We could not conduct a detailed assessment of the *task specificity* view of medial temporal lobe function (Saling, 2009) as there were not sufficient studies using validated measures of associative memory to contrast to other types of task, and furthermore this would have required the addition of associative and non-associative verbal memory tasks in order to adequately test the predictions of this hypothesis, which was beyond the scope of this paper. For similar reasons we were unable to consider the results from a cognitive phenotyping point of view, in light of which we suggest caution in interpreting our data given that the cognitive phenotypes most relevant to our data, the language/memory and global/generalized impairment profiles, together only characterize at most a small majority of TLE patients (Elverman et al., 2019; Reyes et al., 2020). This non-universal status of TLE patients with predominant language/memory impairments, combined with the low prevalence of memory profiles that show highly material-specific lateralization (Castro et al., 2013) likely contribute to the generally low efficacy of nonverbal memory tests for identifying RTLE cases. It therefore may be unreasonable to expect nonverbal memory tests to discriminate LTLE and RTLE with a high degree of accuracy, particularly without accounting for multiple additional contributing factors.

More generally, while information from meta-analyses can be helpful in making broad inferences at the group level, as at the individual level they mask the considerable variations in postsurgical trajectories of cognitive function and therefore may lack predictive value for individual patients (Engman, Andersson-Roswall, Samuelsson & Malmgren, 2006). This limitation must be considered when interpreting our postsurgical change data, that showed a significantly greater right-lateralization effect for recognition than recall measures, particularly as the effect seemed driven by improvement in left TLR patients and not by decline in right TLR patients. To increase clinical applicability to individual patients, future work could combine our approach to characterizing memory tasks with important predictors of individual decline (i.e., demographics, psychiatric background, length of illness, imaging results, cognitive phenotype) and use change data from individual patients.

Given the modest effect sizes of most tests examined and the lack of moderating effects of test-related factors on the capacity of nonverbal memory tests to indicate impairment in RTLE presurgical samples, there remains a clear and urgent need for improved tests to predict the effects of right temporal lobe pathology. The results of this study emphasize the importance of a systematic approach when examining multiple test-related factors and we hope this will guide future test development and validation. While the WRMTF has the strongest evidence and therefore in principle should be supported for future work, we recognize that this is partly an artifact of its age and it is now rarely used due to several important flaws (primarily its bias against non-Caucasian patients due to the use of only Caucasian males as stimuli). A contemporary version of the WRMTF could also be developed and investigated and/or highly promising tests with limited research background should be examined in more detail such as the Doors test (Morris, Abrahams, Baddeley & Polkey, 1995) and the Dade Face Learning Test (Dade & Jones-Gotman, 2001). The Design Learning test from the AMIPB had the strongest evidence for indicating nonverbal memory impairment in RTLE presurgical samples, and we encourage further clinical and research work with this test.

Conclusion

This comprehensive meta-analysis has shown the value of nonverbal recognition measures in detecting postsurgical change in right TLR patients. Our findings have ramifications for the choice of measure in the clinical assessment of unilateral TLE patients and also on the design of future measures for this purpose.

Ethical approval: For this type of study formal consent is not required.

Conflict of Interest: The authors declare that they have no conflict of interest.

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* Asterisks indicate studies that were included in the meta-analysis

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Supplementary Material

Formulae for combining multiple groups

If multiple within-study subgroups satisfied inclusion criteria, these data were pooled into one group using the following formulae:

$$M_{pooled} = M1.\left(\frac{n1}{n1+n2}\right) + M2.\left(\frac{n2}{n1+n2}\right) \quad (1)$$

$$SD_{pooled} = \sqrt{([SD1^2.(n1-1) + SD2^2.(n2-1)]/[n1+n2-2])} \quad (2)$$

where M_{pooled} and SD_{pooled} are the pooled mean and standard deviation, respectively, and *M*1, *SD*1, *n*1 and *M*2, *SD*2, *n*2 are the means, standard deviations, and sample size of the first and second groups, respectively. When more than two within-study groups were pooled, this process was repeated until all groups were combined. When multiple papers used part or all of the same sample of patients, only the paper with the largest sample size was included, presuming this paper also met all other inclusion criteria.

Supplemental analyses - Results by individual tests

Meta-analysis results from individual test measures are briefly summarized here (please see Supplementary Tables 2 to 5 below for complete results for presurgical, postsurgical, and postsurgical change results, respectively).

Presurgical patients Only 25 out of the 111 total individual test measures (23%) showed significant lateralization effects in presurgical patients (R < L TLE; note, two showed significant L < R TLE), consistent with the small effect sizes seen for the overall sample of nonverbal memory tests. However, several test measures showed significant lateralization (R > L) with large effect sizes (*ds* > 0.7), albeit from few studies:

1. Route Learning Test (d = -2.65, p < .001, k = 1. Note, this measure was not included within any moderator analysis as its test format was a mixture of recall and recognition);

2. Figure Learning test from the Adult Memory and Information Processing Battery (AMIPB; Immediate Recall: d = -1.40, p = .01, k = 1; and Delayed Recall: d = -0.74, p < .001, k = 3);

3. Dade Face Learning Test (Learning 4th Exposure: d = -1.32, p < .001; and Immediate Recognition: d = -1.05, p = .003; k = 1);

4. Diagnostikum für Cerebralschädigung (DCS; Delayed Recall: d = -0.86, p = .04, k = 1).

The largest significant effect size for a measure with five or more studies was for Design Learning from the AMIPB (Total Learning Score Trials 1 to 5: d = -0.51, p < .001, k = 8).

Among the most widely-used clinical measures with five or more studies, measures from the Rey Complex Figure Test (RCFT; Immediate Recall, Delay Recall and Percent Retention), Visual Reproduction (VR, from original WMS; Delayed Recall and Percent Retention) and the Visual Delayed Index from the WMS-III showed statistically significant TLE lateralization albeit associated with small effect sizes (*ds* < 0.23). However, other measures from popular tests were not significant (see Supplementary Table 2 for full results), including: the Benton Visual Recognition Test; all WMS-III visual tests (i.e., VR, Faces, and Family Pictures); VR and Visual Paired Associates from WMS-R; the Warrington Recognition Memory Test for Faces (hereafter, WRMTF; note, this was borderline significant with p = .06).

Postsurgical patients Only 22 of the 75 individual test measures (29%) showed significant lateralization effects in postsurgical patients (all R < L TLR). The WRMTF had the largest significant effect size among measures with five or more studies (d = -0.65, p < .001, k = 11), and other measures with significant medium-sized lateralization effects (R < L) from more than one study included all the remaining measures involving facial stimuli, that is, Faces I and II from the WMS-III (respective *ds* = -0.56 and -0.37, p = .03 and .02, *ks* = 3), the Graduate Hospital Facial Memory Test (GHFMT; Immediate Recognition; d = -0.49, p = .02, k = 2), and in addition RCFT Percent Retention (d = -0.50, p = .005, k = 3), Design Learning from AMIPB (Total Learning Score Trials 1 to 5: d = -0.44, p < .001, k = 3), the Visual Immediate and Delayed Indexes from the WMS-III (respective *ds* = -0.46 and -0.35, *ps* = <.001, *ks* = 4 and 5).

The measures with the largest lateralization effect for postsurgical patients (in descending order, all k = 1) were the Doors Test (d = −1.99, p < .001), Figure Learning from the AMIPB (Percent Retention: d = -1.88, p = .001), the Continuous Visual Memory Test (CVMT; Delayed Recognition: d = -1.64, p < .001), the Brown Location Test (Total Learning Trials 1 to 5: d = -1.56, p < .001; also note this test's large effect sizes for Short Delayed Recall d = -1.09, p = .03, Rotation Delayed Recall, d = -1.09, p = .03, and Long Delayed Recall, d = -1.04, p = .04), VR I from the WMS-III (Immediate Recall: d = -1.30, p =.02) and Designs I (Immediate Recall: d = −1.00, p = .03), and VR I (Immediate Recall: d = −0.96, p = .04) from the WMS-IV. Among the most popular clinical measures with five or more studies, VR I and II from the WMS (original edition) and RCFT Delayed Recall also showed significant lateralization effects (*ds* < 0.22).

Postsurgical change Only 9 of the 42 individual test measures (21%) showed significant lateralization effects in postsurgical change for either left or right TLR patients. WRMTF was the only test measure that showed significant differences in postsurgical change between left and right TLR patients, d = -0.55, p = .004, where left-TLR patients showed a significant improvement, d = 0.23, p = .03, and right TLR patients showed a significant decline, d = -0.30, p = .007. Other tests showed significant improvement for the left-TLR group only (Rey Visual Design Learning Test, Delayed Recall and Recognition; WMS-III, VR II ; CVMT, Delayed Recognition; AMIPB Figure Learning, Percent Retention; GHFMT, Immediate Recognition; RCFT, Immediate Recall), significant decline for right TLR only (DCS, Total Trials 1 to 5; Nonverbal Selective Reminding Test, Delayed Recall), or improvement for both left and right TLR (RCFT, Delayed Recall).

Supplementary Table 1. Included papers with number of patients, age at assessment and age of epilepsy onset, and test measures.

First author	Year	Paper No	*N*-pre L	*N*-pre R	*N*-post L	*N*-post R	*Age*-L	*Age*-R	*Onset*-L	*Onset*-R	Surgery	Follow-up	Test measures
Abrahams	1999	1	25	22			30.6	32.0	5.9	7.8			RCF (Dl_Rcl, Pc_Ret)
Adda	2008	2	22	26			37.2	38.2	10.5	11.5			RCF (Im Rcl, Dl_Rcl)
Akanuma	2003	3	51	47			29.2	32.4	8.2	11.7			RCF (Pc_Ret)
Alessio	2006	4	20	19									VMI_WMSR
Alessio	2013	5	8	8			37.6	40.3	5.4	6.5			VMI_WMSR
Araujo	2009	6	32	20			39.1	40.1					VR_WMS3 (Im_Rcl, Dl_Rcl, Pc_Ret); RULIT (Dl_Rcl, Cor_Tr2)
Baker	2003	7	63	36			34.5	32.6	14.4	17.6			VII_WMS3; VDI_WMS3; Fac_WMS3 (Im_Rcg, Dl_Rcg); FamPic_WMS3 (Im_Rcl, Dl_Rcl)
Bandt	2013	8	6	13	6	13	48.5	39.6	13.5	12.8	tmtg-SAH	≥ 12	VR_WMS3 (Im_Rcl, Dl_Rcl)
Barnett	2015	9	12	14			35.9	36.2	19.0	20.9			VM_FACT
Barr	1997a~	10	57	48			31.3	33.0	13.2	15.8			Denman_FacLT_Rcg; VMI_WMSR
Barr	1997a~	10	33	32			31.3	33.0	13.2	15.8			724SLT (Short_Dl_Rcl, Long_Dl_Rcl, Tot_Lrn_Rcl)
Barr	1997b	11	47	35			32.1	34.4	13.2	15.7			VR_WMSR (Im_Rcl; Dl_Rcl; Pc_Ret); VPA_WMSR (Im_Cue_Rcg; Dl_Cue_Rcg); VMI_WMSR
Barr	1997c~	12	187	168			32.3	32.4	11.8	13.5			RCF (Dl_Rcl; Pc_Ret)
Barr	1997c~	12	84	82			31.8	32.4	13.2	14.5			VR_RUS_WMS1 (Im_Rcl, Dl_Rcl, Pc_Ret)
Barr	1997c~	12	277	256			31.6	32.2	12.4	13.6			VR_WMS1 (Im_Rcl, Dl_Rcl, Pc_Ret)
Barr	2004	13	25	22			35.4	34.7	26.5	18.4			BVMTR (Tot_Lrn, Dl_Rcl, Rcg_Hit)
Baxendale	1997	14	28	24	28	24					ATL	3	Warr_Fac_Rcg
Baxendale	1997	14	55	44			30.4	32.7	11.7	9.9			Warr_Fac_Rcg
Baxendale	1998	15	42	27			29.1	29.7	12.1	9.8			Des_AMIPB (Lrn_Tr1_5, Dl_Rcl); Fig_AMIPB (Dl_Rcl; Pc_Ret))
Baxendale	2000	16	9	8	9	8	31.1	28.7	14.1	14.2	ATL	3	Des_AMIPB (Lrn_Tr1_5); Fig_AMIPB (Im_Rcl; Dl_Rcl; Pc_Ret)
Baxendale	2008	17	132	105	132	105	31.1	32.7	9.4	9.7	ATL	≥ 12	Des_AMIPB (Lrn_Tr1_5)
Baxendale	2012	18	33	37	33	37	33.1	34.5	9.6	14.6	ATL	3, 12 and 109.2	Des_AMIPB (Lrn_Tr1_5)
Bell	2005	19	22	20			34.0	40.0	13.9	13.1			VSRT (Lrn_Rcl_Tr1_5; Rcl_Tr6; Dl_Rcl)
Bengner	2006	20	19	30			41.0	40.0	23.0^	23.0^			AFT_Im_Rcg_CorctdHitrate
Bianchin	2013	21	105	93	105	93					ATL	6 to 9	VR_WMSR (Im_Rcl, Dl_Rcl); RCF (Dl_Rcl); RVDLT (Im_Rcl, Dl_Rcl, Rcg)

Bigras	2013	22	25	19			35.9	42.3	17.7	5.47			Warr_Fac_Rcg
Binder	2008˜	23	58	59	58	59	34.4#	40.3#	15.1#	14.9#	ATL	6	724SLT (Long_Dl_Rcl, Tot_Lrn_Rcl)
Binder	2008˜	23	59	62	59	62	34.4#	40.3#	15.1#	14.9#	ATL	6	VR_WMS1 (Dl_Rcl)
Bjornaes	2005	24	41	50	41	50	33.4	31.2	14.7	11.4	ATL-H+ or ATL-H-	6 and 24	BVRT (Im_Rcg_Cor)
Blake	2000	25	9	5			36.7	32.3	14.3	9.8			VR_WMSR (Im_Rcl, Dl_Rcl); TopogRMT_CAM (Im_Rcg)
Bonelli	2010	26	41	31									Des_AMIPB (Lrn_Tr1_5)
Boucher	2015	27	14	17	14	17					ATL or SAH	6 to 108	RCF (Im Rcl, Dl_Rcl)
Breier	1996	28	24	30			32.8	34.6	12.1	13.5			RCF (Pc_Ret)
Breier	1997	29	22	28			36.6	34.3	16.9	13.6			VR_WMSR (Dl_Rcl)
Brown	2010	30			9	9					ATL	72	BLT (Lrn_Tr1_5, Short_Dl_Rcl, Long_Dl_Rcl, Rot_Dl_Rcl, Rcg_Tot)
Busch	2011	31	110	101	110	101	34.9	35.8	15.4	16.1	ATL	7.39	VDI_WMS3
Carvajal	2009	32			20	23	35.4	35.0	17.0	18.1	ATL	6 to 8	VR_WMSR (Im_Rcl)
Castro	2013	33	43	44			37.6	37.5	9.4	9.5			RCF (Im_Rcl, Dl_Rcl); RVDLT (Im_Rcl, Dl_Rcl, Rcg)
Chelune	1991	34	23	19	23	19	30.3	28.3	12.1	12.2	ATL	6	VR_WMSR (Im_Rcl, Dl_Rcl); VMI_WMSR
Chelune	1993	35	47	49	47	49	29.4	29.5	12.5	13.8	ATL	10.87	VMI_WMSR
Chiaravalloti	2004	36	10	16	10	16	36.3	38.9	5.5	9.13	ATL	0.75	Fac_WMS3 (Im_Rcg, Dl_Rcg); GHFMT (Im_Rcg, Dl_Rcg)
Dade	2001	37			19	17	33.5	35.9			SAH or CAH	NR	Dade_FacLT (Im_Rcg; Lrn_4th_Exp)
Demin	2018	38	95	67			36.2	35.5	19.8	18.4			NVLT (Lrn_Rcg)
Dige	2001	39	12	12			29.4	38.1	9.6	18.3			DCSM (Lrn_Tr1_5, Dl_Rcl, Rcg_Tot_Corr)
Dodrill	2007	40	79	47									RCF (Im Rcl, Dl_Rcl)
Doss	2000˜	41			11	19	34.6	35.5	16.1	11.8	ATL	6.4	VII_WMS3; VDI_WMS3
Doss	2000˜	41			22	11	32.3	31.2	14.6^	7.3^	ATL	12.3	VII_WMS3_SP; VDI_WMS3_SP
Doss	2004	42			56	51	32.7	34.3	13.8	13.9	ATL	8.27	Faces_WMS3 (Im_Rcg, Dl_Rcg); FamPic_WMS3 (Im_Rcl, Dl_Rcl); VII_WMS3; VDI_WMS3
Doucet	2013	43	8	8									Faces_WMS3 (Im_Rcg, Dl_Rcg)
Doucet	2015	44	16	16	16	16	43.0	43.0	25.0	21.0	ATL w partial AH+	NR	Faces_WMS3 (Im_Rcg, Dl_Rcg)
Dulay	2002	45	36	21			38.0	37.0	22.5	20.9			BVRT (Im_Rcg_Cor); Warr_Fac_Rcg; FamPic_WMS3 (Im_Rcl, Dl_Rcl)
Dulay	2009˜	46	24	37	24	37	28.8#	31.3#	13.5#	14.8#	ATL	11.14	BVRT (Im_Rcg_Cor)
Dulay	2009˜	46	15	15	15	15	28.8#	31.3#	13.5#	14.8#	ATL	11.14	Warr_Fac_Rcg
Dulay	2009˜	46	34	44	34	44	28.8#	31.3#	13.5#	14.8#	ATL	11.14	NVSRT (Dl_Rcl)
Dulay	2009˜	46	17	18	17	18	28.8#	31.3#	13.5#	14.8#	ATL	11.14	RCF (Dl_Rcl)

Dupont	2010˜	47	10	12			40.0#	37.4#	11.2#	16.1#			AggFLT (Dl_Rcg)
Dupont	2010˜	47	10	14			40.0#	37.4#	11.2#	16.1#			RCF (Dl_Rcl)
Dupont	2010˜	47	10	15	9	15	40.0#	37.4#	11.2#	16.1#	ATL	6	RCF_AggFLT_Avg (Dl_Rcl)
Elliot	2018	48	14	11	14	11	39.1	39.6	18.6	16.1	ATL or SAH	20.4	CVMT_Dl_Rcg
Focke	2008˜	49	40	28									Des_AMIPB (Lrn_Tr1_5)
Focke	2008˜	49	37	35									Warr_Fac_Rcg
Focke	2008˜	49	39	32									Fig_AMIPB (Dl_Rcl)
Frank	2003	50			20	19	33.2	35.7	5.2	8.8	SAH or anteromedial ATL	5.9	RCF (Dl_Rcl)
Gargaro	2013	51	203	191	203	191	36.9	37.0	9.1	9.3	ATL+AH	12	VR_WMSR (Dl_Rcl); RCF (Dl_Rcl); RVDLT (Dl_Rcl)
Giovagnoli	2007	52	12	12	12	12	34.3	31.7	27.9	21.4	Tailored lesionectomy	9.88	RCF (Dl_Rcl); VSRT (STS, CLTR)
Gleissner	2002	53	66	74	66	74	32.8	31.7	11.1	11.2	SAH	3	DCSR (Lrn_Cap)
Glosser	2002	54	25	46			32.8	35.2	12.3	14.7			BFLTE (Dl_Rcl, Im_Rcl, Lrn_Tr1, Pc_Ret, Rcg_Discrmn, Rcg_FA, Rcg_Hit, Tot_Lrn)
Goldstein	1992	55			29	17	25.0	26.9	7.0	11.4	ATL or SAH	17.06	RCF_Pc_Ret
Goldstein	1993	56	22	20	22	20	26.9	30.6	6.7	12.3	ATL or SAH	1 to 4	RCF_Pc_Ret; BVRT (Im_Rcg_Cor, Im_Rcg_Er)
Grammaldo	2006	57	36	37			35.9	36.1	14.0	16.1			RCF (Im Rcl, Dl_Rcl)
Grammaldo	2009	58	35	47	35	47					ATL	12 and 24	RCF (Im Rcl, Dl_Rcl)
Griffith	2000	59	27	33	27	33	34.0	31.3	13.2	3.72	ATL	7.4	VR_WMS1 (Im Rcl, Dl_Rcl)
Hanoglu	2004	60	11	11	11	11	26.2	28.6	8.0	13.9	SAH	6	VR_WMS1 (Im Rcl, Dl_Rcl)
Harvey	2008	61	80	81	80	81	33.9	36.1	13.3	14.5	ATL	7.6	VII_WMS3; VDI_WMS3
Helmstaedter	1992	62	26	26			11.6	14.9	27.0	29.5			DCSR (LrnCap)
Helmstaedter	1995	63	30	30			27.0	30.7	12.4	14.6			BVRT (Im_Rcg_Cor, Im_Rcg_Er)
Helmstaedter	2000	64	24	21					13.0	13.0			BVRT (Im_Rcg_Cor); DCSR (LrnCap)
Helmstaedter	2004a	65	14	20	14	20					ATL	3	DCS (Lrn_Tr1_5)
Helmstaedter	2004b	66	42	37			33.9	6.11	13.2	13.1			DCS (Lrn_Tr1_5)
Helmstaedter	2008	67	51	46	51	46					TPR w ts-SAH or SAH	12	DCSR (Lrn_Tr1_5, Rcg_CorrMinEr)
Helmstaedter	2011a	68	20	10	20	10	38.0	36.5	14.4	13.6	ATL or SAH or ATL-AH+ or ATL-AH-	12	DCSR (LrnCap)
Helmstaedter	2011b	69	32	31	32	31					ts-SAH	12	DCSR (Lrn_Tr1_5, Rcg_CorrMinEr)

Hermann	1995	70	48	29	48	29	30.6	34.2	11.1	12.5	ATL	6 to 8	Warr_Fac_Rcg
Hermann	1997	71	62	45			31.3	31.9	12.4	11.1			VR_WMS1 (Im Rcl, Dl_Rcl, Pc_Ret)
Hill	2012	72	25	22	25	22	39.9	34.6	15.3	14.4	SAH	6.9	BVMTR (Dl_Rcl)
Hocking	2013	73	16	18			35.3	36.2	19.3	16.3			AustMZ (Er_Tr1, Er_Tr10, Er_AllTr)
Hurtado	2009	74	46	48			32.1	32.9	9.9	8.9			Warr_Fac_Rcg
Immonen	2010	75	23	15	23	15					ATL+AH or SAH	12	VR_WMS1 (Im Rcl, Dl_Rcl, Pc_Ret)
Jeong	2018	76	17	18	17	18	27.9	26.5	14.7	14.9	ATL or SAH	75.72	RCF (Im Rcl, Dl_Rcl)
Jutila	2014	77	44	54	44	54	34.0	34.0	14.0	12.0	ATL or tmtg-SAH	12.3 and 37.0[$]	VR_WMS1 (Im_Rcl, Dl_Rcl); RCF (Dl_Rcl)
Kessels	2004	78			16	9	40.2	39.7	11.3	19.0	SAH	53.26	VMI_WMSR
Kikuchi	2001	79	15	9									VR_WMSR (Im_Rcl); BVRT (Im_Rcg_Cor, Im_Rcg_Er); Warr_Fac_Rcg
Kim	2003	80	24	40			30.8	28.6	16.2	14.0			RCF (Im Rcl, Dl_Rcl)*
Kneebone	2007	81	42	38	42	38					ATL	14.77	RCF (Dl_Rcl)
Kubu	2000	82	5	2	5	2					ATL	31.2	VR_WMS1 (Im_Rcl); RCF (Dl_Rcl)
La Cour	2006˜	83	12	12			43.1	37.0					VGest (Dl_Reprd_Im_Rtn, Dl_Reprd_No_Er_Sheets, Dl_Reprd_Tot_Er, Err_Sheet_Lrn_min_Reprd, Err_Sheet_Lrn_plus_Reprd, Lrn_Im_Rcl)
La Cour	2006˜	83			26	34	31.7	31.8			ATL	> 14	VGest (Dl_Reprd_Im_Rtn, Dl_Reprd_No_Er_Sheets, Dl_Reprd_Tot_Er, Err_Sheet_Lrn_min_Reprd, Err_Sheet_Lrn_plus_Reprd, Lrn_Im_Rcl)
Lacritz	2004	84	25	25			34.0	36.7					VR_WMS3 (Im Rcl, Dl_Rcl, Pc_Ret)
Lah	2004	85			15	15	33.5	33.9	9.8	12.7	ATL	52.8	RCF (Dl_Rcl); FamPic_WMS3 (Im_Rcl, Dl_Rcl)
Lah	2006	86	15	14			37.8	42.7	18.1	26.6			RCF (Dl_Rcl); FamPic_WMS3 (Dl_Rcl)
Lah	2008	87	7	8	7	8	40.4	43.7	16.3	24.7	ATL	1.85	RCF (Dl_Rcl); FamPic_WMS3 (Im_Rcl, Dl_Rcl)
Lambon Ralph	2010	88			3	2	40.0	39.0	37.0	36.0	ATL	37.2	Warr_Fac_Rcg
Lambon Ralph	2012	89			9	11	33.8	35.6	16.9	9.6	ATL	35	RCF* (Im_Rcl)
Lee	2016	90	25	28			45.9	40.2			ATL	2.56	RCF (Dl_Rcl)
Leijten	2005	91	34	46	34	36	34.4	36.0	11.0	9.0	ATL	6	RCF* (Dl_Rcl)
Lespinet	2002	92	24	32			30.8	29.2	9.9	11.0			VR_WMSR (Im_Rcl, Dl_Rcl); RCF (Im_Rcl); VPA_WMSR (Im_Cue_Rcg; Dl_Cue_Rcg)
Loring	2000	93	51	50			31.2	31.8	11.2	12.7			VR_MAS (Im_Rcl, Dl_Rcl); VRcg_MAS_Rcg; VMI_MAS_Im_Rcl
Lutz	2004	94	40	40	40	40	35.2	38.3	10.6	11.8	ts-SAH or tc-SAH	7.3	DCSI (Lrn_Tr1_5, Rcg_CorrMinEr)

Malikova	2014	95	43	32	43	32					ATL or SRF-SAH	12	VMI_WMSR_VMQ
Mantoan	2009	96	15	14			38.9	36.4	14.3	12.6			VR_WMSR (Im_Rcl, Dl_Rcl); RCF (Im_Rcl, Dl_Rcl)
Marquez de la Plata	2009	97	23	15			40.4	32.9	17.0	9.0			VR_WMSR (Im_Rcl, Dl_Rcl, Pc_Ret); RCF (Im_Rcl, Dl_Rcl)
Martin	2002	98	25	30	25	30					ATL	12	VR_WMSR (Im_Rcl, Dl_Rcl)
Martin	1999a	99	22	25			31.5	32.6	15.7	11.5			VR_WMS1 (Im_Rcl, Dl_Rcl, Pc_Ret)
Martin	1999b	100	32	14			35.7	33.0	11.8	18.7			VR_WMS1 (Im_Rcl, Pc_Ret)
McConley	2008	100	55	44			33.2	33.6	11.1	14.3			RCF (Im_Rcl, Dl_Rcl)
McCormick	2013	101	18	20	9	10	36.2	37.3	15.8	19.3	ATL	8.84	Warr_Fac_Rcg
McDonald	2008	102	9	8									Faces_WMS3 (Dl_Rcg)
Moore & Baker	2002	104	77	61			30.7	31.4	12.9	13.1			VR_WMSR (Im_Rcl, Dl_Rcl); VPA_WMSR (Im_Cue_Rcg; Dl_Cue_Rcg); VMI_WMSR
Moran	2005	105			15	15	38.1	35.9	9.9^	12.3^	ATL	32.85	VR_WMSR (Im_Rcl, Dl_Rcl); Warr_Fac_Rcg
Morino	2006	106	26	23	26	23					ATL or ts-SAH	12	BVRT (Im_Rcg_Cor)
Morino	2009	107	31	31	31	31	34.4	34.4	13.2	17.5	ts-SAH	1 and 12	BVRT (Im_Rcg_Cor); VMI_WMSR
Morris	1995a	108			24	23	33.5	34.8			ATL	60.92	RCF (Pc_Ret); Warr_Fac_Rcg
Morris	1995b	109			24	23	33.5	34.8			ATL	≥9	Doors_DandP (Rcg); Shapes_DandP (Im_Rcl)
Moser	2000	110	26	18			33.7	34.8	11.9	10.2			NVMem_RCF/VRII_WMSR [Dl_Rcl])
Narayanan	2012	111	8	6			32.9	34.5					RCF* (Dl_Rcl, Rcg)
Naugle	1993	112	30	30	30	30	28.3	30.6	11.9	15.9	ATL	6.07	VR_WMSR (Im_Rcl, Dl_Rcl); VMI_WMSR
Naugle	1994	113	27	36	27	36	31.0	31.0	10.8	15.0	ATL	6	Warr_Fac_Rcg
Neves	2012	114	27	27			36.7	38.5	13.2	17.2			VR_WMSR (Im_Rcl, Dl_Rcl); RCF (Im_Rcl, Dl_Rcl)
Ogden-Epker	2001	115	27	29			36.9	33.1	13.1	10.3			VR_WMSR (Pc_Ret); RCF (Dl_Rcl); Warr_Fac_Rcg
Pacagnella	2014	116	4	18									VMI_WMSR
Paradiso	2001	117	47	23									VR_WMS1 (Im_Rcl, Pc_Ret); Warr_Fac_Rcg
Parente	2013	118	67	41			38.9	37.6	23.5	17.8			RCF (Dl_Rcl)
Pauli	2000	119	4	4									VMI_WMSR
Pegna	2002	120	16	13			32.3	34.7	12.3	15.7			RVDT* (Lrn_Tr1_5, Dl_Rcl)
Pereira	2010	121	8	8									VMI_WMSR
Pereira	2010	122	20	20			36.0	38.5	20.9	19.5			RouteLT
Phillips	1995	123	13	25	13	25	32.9	28.4	11.9	8.5	ATL	13	VR_WMS1 (Im_Rcl); RCF (Dl_Rcl); Warr_Fac_Rcg; ReccFig (Rcg_Discrmn)
Piguet	1994	124	26	44	26	44	31.7	29.9	10.2	11.6	ATL	8.78	RCF (Dl_Rcl)

Powell	2007	125	7	7			32.3	36.3	11.9	11.9			Des_AMIPB (Lrn_Tr1_5_Pc)
Powell	2008	126	7	7	7	7	32.6	37.1	7.3	13.8	ATL	3	Des_AMIPB (Lrn_Tr1_5_Pc)
Raspall	2005	127	12	17			38.2	39.1	13.5	17.7			VR_WMS3 (Im_Rcl, Dl_Rcl); Faces_WMS3 (Im_Rcg, Dl_Rcg)
Rausch	1990	128			27	36	30.8	31.0			ATL	19.2	VR_WMS1 (Im_Rcl, Dl_Rcl)
Rausch	1991	129	19	32			25.5	25.8	10.2	12.2			VR_WMS1 (Im_Rcl, Dl_Rcl, Pc_Ret); RCF (Dl_Rcl)
Rausch	1993	130	12	13	12	13					ATL (1 w SAH)	14.4	VR_WMS1 (Im_Rcl, Dl_Rcl); RCF (Dl_Rcl)
Rodriguez	2018	131											VMI_WMS4
Rougier	1994	132			6	6	37.0	36.0	17.0	23.0	ATL	42	PMQ_WMS1
Samson	1992	133			20	20	30.3	30.0			ATL	0.46 to ≥12	VR_WMS1 (Im_Rcl, Dl_Rcl); RCF (Dl_Rcl)
Sass	1992	134			28	31	29.8	32.0	10.8	10.5	ATL w radical H+	≥12	VR_WMS1 (Im_Rcl, Dl_Rcl, Pc_Ret)
Sawrie	1998	135			79	62					ATL		VR_WMS1 (Im_Rcl), RCF (Im_Rcl, Dl_Rcl)
Schoenberg	2018	136	23	31	23	31	36.7	35.0	17.1	16.5	SAH (ITG approach)	17.67	RCF (Dl_Rcl)
Seidenberg	1998	137	31	21	31	21	30.2	33.8	6.7	5.6	ATL	NR	VR_WMS1 (Dl_Rcl)
Selwa	1994	138	17	14	17	14	29.0	31.4	11.2	14.2	ATL	5.77	VR_WMS1 (Im_Rcl, Pc_Ret)
Shin	2009	139	30	24	30	24	30.1	30.1	15.2	16.2	ATL	11.1	RCF (Im_Rcl, Dl_Rcl); VII_WMS3; VDI_WMS3
Sidhu	2015	140	29	24			40.0	42.5	14.6	13.2			Des_AMIPB (Dl_Rcl)
Soble	2014	141	28	29			38.4	41.3	20.0	24.4			VMI_WMS4
Sperling	1996	142	33	34	33	34					ATL	12	VR_WMS1 (Im_Rcl, Dl_Rcl); GHFacMT (Im_Rcg, Dl_Rcg)
Spiers	2001	143			13	17	34.8	37.5	8.5	10.9	ATL	55.08	RCF (Im_Rcl, Dl_Rcl); Warr_Fac_Rcg
St-Laurent	2014	144	28	28	28	28	37.5	38.4	12.3	17.0	ATL or SAH	9[$]	Warr_Fac_Rcg; RVDLT (Tot_Lrn)
Suresh	2015	145	13	5			34.6	40.6	18.6	19.4			VDI_WMS3_Dl
Tanriverdi	2010	146	132	124	132	124	29.7	36.1	8.5	11.5	SAH or CAH	12	VR_WMS1 (Im_Rcl, Dl_Rcl); RCF (Dl_Rcl)
Testa	2004	147	26	27			36.6	35.6	19.6	17.8			Warr_Fac_Rcg
Trennery	1993[~]	148	42	30	42	30	33.8#	33.8#	11.1#	13.8#	ATL	4.04	VR_WMSR (Im_Rcl, Dl_Rcl, Pc_Ret)
Trennery	1993[~]	148	36	32			33.8#	33.8#	11.1#	13.8#			VSLT (Lrn_Tr1_5; Pc_Ret)
Tudesco	2010	149	20	19			33.9	36.5	14.4	14.0			VR_WMSR (Im_Rcl, Dl_Rcl); RCF (Im_Rcl, Dl_Rcl)
Vanli Tavuz	2016[~]	150	31	25	15	15					Not indicated	12	VR_WMS1 (Im_Rcl, Dl_Rcl)
Vanli Tavuz	2016[~]	150	37	31	19	15					Not indicated	12	VR_WMS1 (Tot_Rcl)
Vingerhoets	2006	151	39	50			31.9	31.9					RCF (Dl_Rcl); VDLT (Lrn_Rcl_Tr1_5, Rcg)

Wagner	2013	152	30	24	30	24					ATL	10	DCSR (Lrn_Tr1_5)
Wang	2011˜	153	24	25									BVRT (Im_Rcg_Cor, Im_Rcg_Er)
Wang	2011˜	153	21	21									VR_WMS3 (Im_Rcl, Dl_Rcl)
Wechsler	1997	154			15	12					ATL	NR	VII_WMS3; VDI_WMS3
Wechsler	2009	155			8	15					ATL	NR	VR_WMS4 (Im_Rcl, Dl_Rcl); VMI_WMS4; Des_WMS4 (Im_Rcl_Content, Im_Rcl_Spatial, Im_Rcl_Total, Dl_Rcl_Content, Dl_Rcl_Spatial, Dl_Rcl_Total)
Weniger	2012	156	24	20			38.5	41.5	17.5	21.5			Route_RBMT; LGT-3 (Dl_Rcl); VMI_WMSR
Wilde	2001~	157	55	47			34.2#	34.0#	15.9#	15.2#			Faces_WMS3 (Im_Rcg, Dl_Rcg)
Wilde	2001~	157	53	47			34.2#	34.0#	15.9#	15.2#			FamPic_WMS3 (Im_Rcl, Dl_Rcl)
Wilde	2001~	157	55	46			34.2#	34.0#	15.9#	15.2#			VDI_WMS3
Wilde	2001~	157	53	47			34.2#	34.0#	15.9#	15.2#			VII_WMS3
Wilkinson	2012	158	15	12			34.8	38.7	11.5	17.3			RCF (Im_Rcl, Dl_Rcl)

Data for age and epilepsy onset are mean years, data for follow-up is in months. * modification or adaptation of the standard test. ^ age of epilepsy onset calculated from participant age minus duration of epilepsy. # age/onset provided is from total sample which contains additional participants. ˜ non-equivalent samples within same paper. NR: time of postsurgical testing not reported. $: median reported instead of mean.

Surgery: +, including; -, sparing; w, with; AH, amygdalohippocampetcomy; ATL, standard 2/3 anterior temporal lobectomy or a tailored variant of this procedure; H, hippocampus; CAH, selective cortico-AH; ITG, Inferior Temporal Gyrus; SAH, selective-AH; SRF-SAH, stereotactic radiofrequency-SAH; tc-SAH: trans-cortical SAH; ts-SAH, trans-Sylvian SAH; tmtg-SAH: trans-middle temporal gyrus SAH; TPR+, additional temporal pole resection

Tests: 724_SLT, 7/24 Spatial Learning Test; AggFLT, Aggie Figure Learning Test; AustMZ, Austin Maze; BFLTE, Biber Figure Learning Test - Extended; BLT, Brown Location Test; BVMTR, Brief Visuospatial Memory Test - Revised; BVRT, Benton Visual Retention Test; CVMT, Continuous Visual Memory Test; DCS/DCSI, Diagnostikum für Cerebralschädigung; DCSM, Diagnostikum für Cerebralschädigung (Modified); DCSR, Diagnostikum für Cerebralschädigung (Revised); Des_WMS4, Designs - WMS-IV; Des_AMIPB, Design Learning - Adult Memory and Information Processing Battery; Doors_DandP, Doors test - Doors & People test; AFT, Alsterdorfer Faces Test; Dade_FacLT, Dade Face Learning Test; Denman_FacLT, Denman Facial Recognition Test; Faces_WMS3, Faces - WMS-III; Warr_Fac_Rcg, Warrington Recognition Memory Test for Faces; FamPic_WMS3, Family Pictures - WMS-III; Fig_AMIPB, Figure Learning - Adult Memory and Information Processing Battery; GHFacMT, Graduate Hospital Facial Memory Test; LGT-3, Lern- und Gedächtnistest-3; NVSRT, Nonverbal Selective Reminding Test; PMQ_WMS1, Performance Memory Quotient - WMS-I; RCF, Rey Complex Figure test; RCF_AggFLT_Avg, Rey Complex Figure test and/or Aggie Figure Learning Test; NVMem_RCF_VR2_WMS-R, average of Rey Complex Figure test (Delay) and VR-II; ReccFig, Recurring Figures Learning Test; Route_RBMT, Remembering a new route - Rivermead Behavioural memory Test ; RouteLT, Route Learning Test; RULIT, Ruff-Light Trail Learning Test; RVDLT, Rey Visual Design Learning Test; RVDT, Rey Visual Design Test; Shapes_DandP, Shapes test - Doors & People test; TopogRMT_CAM, Topographical Recognition Memory Test - Camden Memory Test battery; VDI_WMS3, Visual Delayed memory Index (Faces II, Family Pictures II); VDLT, Visual Design Learning Test; VGT, Visual Gestalt Test; VII_WMS3, Visual Immediate memory Index (Faces I, Family Pictures I); VII_WMS3_SP, Visual Immediate memory Index - Standardization Protocol; VM_FACT, composite measure made up of Warrington Faces (total score), Rey Visual Design Learning Test (Sum of Learning Trials 1 to 5), and Spatial Conditional Associative Learning Task (total trials to criterion); VMI_MAS, composite measure from VR_MAS and VRecog_MAS; VMI_WMSR, Visual Memory quotient from WMS-R (Figural Memory, Visual Paired Associates I, Visual Reproduction I); VMI_WMS4, Visual Memory Index - WMS-IV; VMI_WMS4, Visual Memory Index (Designs I, Designs II, Visual Reproduction I, Visual Reproduction II); VPA_WMSR, Visual Paired Associates - WMS-R; VR_MAS, Visual Reproduction - Memory Assessment Scale version; VR_WMS1, Visual Reproduction - WMS-I; VR_WMS1_RUS, Visual Reproduction - WMS-I (Russell Revision); VR_WMS3, Visual Reproduction - WMS-III; VR_WMSR, Visual Reproduction - WMS-R; VRecog_MAS, Visual Recognition test - Memory Assessment Scale; VSLT, Visual Spatial Learning Test; VSRT, Visual Selective Reminding Test (precursor test to version in TOMAL-2 battery).

Test measures: Im: Immediate; Lrn: Learning; Dly: Delayed; Rcg: Recognition; Rcl: Recall; Pc: Percent; Ret: Retention; Cor: Correct; Er: Error; No: Number (of); Tot: Total; Tr: Trial(s); 1_5: 1 to 5; Cue: Cued; Reprd: Reproduction; Cap: Capacity; Discrmn: Discrimination; Exp: Exposure; Corctd: Corrected; CorrMinEr: Correct minus errors; CLTR: Continuous Long-Term Retrieval; STS: Short Term Storage.

Supplementary Table 2. Meta-analytic results of visual memory test performance on individual test measures in left versus right presurgical TLE patients.

Test measure	Stimulus	Learning	Delay	Format	*k*	*d*	*95%_lo*	*95%_up*	*z*	*p*	*Q*	*Q_p*	I^2	I^2_B	I^2_W	N_{fs}
724SLT_Long_Dly_Rcl^	Spa	Rep	Dly	Rcl	2	-0.27	-0.56	0.02	-1.79	0.07	0.01	0.91	0%	0%	0%	-
724SLT_Short_Dly_Rcl^	Spa	Rep	Lrn	Rcl	1	-0.3	-0.79	0.19	-1.2	0.23	-	-	-	-	-	-
724SLT_Tot_Lrn_Rcl	Spa	Rep	Lrn	Rcl	2	0.01	-0.29	0.3	0.04	0.97	0.05	0.83	0%	0%	0%	-
AFT_Im_Rcg_CorctdHitrate	Fac	Sin	Lrn	Rcg	1	-0.25	-0.82	0.33	-0.84	0.4	-	-	-	-	-	-
AggFLT_Dly_Rcg	Des	Rep	Dly	Rcg	1	-0.44	-1.28	0.41	-1.01	0.31	-	-	-	-	-	-
AggFLT_Im_Rcg	Des	Rep	Lrn	Rcg	1	-0.28	-1.12	0.57	-0.64	0.52	-	-	-	-	-	-
AustMZ_Er_AllTr*	Spa	Rep	Lrn	Rcl	1	**-0.86**	**-1.56**	**-0.15**	**-2.39**	**0.02**	**-**	**-**	**-**	**-**	**-**	85
AustMZ_Er_Tr1	Spa	Sin	Lrn	Rcl	1	-0.43	-1.11	0.25	-1.23	0.22	-	-	-	-	-	-
AustMZ_Er_Tr10^	Spa	Rep	Lrn	Rcl	1	-0.67	-1.36	0.03	-1.89	0.06	-	-	-	-	-	-
BFTLE_Dly_Rcl^	Des	Rep	Dly	Rcl	1	-0.44	-0.93	0.05	-1.75	0.08	-	-	-	-	-	-
BFTLE_Im_Rcl*	Des	Rep	Lrn	Rcl	1	**-0.51**	**-1.01**	**-0.02**	**-2.04**	**0.04**	-	-	-	-	-	50
BFTLE_Lrn_Tr1	Des	Sin	Dly	Rcl	1	-0.37	-0.86	0.12	-1.47	0.14	-	-	-	-	-	-
BFTLE_Pc_Ret*	Des	Rep	Dly	Rcl	1	**-0.57**	**-1.07**	**-0.07**	**-2.25**	**0.02**	-	-	-	-	-	56
BFTLE_Rcg_Discrmn	Des	Rep	Dly	Rcg	1	-0.4	-0.89	0.1	-1.58	0.11	-	-	-	-	-	-
BFTLE_Rcg_FA	Des	Rep	Dly	Rcg	1	0.13	-0.38	0.62	0.52	0.6	-	-	-	-	-	-
BFTLE_Rcg_Hit*	Des	Rep	Dly	Rcg	1	**-0.55**	**-0.2**	**-0.06**	**-2.19**	**0.03**	-	-	-	-	-	54
BFTLE_Tot_Lrn^	Des	Rep	Lrn	Rcl	1	-0.45	-0.s95	0.04	-1.81	0.07	-	-	-	-	-	-
BVMT_Dly_Rcl	Des	Rep	Dly	Rcl	2	-0.31	-0.72	0.1	-1.49	0.14	2.47	0.12	0.6	0.3	0.3	-
BVMT_Rcg_FP^	Des	Rep	Dly	Rcg	1	0.55	-0.03	1.14	1.85	0.07	-	-	-	-	-	-
BVMT_Rcg_Hit	Des	Rep	Dly	Rcg	1	-0.36	-0.94	0.21	-1.24	0.22	-	-	-	-	-	-
BVMT_Tot_Lrn	Des	Rep	Lrn	Rcl	1	-0.13	-0.71	0.44	-0.45	0.65	-	-	-	-	-	-
BVRT_Im_Rcg_Cor	Des	Sin	Lrn	Rcg	10	-0.07	-0.31	0.16	-0.62	0.54	**17.17**	**0.046**	45%	22%	22%	-
BVRT_Im_Rcg_Er	Des	Sin	Lrn	Rcg	4	-0.35	-0.85	0.16	-1.35	0.18	7.71	0.05	62%	31%	31%	-
CVMT_Dly_Rcg	Des	Rep	Dly	Rcg	1	-0.49	-1.29	0.32	-1.19	0.23	-	-	-	-	-	-
Dade_FacLT_Im_Rcg**	Fac	Sin	Lrn	Rcg	1	**-1.05**	**-1.75**	**-0.35**	**-2.95**	**0.003**	-	-	-	-	-	104
Dade_FacLT_Lrn_4th_Exp***	Fac	Rep	Lrn	Rcg	1	**-1.32**	**-2.04**	**-0.6**	**-3.58**	**0.0003**	-	-	-	-	-	131
DCS_Dly_Rcl*	Des	Rep	Dly	Rcl	1	**-0.86**	**-1.7**	**-0.03**	**-2.02**	**0.04**	-	-	-	-	-	85
DCS_Lrn_Cap	Des	Rep	Lrn	Rcl	4	-0.24	-0.98	0.5	-0.64	0.52	**19.35**	**0.0002**	86%	43%	43%	-
DCS_Lrn_Tr1_5	Des	Rep	Lrn	Rcl	7	-0.13	-0.33	0.08	-1.22	0.22	8.05	0.23	10%	5%	5%	-
DCS_Rcg_CorrMinEr	Des	Rep	Dly	Rcg	2	0.12	-0.13	0.38	0.95	0.34	0.45	0.8	0%	0%	0%	-
DCS_Rcg_Tot_Corr	Des	Rep	Dly	Rcg	1	-0.25	-1.05	0.56	-0.6	0.55	-	-	-	-	-	-

Supplementary Table 2. Meta-analytic results of visual memory test performance on individual test measures in left versus right presurgical TLE patients.

Test measure	Stimulus	Learning	Delay	Format	*k*	*d*	*95%_lo*	*95%_up*	*z*	*p*	*Q*	*Q_p*	I^2	I^2_B	I^2_W	N_{fs}
Denman_FacLT_Rcg*	Fac	Sin	Lrn	Rcg	1	**-0.5**	**-0.89**	**-0.11**	**-2.51**	**0.01**	-	-	-	-	-	49
Des_AMIPB_Dly_Rcl*	Des	Rep	Dly	Rcl	2	**-0.47**	**-0.88**	**-0.07**	**-2.28**	**0.02**	1.22	0.27	18%	9%	9%	92
Des_AMIPB_Lrn_Tr1_5***	Des	Rep	Lrn	Rcl	8	**-0.51**	**-0.73**	**-0.28**	**-4.45**	**< .0001**	6.29	0.28	26%	13%	13%	400
Des_AMIPB_Lrn_Tr1_5_Pc^	Des	Rep	Lrn	Rcl	3	-0.39	-0.79	0.01	-1.93	0.05	1.44	0.49	0%	0%	0%	-
Fac_WMS3_Dly_Rcg	Fac	Sin	Dly	Rcg	7	-0.09	-0.31	0.14	-0.76	0.45	3.93	0.69	0%	0%	0%	56
Fac_WMS3_Im_Rcg	Fac	Sin	Lrn	Rcg	6	-0.17	-0.43	0.1	-1.23	0.22	7.33	0.2	18%	9%	9%	96
FamPic_WMS3_Dly_Rcl	Scene	Sin	Dly	Rcl	5	-0.04	-0.27	0.19	-0.32	0.75	1.3	0.86	0%	0%	0%	-
FamPic_WMS3_Im_Rcl	Scene	Sin	Lrn	Rcl	4	-0.15	-0.4	0.11	-1.1	0.27	2.94	0.4	8%	4%	4%	-
Fig_AMIPB_Dly_Rcl***	Des	Sin	Dly	Rcl	3	**-0.74**	**-1.15**	**-0.33**	**-3.55**	**0.0004**	3.21	0.2	28%	14%	14%	219
Fig_AMIPB_Im_Rcl**	Des	Sin	Lrn	Rcl	1	**-1.4**	**-2.46**	**-0.34**	**-2.58**	**0.01**	-	-	-	-	-	139
Fig_AMIPB_Pc_Ret^	Des	Sin	Dly	Rcl	2	-0.58	-1.23	0.07	-1.74	0.08	1.58	0.21	37%	18%	18%	-
GHFacMT_Dly_Rcg	Fac	Sin	Dly	Rcg	2	-0.15	-0.74	0.44	-0.49	0.62	1.73	0.19	42%	21%	21%	-
GHFacMT_Im_Rcg	Fac	Sin	Lrn	Rcg	2	-0.32	-1.3	0.66	-0.64	0.52	4.27	0.04	77%	38%	38%	-
LGT3_Dly_Rcl^	Spa	Sin	Dly	Rcl	1	-0.51	-1.12	0.09	-1.67	0.09	-	-	-	-	-	-
NVLT_Lrn_Rcg**	Des	Rep	Lrn	Rcg	1	**-0.43**	**-0.74**	**-0.11**	**-2.65**	**0.008**	-	-	-	-	-	42
NVMem_RCF_VR2_WMSR_Dly_Rcl	Des	Sin	Dly	Rcl	1	-0.27	-0.87	0.34	-0.86	0.39	-	-	-	-	-	-
NVSRT_Dly_Rcl	Spa	Rep	Dly	Rcl	1	0.25	-0.2	0.7	1.08	0.28	-	-	-	-	-	-
RCF_AggFLT_Avg_Dly_Rcl	Des	Sin	Dly	Rcl	1	-0.37	-1.18	0.43	-0.91	0.36	-	-	-	-	-	-
RCF_Dly_Rcl***	Des	Sin	Dly	Rcl	39	**-0.16**	**-0.25**	**-0.08**	**-3.72**	**<.001**	48.79	0.14	21%	21%	0%	585
RCF_Im_Rcl*	Des	Sin	Lrn	Rcl	16	**-0.17**	**-0.32**	**-0.02**	**-2.25**	**0.02**	18.56	0.23	18%	9%	9%	256
RCF_Pc_Ret*	Des	Sin	Dly	Rcl	5	**-0.16**	**-0.32**	**-0.0008**	**-1.97**	**0.0489**	4.21	0.38	0%	0%	0%	75
RCF_Rcg	Des	Sin	Dly	Rcg	1	-0.32	-1.38	0.75	-0.59	0.56	-	-	-	-	-	-
ReccFig_Rcg_Discrmn	Des	Rep	Lrn	Rcg	1	0.37	-0.31	1.04	1.07	0.28	-	-	-	-	-	-
Route_RBMT	Spa	Sin	Lrn	Rcl	1	-0.08	-0.67	0.51	-0.27	0.79	-	-	-	-	-	-
RouteLT***	Spa	Rep	Lrn	N/A	1	**-2.65**	**-3.5**	**-1.8**	**-6.12**	**<.0001**	-	-	-	-	-	264
RULIT_Cor_Tr2^ (R > L)	Spa	Rep	Lrn	Rcl	1	0.56	-0.005	1.13	1.94	0.05	-	-	-	-	-	-
RULIT_Dly_Rcl* (R > L)	Spa	Rep	Dly	Rcl	2	**0.44**	**0.04**	**0.84**	**2.16**	**0.03**	0.001	0.98	0%	0%	0%	86
RVDLT_Dly_Rcl	Des	Rep	Dly	Rcl	2	0.08	-0.18	0.35	0.6	0.55	4.7	0.1	60%	30%	30%	-
RVDLT_Im_Rcl	Des	Rep	Dly	Rcl	2	-0.06	-0.43	0.54	0.23	0.82	3.67	0.06	72%	36%	36%	-
RVDLT_Rcg	Des	Rep	Dly	Rcg	2	-0.04	-0.27	0.19	-0.32	0.75	0.5	0.48	0%	0%	0%	-
RVDLT_Tot_Lrn	Des	Rep	Lrn	Rcl	1	-0.07	-0.59	0.46	-0.26	0.8	-	-	-	-	-	-

Supplementary Table 2. Meta-analytic results of visual memory test performance on individual test measures in left versus right presurgical TLE patients.

Test measure	Stimulus	Learning	Delay	Format	*k*	*d*	*95%_lo*	*95%_up*	*z*	*p*	*Q*	*Q_p*	I^2	I^2_B	I^2_W	N_{fs}
RVDT_Dly_Rcl	Des	Rep	Dly	Rcg	1	-0.55	-1.29	0.2	-1.44	0.15	-	-	-	-	-	-
RVDT_Lrn_Tr1_5*	Des	Rep	Lrn	Rcl	1	**-0.86**	**-1.62**	**-0.09**	**-2.19**	**0.03**	-	-	-	-	-	85
TopogRcgMT_Im_Rcg	Scene	Sin	Lrn	Rcg	1	0.09	-1.01	1.17	0.14	0.89	-	-	-	-	-	-
VDI_WMS3_Dly*	N/A	Sin	Dly	N/A	6	**-0.22**	**-0.37**	**-0.06**	**-2.73**	**0.006**	0.99	0.97	0%	0%	0%	126
VDLT_Dly_Rcl	Des	Rep	Dly	Rcl	1	0.06	-0.36	0.47	0.26	0.79	-	-	-	-	-	-
VDLT_Lrn_Rcl_Tr1_5	Des	Rep	Lrn	Rcl	1	0.18	-0.24	0.6	0.85	0.39	-	-	-	-	-	-
VDLT_Rcg	Des	Rep	Dly	Rcg	1	0.23	-0.19	0.65	1.07	0.28	-	-	-	-	-	-
VGest_Dly_Reprd_Im_Rtn	Des	Rep	Dly	Rcl	1	0.38	-0.43	1.19	0.93	0.35	-	-	-	-	-	-
VGest_Dly_Reprd_No_Er_Sheets	Des	Rep	Dly	Rcl	1	0.56	-0.26	1.38	1.34	0.18	-	-	-	-	-	-
VGest_Dly_Reprd_Tot_Er	Des	Rep	Dly	Rcl	1	0.43	-0.38	1.23	1.04	0.3	-	-	-	-	-	-
VGest_Err_Sheet_Lrn_min_Reprd	Des	Rep	Dly	Rcl	1	-0.59	-1.4	0.23	-1.41	0.16	-	-	-	-	-	-
VGest_Err_Sheet_Lrn_plus_Reprd	Des	Rep	Lrn	Rcl	1	0.45	-0.36	1.26	1.09	0.27	-	-	-	-	-	-
VGest_Lrn_Im_Rcl	Des	Rep	Lrn	Rcl	1	-0.2	-1	0.6	-0.49	0.62	-	-	-	-	-	-
VGest_Lrn_Tot_Er	Des	Rep	Lrn	Rcl	1	-0.02	-0.82	0.78	-0.06	0.95	-	-	-	-	-	-
VII_WMS3**	N/A	Sin	Lrn	N/A	4	**-0.26**	**-0.45**	**-0.06**	**-2.59**	**0.01**	0.45	0.93	0%	0%	0%	100
VM_Fact^	N/A	N/A	N/A	N/A	1	-0.78	-1.58	0.02	-1.92	0.0548	-	-	-	-	-	-
VMI_MAS_Im_Rcl*	N/A	Sin	Lrn	Rcl	1	**-0.4**	**-0.8**	**-0.01**	**-2**	**0.045**	-	-	-	-	-	39
VMI_WMS4	N/A	Sin	N/A	N/A	2	-0.25	-0.72	0.21	-1.07	0.28	0	0.96	0%	0%	0%	-
VMI_WMSR	N/A	N/A	N/A	N/A	13	-0.05	-0.19	0.1	-0.63	0.53	14.99	0.24	0%	0%	0%	-
VMI_WMSR_VMQ	N/A	N/A	N/A	N/A	1	0.15	-0.31	0.61	0.63	0.53	-	-	-	-	-	-
VPA_Dly_Cue_Rcg	Assoc	Sin	Dly	Rcg	3	0.16	-0.08	0.4	1.32	0.19	2.12	0.35	0%	0%	0%	-
VPA_Im_Cue_Rcg	Assoc	Sin	Lrn	Rcg	3	0.3	-0.24	0.83	1.08	0.28	**7.68**	**0.02**	78%	39%	39%	-
VR_MAS_Dly_Rcl	Des	Sin	Dly	Rcl	1	-0.14	-0.53	0.25	-0.68	0.5	-	-	-	-	-	-
VR_MAS_Im_Rcl	Des	Sin	Lrn	Rcl	1	-0.39	-0.78	0.005	-1.094	0.05	-	-	-	-	-	-
VR_WMS1_Dly_Rcl*	Des	Sin	Dly	Rcl	13	**-0.15**	**-0.28**	**-0.03**	**-2.43**	**0.01**	9.48	0.66	0%	0%	0%	182
VR_WMS1_Im_Rcl^	Des	Sin	Lrn	Rcl	16	-0.1	-0.23	0.02	-1.65	0.1	11.22	0.74	0%	0%	0%	144
VR_WMS1_Pc_Ret*	Des	Sin	Dly	Rcl	7	**-0.26**	**-0.46**	**-0.05**	**-2.45**	**0.01**	4.96	0.55	0%	0%	0%	175
VR_WMS1_RUS_Dly_Rcl	Des	Sin	Dly	Rcl	1	-0.22	-0.53	0.08	1	0.16	-	-	-	-	-	-
VR_WMS1_RUS_Im_Rcl	Des	Sin	Lrn	Rcl	1	-0.16	-0.46	0.15	1	0.32	-	-	-	-	-	-
VR_WMS1_RUS_Pc_Ret	Des	Sin	Dly	Rcl	1	-0.21	-0.51	0.1	-1.35	0.18	-	-	-	-	-	-
VR_WMS1_Tot_Rcl	Des	Sin	N/A	Rcl	1	-0.17	-0.69	0.36	-0.62	0.54	-	-	-	-	-	-

Supplementary Table 2. Meta-analytic results of visual memory test performance on individual test measures in left versus right presurgical TLE patients.

Test measure	Stimulus	Learning	Delay	Format	*k*	*d*	*95%_lo*	*95%_up*	*z*	*p*	*Q*	*Q_p*	I^2	I^2_B	I^2_W	N_{fs}
VR_WMS3_Dly_Rcl	Des	Sin	Dly	Rcl	5	0.08	-0.62	0.77	0.22	0.83	**19.6**	**0.0006**	81%	40%	40%	-
VR_WMS3_Im_Rcl	Des	Sin	Lrn	Rcl	5	-0.12	-1.14	0.91	-0.22	0.82	**25.24**	**<.0001**	91%	45%	45%	-
VR_WMS3_Pc_Ret	Des	Sin	Dly	Rcl	2	-0.07	-0.47	0.32	-0.36	0.72	0.02	0.9	0%	0%	0%	-
VR_WMS4_Dly_Rcl	Des	Sin	Dly	Rcl	1	-0.4	-0.94	0.14	-1.44	0.15	-	-	-	-	-	-
VR_WMS4_Im_Rcl	Des	Sin	Lrn	Rcl	1	0.23	-0.31	0.77	0.83	0.41	-	-	-	-	-	-
VR_WMSR_Dly_Rcl	Des	Sin	Dly	Rcl	16	-0.01	-0.15	0.13	-0.11	0.91	**25.54**	**0.04**	42%	42%	0%	-
VR_WMSR_Im_Rcl	Des	Sin	Lrn	Rcl	15	-0.03	-0.8	0.13	0.49	0.62	9.04	0.83	0%	0%	0%	30
VR_WMSR_Pc_Ret* (R > L)	Des	Sin	Dly	Rcl	5	**0.16**	**0.02**	**0.31**	**2.28**	**0.02**	1.87	0.76	0%	0%	0%	75
VRcg_MAS_Rcg	N/A	Sin	Lrn	Rcg	1	-0.27	-0.66	0.12	-1.34	0.18	-	-	-	-	-	-
VSLT_Lrn_Rcl_Tr1_5	Des	Rep	Lrn	Rcl	1	0.04	-0.45	0.53	0.17	0.87	-	-	-	-	-	-
VSLT_Pc_Ret	Des	Rep	Dly	Rcl	1	-0.1	-0.57	0.38	-0.39	0.7	-	-	-	-	-	-
VSRT_CLTR	Des	Rep	Lrn	Rcl	1	-0.1	-0.9	0.7	-0.25	0.8	-	-	-	-	-	-
VSRT_Dly_Rcl^ (R > L)	Des	Rep	Dly	Rcl	1	0.52	-0.09	1.14	1.67	0.1	-	-	-	-	-	-
VSRT_Lrn_Rcl_Tr1_5	Des	Rep	Lrn	Rcl	1	0	-0.61	0.61	0	1	-	-	-	-	-	-
VSRT_Rcl_Tr6	Des	Rep	Lrn	Rcl	1	0.25	-0.36	0.86	0.81	0.42	-	-	-	-	-	-
VSRT_STS	Des	Rep	Lrn	Rcl	1	0	-0.8	0.8	0	1	-	-	-	-	-	-
Warr_Fac_Rcg^	Fac	Sin	Lrn	Rcg	15	-0.16	-0.33	0.01	-1.9	0.06	19.84	0.19	32%	32%	0%	225

*** p < .001, ** p < .01, * p < .05, ^ p < .10. R > L: against the expected pattern, right TLE patients performed better than left TLE patients. Negative *d* values indicate worse postsurgical than presurgical performance.

Tests: 724_SLT: 7/24 Spatial Learning Test; AFT: Alsterdorfer Faces Test; AggFLT: Aggie Figure Learning Test; AustMZ: Austin Maze; BFLTE: Biber Figure Learning Test - Extended; BLT: Brown Location Test; BVMTR: Brief Visuospatial Memory Test - Revised; BVRT: Benton Visual Retention Test; CVMT: Continuous Visual Memory Test; DCS/DCSI: Diagnostikum für Cerebralschädigung; DCSM: Diagnostikum für Cerebralschädigung (Modified); DCSR: Diagnostikum für Cerebralschädigung (Revised); Des_WMS4: Designs - WMS-IV; Des_AMIPB: Design Learning - Adult Memory and Information Processing Battery; Doors_DandP: Doors test - Doors & People test; Dade_FacLT: Dade Face Learning Test; Denman_FacLT: Denman Facial Recognition Test; Faces_WMS3: Faces - WMS-III; Warr_Fac_Rcg: Warrington Recognition Memory Test for Faces; FamPic_WMS3: Family Pictures - WMS-III; Fig_AMIPB: Figure Learning - Adult Memory and Information Processing Battery; GHFacMT: Graduate Hospital Facial Memory Test; LGT-3: Lern- und Gedächtnistest-3; NVLT: Nonverbal Learning Test; NVMem_RCF_VR2_WMS-R: average of Rey Complex Figure test (Delay) and VR-II, WMS-R version; NVSRT: Nonverbal Selective Reminding Test; PMQ_WMS1: Performance Memory Quotient - WMS-I; RCF: Rey Complex Figure test; RCF_AggFLT_Avg: Rey Complex Figure test and/or Aggie Figure Learning Test; ReccFig: Recurring Figures Learning Test; Route_RBMT: Remembering a new route - Rivermead Behavioural Memory Test; RouteLT: Route Learning Test; RULIT: Ruff-Light Trail Learning Test; RVDLT: Rey Visual Design Learning Test; RVDT: Rey Visual Design Test; Shapes_DandP: Shapes test - Doors & People test; TopogRMT_CAM: Topographical Recognition Memory Test - Camden Memory Test battery; VDI_WMS3: Visual Delayed memory Index (Faces II & Family Pictures II); VDLT: Visual Design Learning Test; VGT: Visual Gestalt Test; VII_WMS3: Visual Immediate memory Index (Faces I & Family Pictures II); VII_WMS3_SP: Visual Immediate memory Index - Standardization Protocol; VM_FACT: composite measure made up of Warrington Faces (total score) & Rey Visual Design Learning Test (Sum of Learning Trials 1 to 5) & Spatial Conditional Associative Learning Task (total trials to criterion); VMI_MAS: composite measure from VR_MAS and VRecog_MAS; VMI_WMSR: Visual Memory quotient from WMS-R (Figural Memory, Visual Paired Associates I, & Visual Reproduction I); VMI_WMSR_VMQ: Visual Memory Index - WMS-R (Visual Memory Quotient);VMI_WMS4: Visual Memory Index – WMS-IV (Designs I and II & Visual Reproduction I and II); VPA_WMSR: Visual Paired Associates - WMS-R; VR_MAS: Visual Reproduction - Memory Assessment Scale version; VR_WMS1: Visual Reproduction - WMS-I; VR_WMS1_RUS: Visual Reproduction - WMS-I (Russell Revision); VR_WMS3: Visual Reproduction - WMS-III; VR_WMSR: Visual Reproduction - WMS-R; VRecog_MAS: Visual Recognition test - Memory Assessment Scale; VSLT: Visual Spatial Learning Test; VSRT: Visual Selective Reminding Test (precursor test to version in TOMAL-2 battery).

Test measures: Im: Immediate; Lrn: Learning; Dly: Delayed; Rcg: Recognition; Rcl: Recall; Pc: Percent; Ret: Retention; Cor: Correct; Er: Error; No: Number (of); Tot: Total; Tr: Trial(s); 1_5: 1 to 5; Cue: Cued; Reprd:

Supplementary Table 2. Meta-analytic results of visual memory test performance on individual test measures in left versus right presurgical TLE patients.

Test measure	Stimulus	Learning	Delay	Format	*k*	*d*	*95%_lo*	*95%_up*	*z*	*p*	*Q*	*Q_p*	I^2	I^2_B	I^2_W	N_{fs}

Reproduction; Cap: Capacity; Discrmn: Discrimination; Exp: Exposure; Corctd: Corrected; CorrMinEr: Correct minus errors; CLTR: Continuous Long-Term Retrieval; STS: Short Term Storage.
Moderators: *Stimulus.* Des: Designs; Spa: Spatial; Fac: Facial; Assoc: Associative. *Learning.* Sin: Single trial; Rep: Repeated trials; *Delay.* Lrn: Learning phase; Dly: Delay phase. *Format.* Rcl: Recall; Rcg: Recognition.
Statistics: *k*: number of studies; *n*: number of patients; *d*: pooled estimate of effect size (Cohen's *d*); *CI_lo*: lower bound of 95% confidence interval; *CI_up*: upper bound of 95% confidence interval; *z*: *z*-test for significance of effect size; *p*: *p*-value for *z*-test; *Q*: test for heterogeneity; *Q_p*: significance of test for heterogeneity; Q_M: test of significance of moderators; I^2: percent of total variability explained by heterogeneity; I^2_B: percent of total variability explained by heterogeneity between papers; I^2_W: percent of total variability explained by heterogeneity within papers; N_{fs}: fail-safe N.

Supplementary Table 3. Meta-analytic results of the performance on individual test measures for left versus right postsurgical TLR patients.

Test_measure	Stimulus	Learning	Delay	Format	*k*	*d*	*CI_lo*	*CI_up*	*z*	*p*	*Q*	*Q_p*	I^2	I^2_B	I^2_W	*Nfs*
724SLT_LoDly^	Spa	Rep	Dly	Rcl	1	-0.36	-0.73	0	-1.94	0.05	-	-	-	-	-	-
724SLT_Tot_Lrn_Rcl	Spa	Rep	Lrn	Rcl	1	-0.04	-0.4	0.33	-0.19	0.85	-	-	-	-	-	-
BLT_Long_Dly_Rcl*	Spa	Rep	Dly	Rcl	1	**-1.04**	**-2.02**	**-0.05**	**-2.07**	**0.04**	-	-	-	-	-	103
BLT_Lrn_Tr1_5**	Spa	Rep	Lrn	Rcl	1	**-1.56**	**-2.61**	**-0.5**	**-2.89**	**0.004**	-	-	-	-	-	155
BLT_Rcg_Tot	Spa	Rep	Dly	Rcg	1	-0.48	-1.42	0.46	-1	0.32	-	-	-	-	-	-
BLT_Rot_Dly_Rcl*	Spa	Rep	Dly	Rcl	1	**-1.09**	**-2.08**	**-0.1**	**-2.15**	**0.03**	-	-	-	-	-	108
BLT_Short_Dly_Rcl*	Spa	Rep	Dly	Rcl	1	**-1.09**	**-2.08**	**-0.1**	**-2.15**	**0.03**	-	-	-	-	-	108
BVMT_Dly_Rcl^	Des	Rep	Dly	Rcl	1	-0.51	-1.09	0.07	-1.71	0.09	-	-	-	-	-	-
BVRT_Im_Rcg	Des	Sin	Lrn	Rcg	5	-0.06	-0.29	-0.17	-0.53	0.6	3.11	0.54	0%	0%	0%	-
BVRT_Im_Rcg_Er^	Des	Sin	Lrn	Rcg	1	-0.54	-1.16	0.08	-1.72	0.09	-	-	-	-	-	-
CVMT_Dl_Rcg	Des	Rep	Dly	Rcg	1	**-1.64**	**-2.55**	**-0.73**	**-3.53**	**0.0004**	-	-	-	-	-	163
DCS_Lrn_Cap	Des	Rep	Lrn	Rcl	2	-0.37	-1.01	0.28	-1.11	0.27	2.5	0.11	60%	30%	30%	-
DCS_Lrn_Tr1_5^	Des	Rep	Lrn	Rcl	5	-0.21	-0.43	0.0049	-1.92	0.06	2.54	0.64	0%	0%	0%	-
DCS_Rcg_CorrMinEr	Des	Rep	Dly	Rcg	3	-0.13	-0.39	0.12	-1.02	0.31	0.06	0.97	0%	0%	0%	-
Des_AMIPB_Lrn_Tr1_5***	Des	Rep	Lrn	Rcl	3	**-0.44**	**-0.66**	**-0.22**	**-3.91**	**<.0001**	1.52	0.47	0%	0%	0%	129
Des_AMIPB_Lrn_Tr1_5_Pc	Des	Rep	Lrn	Rcl	1	-0.93	-2.03	0.18	-1.65	0.1	-	-	-	-	-	-
Des_WMS4_Dly_Rcl_Content	Des	Sin	Dly	Rcg	1	0.15	-0.71	1.01	0.33	0.74	-	-	-	-	-	-
Des_WMS4_Dly_Rcl_Spatial	Spa	Sin	Dly	Rcl	1	-0.38	-1.25	0.48	-0.86	0.39	-	-	-	-	-	-
Des_WMS4_Dly_Rcl_Total	Spa	Sin	Dly	Rcl	1	-0.35	-1.21	0.51	-0.79	0.43	-	-	-	-	-	-
Des_WMS4_Im_Rcl_Content	Des	Sin	Lrn	Rcg	1	-0.56	-1.44	0.31	-1.26	0.21	-	-	-	-	-	-
Des_WMS4_Im_Rcl_Spatial	Spa	Sin	Lrn	Rcl	1	-0.74	-1.62	0.14	-1.64	0.1	-	-	-	-	-	-
Des_WMS4_Im_Rcl_Total*	Spa	Sin	Lrn	Rcl	1	**-1**	**-1.91**	**-0.1**	**-2.17**	**0.03**	-	-	-	-	-	-
Doors_DandP_Rcg***	Object	Sin	Lrn	Rcg	1	**-1.99**	**-2.7**	**-1.3**	**-5.59**	**<.0001**	-	-	-	-	-	-
Faces_WMS3_Dly_Rcg*	Fac	Sin	Dly	Rcg	3	**-0.37**	**-0.68**	**-0.06**	**-2.36**	**0.02**	0.51	0.78	0%	0%	0%	108

Supplementary Table 3. Meta-analytic results of the performance on individual test measures for left versus right postsurgical TLR patients.

Test_measure	Stimulus	Learning	Delay	Format	*k*	*d*	*CI_lo*	*CI_up*	*z*	*p*	*Q*	*Q_p*	I^2	I^2_B	I^2_W	*Nfs*
Faces_WMS3_Im_Rcg*	Fac	Sin	Lrn	Rcg	3	-0.56	-1.05	-0.06	-2.19	0.03	3.96	0.14	49%	24%	24%	165
FamPic_WMS3_Dly_Rcl	Scene	Sin	Dly	Rcl	3	-0.07	-0.45	0.3	-0.38	0.7	2.25	0.32	14%	7%	7%	-
FamPic_WMS3_Im_Rcl	Scene	Sin	Lrn	Rcl	3	-0.14	-0.63	0.35	-0.57	0.57	3.58	0.17	39%	20%	20%	-
Fig_AMIPB_Pc_Ret***	Des	Sin	Dly	Rcl	1	-1.88	-3.03	-0.74	-3.23	0.001	-	-	-	-	-	187
FL_AMIPB_Dly_Rcl	Des	Sin	Dly	Rcl	1	-0.81	-1.8	0.18	-1.61	0.11	-	-	-	-	-	-
FL_AMIPB_Im_Rcl	Des	Sin	Lrn	Rcl	1	-0.45	-1.42	0.51	-0.93	0.36	-	-	-	-	-	-
GHFacMT_Dly_Rcg^	Fac	Sin	Dly	Rcg	2	-0.41	-0.82	0.01	-1.92	0.05	0.82	0.36	0%	-	-	-
GHFacMT_Im_Rcg*	Fac	Sin	Lrn	Rcg	2	-0.49	-0.9	-0.07	-2.29	0.02	0.91	0.34	0%	0%	0%	96
NVSRT_Dly	Spa	Rep	Dly	Rcl	1	-0.37	-0.82	0.08	-1.62	0.11	-	-	-	-	-	-
PMQ_WMS1	N/A	N/A	N/A	N/A	1	-0.47	-1.62	0.67	-0.81	0.42	-	-	-	-	-	-
RCF_AggFLT_Avg_Dly_Rcl	Des	Sin	Dly	Rcl	1	-0.55	-1.39	0.29	-1.29	0.2	-	-	-	-	-	-
RCF_Dly_Rcl***	Des	Sin	Dly	Rcl	24	-0.21	-0.33	-0.09	-3.41	0.0007	34.09	0.06	27%	27%	0%	480
RCF_Im_Rcl	Des	Sin	Lrn	Rcl	6	-0.26	-0.62	0.11	-1.39	0.17	9.64	0.09	48%	24%	24%	-
RCF_Pc_Ret**	Des	Sin	Dly	Rcl	3	-0.5	-0.85	-0.15	-2.8	0.005	1.98	0.37	1%	0%	0%	147
ReccFig_Rcg_Discrmn	Des	Rep	Lrn	Rcg	1	-0.03	-0.7	0.64	-0.07	0.94	-	-	-	-	-	-
RVDLT_Dly_Rcl	Des	Rep	Dly	Rcl	2	-0.0005	-0.19	0.19	-0.005	0.99	3.39	0.07	24%	12%	12%	-
RVDLT_Im_Rcl	Des	Rep	Lrn	Rcl	1	0.19	-0.09	0.47	1.34	0.18	-	-	-	-	-	-
RVDLT_Rcg*	Des	Rep	Dly	Rcg	1	-0.29	-0.57	-0.01	-2.02	0.04	-	-	-	-	-	28
RVDLT_Tot_Lrn	Des	Rep	Lrn	Rcl	1	-0.03	-0.55	0.5	-0.1	0.92	-	-	-	-	-	-
Shapes_DandP_Im_Rcl	Des	Sin	Lrn	Rcl	1	-0.45	-1.03	0.13	-1.51	0.13	-	-	-	-	-	-
VDI_WMS3_Dly***	N/A	N/A	Dly	N/A	5	-0.35	-0.52	-0.18	-4.09	<.0001	3.14	0.53	0%	0%	0%	170
VDI_WMS3_PB_Dly	Des	Sin	Dly	Rcl	1	-0.42	-1.16	0.33	-1.09	0.27	-	-	-	-	-	-
VDI_WMS3_SP_Dly	Des	Sin	Dly	Rcl	1	-0.36	-1.09	0.37	-0.98	0.33	-	-	-	-	-	-
VGest_Dly_Reprd_Im_Rtn	Des	Rep	Dly	Rcl	1	-0.5	-1.02	0.02	-1.88	0.06	-	-	-	-	-	-
VGest_Dly_Reprd_No_Er_Sheets	Des	Rep	Dly	Rcl	1	-0.42	-0.93	0.1	-1.58	0.11	-	-	-	-	-	-
VGest_Dly_Reprd_Tot_Er	Des	Rep	Dly	Rcl	1	-0.33	-0.85	0.18	-1.27	0.21	-	-	-	-	-	-
VGest_Err_Sheet_Lrn_min_Reprd	Des	Rep	Dly	Rcl	1	-0.04	-0.56	0.47	-0.17	0.86	-	-	-	-	-	-
VGest_Err_Sheet_Lrn_plus_Reprd^	Des	Rep	Lrn	Rcl	1	-0.52	-1.04	0	-1.95	0.05	-	-	-	-	-	-
VGest_Lrn_Im_Rcl^	Des	Rep	Lrn	Rcl	1	-0.49	-1.01	0.03	-1.84	0.07	-	-	-	-	-	-
VGest_Lrn_Tot_Er	Des	Rep	Lrn	Rcl	1	0.4	-0.11	0.92	1.54	0.12	-	-	-	-	-	-
VII_WMS3***	N/A	Sin	Lrn	N/A	4	-0.46	-0.67	-0.25	-4.24	<.0001	1.15	0.77	0%	0%	0%	180

Supplementary Table 3. Meta-analytic results of the performance on individual test measures for left versus right postsurgical TLR patients.

Test_measure	Stimulus	Learning	Delay	Format	*k*	*d*	*CI_lo*	*CI_up*	*z*	*p*	*Q*	*Q_p*	I^2	I^2_B	I^2_W	*Nfs*
VII_WMS3_SP	N/A	Sin	Lrn	N/A	1	-0.54	-1.28	0.19	-1.44	0.15	-	-	-	-	-	-
VMI_WMS4^	N/A	Sin	N/A	N/A	1	-0.85	-1.74	0.05	-1.86	0.06	-	-	-	-	-	-
VMI_WMSR	N/A	N/A	N/A	N/A	5	0.01	-0.22	0.25	0.12	0.9	2.43	0.66	0%	0%	0%	-
VMI_WMSR_VMQ	N/A	N/A	N/A	N/A	1	0.21	-0.25	0.67	0.91	0.36	-	-	-	-	-	-
VR_WMS1_Dly_Rcl* **	Des	Sin	Dly	Rcl	15	**-0.21**	**-0.33**	**-0.09**	**-3.52**	**0.0004**	12.12	0.6	0%	0%	0%	300
VR_WMS1_Im_Rcl* **	Des	Sin	Lrn	Rcl	16	**-0.22**	**-0.34**	**-0.9**	**-3.43**	**0.0006**	7.03	0.96	0%	0%	0%	336
VR_WMS1_Pc_Ret	Des	Sin	Dly	Rcl	3	0.01	-0.34	0.36	0.06	0.95	1.42	0.49	0%	0%	0%	-
VR_WMS1_Tot_Rcl	Des	Sin	N/A	Rcl	1	-0.4	-1.12	0.33	-1.08	0.28	-	-	-	-	-	-
VR_WMS3_Dly_Rcl	Des	Sin	Dly	Rcl	1	0.43	-0.54	1.41	0.87	0.38	-	-	-	-	-	-
VR_WMS3_Im_Rcl*	Des	Sin	Lrn	Rcl	1	-1.3	-2.36	-0.25	-2.43	0.02	-	-	-	-	-	129
VR_WMS4_Dly_Rcl	Des	Sin	Dly	Rcl	1	-0.56	-1.44	0.31	-1.27	0.21	-	-	-	-	-	-
VR_WMS4_Im_Rcl*	Des	Sin	Lrn	Rcl	1	**-0.96**	**-1.86**	**-0.06**	**-2.08**	**0.04**	-	-	-	-	-	95
VR_WMSR_Dly_Rcl	Des	Sin	Dly	Rcl	6	-0.03	-0.16	0.1	-0.41	0.68	2.44	0.88	0%	0%	0%	-
VR_WMSR_Im_Rcl	Des	Sin	Lrn	Rcl	6	0.03	-0.15	0.21	0.3	0.76	2.45	0.78	0%	0%	0%	-
VR_WMSR_Pc_Ret	Des	Sin	Dly	Rcl	1	-0.07	-0.54	0.4	-0.29	0.78	-	-	-	-	-	-
VSLT_Lrn_Rcl_Tr1_5	Des	Rep	Dly	Rcl	1	0.15	-0.32	0.61	0.62	0.54	-	-	-	-	-	-
VSLT_Pc_Ret	Des	Rep	Dly	Rcl	1	-0.29	-0.76	0.18	-1.22	0.22	-	-	-	-	-	-
VSRT_CLTR	Des	Rep	Lrn	Rcl	1	-0.69	-1.51	0.13	-1.64	0.1	-	-	-	-	-	-
VSRT_STS	Des	Rep	Lrn	Rcl	1	-0.31	-1.12	0.49	-0.77	0.44	-	-	-	-	-	-
Warr_Fac_Rcg* **	Fac	Sin	Lrn	Rcg	11	**-0.65**	**-0.85**	**-0.46**	**-6.61**	**<.0001**	17.07	0.07	0%	0%	0%	704

*** $p < .001$, ** $p < .01$, * $p < .05$, ^ $p < .10$. Negative *d* values indicate worse postsurgical than presurgical performance.

Tests: 724_SLT: 7/24 Spatial Learning Test; AFT: Alsterdorfer Faces Test; AggFLT: Aggie Figure Learning Test; AustMZ: Austin Maze; BFLTE: Biber Figure Learning Test - Extended; BLT: Brown Location Test; BVMTR: Brief Visuospatial Memory Test - Revised; BVRT: Benton Visual Retention Test; CVMT: Continuous Visual Memory Test; DCS/DCSI: Diagnostikum für Cerebralschädigung; DCSM: Diagnostikum für Cerebralschädigung (Modified); DCSR: Diagnostikum für Cerebralschädigung (Revised); Des_WMS4: Designs - WMS-IV; Des_AMIPB: Design Learning - Adult Memory and Information Processing Battery; Doors_DandP: Doors test - Doors & People test; Dade_FacLT: Dade Face Learning Test; Denman_FacLT: Denman Facial Recognition Test; Faces_WMS3: Faces - WMS-III; Warr_Fac_Rcg: Warrington Recognition Memory Test for Faces; FamPic_WMS3: Family Pictures - WMS-III; Fig_AMIPB: Figure Learning - Adult Memory and Information Processing Battery; GHFacMT: Graduate Hospital Facial Memory Test; LGT-3: Lern- und Gedächtnistest-3; NVLT: Nonverbal Learning Test; NVMem_RCF_VR2_WMS-R: average of Rey Complex Figure test (Delay) and VR-II, WMS-R version; NVSRT: Nonverbal Selective Reminding Test; PMQ_WMS1: Performance Memory Quotient - WMS-I; RCF: Rey Complex Figure test; RCF_AggFLT_Avg: Rey Complex Figure test and/or Aggie Figure Learning Test; ReccFig: Recurring Figures Learning Test; Route_RBMT: Remembering a new route - Rivermead Behavioural Memory Test; RouteLT: Route Learning Test; RULIT: Ruff-Light Trail Learning Test; RVDLT: Rey Visual Design Learning Test; RVDT: Rey Visual Design Test; Shapes_DandP: Shapes test - Doors & People test; TopogRMT_CAM: Topographical Recognition Memory Test - Camden Memory Test battery; VDI_WMS3: Visual Delayed memory Index (Faces II & Family Pictures II); VDLT: Visual Design Learning Test; VGT: Visual Gestalt Test; VII_WMS3: Visual Immediate memory Index (Faces I & Family Pictures II); VII_WMS3_SP: Visual Immediate memory Index - Standardization Protocol; VM_FACT: composite measure made up of Warrington Faces (total score) & Rey Visual Design Learning Test (Sum of Learning Trials 1 to 5) & Spatial Conditional Associative Learning Task (total trials to criterion); VMI_MAS: composite measure from VR_MAS and VRecog_MAS; VMI_WMSR: Visual Memory quotient from WMS-R (Figural Memory, Visual Paired Associates I, & Visual Reproduction I); VMI_WMSR_VMQ: Visual Memory Index - WMS-R (Visual Memory Quotient);VMI_WMS4: Visual Memory Index – WMS-IV (Designs I and II & Visual Reproduction I and II); VPA_WMSR: Visual

Paired Associates - WMS-R; VR_MAS: Visual Reproduction - Memory Assessment Scale version; VR_WMS1: Visual Reproduction - WMS-I; VR_WMS1_RUS: Visual Reproduction - WMS-I (Russell Revision); VR_WMS3: Visual Reproduction - WMS-III; VR_WMSR: Visual Reproduction - WMS-R; VRecog_MAS: Visual Recognition test - Memory Assessment Scale; VSLT: Visual Spatial Learning Test; VSRT: Visual Selective Reminding Test (precursor test to version in TOMAL-2 battery).
<u>Test measures:</u> Im: Immediate; Lrn: Learning; Dly: Delayed; Rcg: Recognition; Rcl: Recall; Pc: Percent; Ret: Retention; Cor: Correct; Er: Error; No: Number (of); Tot: Total; Tr: Trial(s); 1_5: 1 to 5; Cue: Cued; Reprd: Reproduction; Cap: Capacity; Discrmn: Discrimination; Exp: Exposure; Corctd: Corrected; CorrMinEr: Correct minus errors; CLTR: Continuous Long-Term Retrieval; STS: Short Term Storage.
<u>Moderators:</u> *Stimulus.* Des: Designs; Spa: Spatial; Fac: Facial; Assoc: Associative. *Learning.* Sin: Single trial; Rep: Repeated trials; *Delay*. Lrn: Learning phase; Dly: Delay phase. *Format.* Rcl: Recall; Rcg: Recognition.
<u>Statistics:</u> *k*: number of studies; *n*: number of patients; *d*: pooled estimate of effect size (Cohen's *d*); *CI_lo*: lower bound of 95% confidence interval; *CI_up*: upper bound of 95% confidence interval; *z*: *z*-test for significance of effect size; *p*: *p*-value for *z*-test; *Q*: test for heterogeneity; *Q_p*: significance of test for heterogeneity; Q_M: test of significance of moderators; I^2: percent of total variability explained by heterogeneity; I^2_B: percent of total variability explained by heterogeneity between papers; I^2_W: percent of total variability explained by heterogeneity within papers; N_{fs}: fail-safe N.

Supplementary Table 4. Meta-analytic results of the presurgical minus postsurgical difference in performance on individual test measures for left- and right-sided TLR patients.

Test_measure	Stimulus	Learning	Delay	Format	*k*	*Hem*	*d*	*CI_lo*	*CI_up*	*z*	*p*	*Q*	*Q_p*	I^2	I^2_B	I^2_W	*Nfs*
RCF_Dly_Rcl	Des	Sin	Dly	Rcl	18	**L***	**0.13**	**0.01**	**0.24**	**2.15**	**0.03**	15.11	0.65	14%	14%	0%	212
						R*	**0.11**	**0.01**	**0.21**	**2.12**	**0.03**	17.37	0.50	3%	3%	0%	177
VR_WMS1_Im_Rcl	Des	Sin	Lrn	Rcl	11	L	0.10	-0.05	0.25	1.29	0.20	4.93	0.90	0%	0%	0%	-
						R	-0.03	-0.18	0.12	-0.39	0.69	4.40	0.93	0%	0%	0%	-
VR_WMS1_Dly_Rcl	Des	Sin	Dly	Rcl	10	L	0.11	-0.03	0.25	1.54	0.12	8.54	0.48	0%	0%	0%	-
						R	0.00	-0.14	0.14	-0.01	0.99	6.41	0.70	0%	0%	0%	-
Warr_Fac_Rcg*	Fac	Sin	Lrn	Rcg	7	**L***	**0.23**	**0.02**	**0.44**	**2.12**	**0.03**	2.01	0.92	0%	0%	0%	154
						R*	**-0.30**	**-0.51**	**-0.08**	**-2.72**	**0.01**	4.98	0.55	0%	0%	0%	201
VR_WMSR_Dly_Rcl	Des	Sin	Dly	Rcl	7	L	0.12	-0.10	0.34	1.10	0.27	10.52	0.10	51%	51%	0%	-
						R	-0.05	-0.18	0.09	-0.72	0.47	2.86	0.83	0%	0%	0%	-
BVRT_Im_Rcg_Cor	Des	Sin	Lrn	Rcg	5	L	-0.02	-0.25	0.21	-0.16	0.88	**3.79**	**0.00**	0%	0%	0%	-
						R	-0.13	-0.35	0.09	-1.19	0.23	2.52	0.64	0%	0%	0%	-
DCS_Lrn_Tr1_5*	Des	Rep	Lrn	Rcl	5	L	-0.05	-0.26	0.16	-0.45	0.65	2.75	0.60	0%	0%	0%	-
						R*	**-0.29**	**-0.55**	**-0.02**	**-2.12**	**0.03**	5.07	0.28	29%	14%	14%	139
VR_WMSR_Im_Rcl	Des	Sin	Lrn	Rcl	5	L	0.06	-0.12	0.25	0.65	0.52	0.14	1.00	0%	0%	0%	-
						R	-0.02	-0.22	0.17	-0.23	0.82	1.39	0.85	0%	0%	0%	-
RCF_Im_Rcl*	Des	Sin	Lrn	Rcl	4	**L***	**0.43**	**0.01**	**0.85**	**2.03**	**0.04**	5.86	0.12	50%	25%	25%	169
						R^	0.23	-0.04	0.50	1.69	0.09	2.35	0.50	0%	0%	0%	-
VMI_WMSR	N/A	N/A	N/A	N/A	4	L	0.13	-0.11	0.37	1.05	0.29	0.34	0.95	0%	0%	0%	-
						R	0.11	-0.14	0.35	0.85	0.39	1.58	0.66	0%	0%	0%	-
DCS_Rcg_CorrMinEr	Des	Rep	Dly	Rcg	3	L	0.03	-0.22	0.28	0.25	0.80	0.80	0.66	0%	0%	0%	-
						R	-0.21	-0.50	0.09	-1.36	0.17	2.57	0.28	24%	12%	12%	-

Supplementary Table 4. Meta-analytic results of the presurgical minus postsurgical difference in performance on individual test measures for left- and right-sided TLR patients.

Test_measure	**Stimulus**	**Learning**	**Delay**	**Format**	***k***	***Hem***	***d***	***CI_lo***	***CI_up***	***z***	***p***	***Q***	***Q_p***	I^2	I^2_B	I^2_W	***Nfs***
Des_AMIPB_Lrn_Tr1_5	Des	Rep	Lrn	Rcl	3	L	-0.04	-0.25	0.17	-0.37	0.71	0.03	0.98	0%	0%	0%	-
						R	-0.03	-0.26	0.20	-0.26	0.72	1.22	0.54	1%	0%	0%	-
VDI_WMS3_Dly	N/A	N/A	Dly	N/A	3	L	0.14	-0.05	0.33	1.46	0.15	0.28	0.87	0%	0%	0%	-
						R	-0.04	-0.23	0.15	-0.40	0.69	2.36	0.31	0%	0%	0%	-
VII_WMS3	N/A	Sin	Lrn	N/A	2	L	0.23	-0.04	0.50	1.70	0.09	0.85	0.36	0%	0%	0%	-
						R	0.04	-0.23	0.31	0.31	0.76	0.17	0.68	0%	0%	0%	-
DCS_LrnCap	Des	Rep	Lrn	Rcl	2	L	0.04	-0.26	0.33	0.23	0.82	0.01	0.91	0%	0%	0%	-
						R	-0.11	-0.41	0.19	-0.71	0.48	0.23	0.63	0%	0%	0%	-
Fac_WMS3_Dly_Rcg	Fac	Sin	Dly	Rcg	2	L	0.39	-0.16	0.94	1.38	0.17	0.40	0.53	0%	0%	0%	-
						R	0.15	-0.34	0.64	0.59	0.55	0.36	0.55	0%	0%	0%	-
Fac_WMS3_Im_Rcg	Fac	Sin	Lrn	Rcg	2	L	0.36	-0.19	0.91	1.28	0.20	0.00	0.98	0%	0%	0%	-
						R	0.15	-0.34	0.64	0.59	0.55	0.36	0.55	0%	0%	0%	-
GHFacMT_Im_Rcg*	Fac	Sin	Lrn	Rcg	2	**L***	**0.50**	**0.07**	**0.93**	**2.26**	**0.02**	0.60	0.44	0%	0%	0%	98
						R	0.13	-0.26	0.53	0.67	0.50	0.11	0.73	0%	0%	0%	-
GHFacMT_Dly_Rcg^	Fac	Sin	Dly	Rcg	2	L^	0.41	-0.02	0.84	1.89	0.06	0.41	0.52	0%	0%	0%	-
						R	0.04	-0.35	0.43	0.19	0.85	0.26	0.61	0%	0%	0%	-
RVDLT_Dly_Rcl*	Des	Rep	Dly	Rcl	2	**L***	**0.17**	**0.01**	**0.33**	**2.14**	**0.03**	0.00	0.95	0%	0%	0%	33
						R	0.02	-0.15	0.18	0.23	0.82	0.07	0.79	0%	0%	0%	-
VR_WMS1_Pc_Ret	Des	Sin	Dly	Rcl	2	L	-0.04	-0.56	0.32	-0.54	0.59	0.00	1.00	0%	0%	0%	-
						R	-0.04	-0.55	0.48	-0.14	0.89	0.34	0.56	0%	0%	0%	-
724SLT_Long_Dly_Rcl	Spa	Rep	Dly	Rcl	1	L	-0.05	-0.42	0.31	-0.29	0.78	-	-	-	-	-	-
						R	-0.12	-0.48	0.24	-0.65	0.52	-	-	-	-	-	-
724SLT_Tot_Lrn_Rcl	Spa	Rep	Lrn	Rcl	1	L	0.00	-0.36	0.36	0.00	1.00	-	-	-	-	-	-
						R	-0.02	-0.38	0.34	-0.09	0.93	-	-	-	-	-	-
BVMT_Dly_Rcl	Des	Rep	Dly	Rcl	1	L	-0.19	-0.74	0.37	-0.67	0.51	-	-	-	-	-	-
						R	-0.08	-0.67	0.51	-0.26	0.80	-	-	-	-	-	-
BVRT_Im_Rcg_Er	Des	Sin	Lrn	Rcg	1	L	-0.21	-0.80	0.38	-0.69	0.49	-	-	-	-	-	-
						R	-0.29	-0.91	0.33	-0.91	0.36	-	-	-	-	-	-
CVMT_Dl_Rcg*	Des	Rep	Dly	Rcg	1	**L***	**1.15**	**0.35**	**1.95**	**2.81**	**0.01**	-	-	-	-	-	114

Supplementary Table 4. Meta-analytic results of the presurgical minus postsurgical difference in performance on individual test measures for left- and right-sided TLR patients.

Test_measure	Stimulus	Learning	Delay	Format	*k*	*Hem*	*d*	*CI_lo*	*CI_up*	*z*	*p*	*Q*	*Q_p*	I^2	I^2_B	I^2_W	*Nfs*
						R	-0.06	-0.90	0.77	-0.14	0.88	-	-	-	-	-	-
Fig_AMIPB_Dly_Rcl	Des	Sin	Dly	Rcl	1	L	-0.60	-1.55	0.34	-1.25	0.21	-	-	-	-	-	-
						R	0.17	-0.81	1.15	0.34	0.73	-	-	-	-	-	-
FL_AMIPB_Im	Des	Sin	Lrn	Rcl	1	L	-0.43	-1.37	0.50	-0.91	0.36	-	-	-	-	-	-
						R	0.39	-0.60	1.38	0.78	0.44	-	-	-	-	-	-
Fig_AMIPB_Pc_Ret*	Des	Sin	Dly	Rcl	1	**L***	**-1.05**	**-2.04**	**-0.07**	**-2.09**	**0.04**	-	-	-	-	-	104
						R	-0.10	-1.08	0.88	-0.20	0.84	-	-	-	-	-	-
NVSRT_Dly_Rcl*	Spa	Rep	Dly	Rcl	1	L	0.18	-0.30	0.66	0.74	0.46	-	-	-	-	-	-
						R*	**-0.44**	**-0.86**	**-0.01**	**-2.03**	**0.04**	-	-	-	-	-	43
RCF_Pc_Ret	Des	Sin	Dly	Rcl	1	L	0.12	-0.47	0.71	0.39	0.70	-	-	-	-	-	-
						R	-0.04	-0.66	0.58	-0.14	0.89	-	-	-	-	-	-
ReccFig_Rcg_Discrmn	Des	Lrn	Rep	Rcg	1	L	-0.02	-0.79	0.75	-0.05	0.96	-	-	-	-	-	-
						R	-0.35	-0.91	0.21	-1.22	0.22	-	-	-	-	-	-
RVDLT_Tot_Lrn	Des	Rep	Rep	Rcl	1	L	-0.28	-0.80	0.25	-1.03	0.30	-	-	-	-	-	-
						R	-0.23	-0.76	0.30	-0.86	0.39	-	-	-	-	-	-
RVDLT_Rcg***	Des	Rep	Dly	Rcg	1	**L*****	**0.49**	**0.21**	**0.76**	**3.47**	**<.001**	-	-	-	-	-	48
						R	0.18	-0.11	0.46	1.20	0.23	-	-	-	-	-	-
VR_WMSR_Pc_Ret	Des	Sin	Dly	Rcl	1	L	0.13	-0.30	0.56	0.60	0.55	-	-	-	-	-	-
						R	-0.30	-0.81	0.21	-1.16	0.24	-	-	-	-	-	-
VR_WMS3_Im_Rcl	Des	Sin	Lrn	Rcl	1	L	-0.41	-1.55	0.73	-0.70	0.48	-	-	-	-	-	-
						R^	0.67	-0.12	1.46	1.67	0.09	-	-	-	-	-	-
VR_WMS3_Dly_Rcl	Des	Sin	Dly	Rcl	1	L	0.16	-0.97	1.30	0.28	0.78	-	-	-	-	-	-
						R**	**1.16**	**0.34**	**2.00**	**2.75**	**0.01**	-	-	-	-	-	115
VR_WMS4_Dly_Rcl	Des	Sin	Dly	Rcl	1	L	-0.15	-0.73	0.43	-0.52	0.61	-	-	-	-	-	-
						R	0.08	-0.42	0.58	0.33	0.74	-	-	-	-	-	-
VSRT_CLTR	Des	Rep	Lrn	Rcl	1	L	0.35	-0.46	1.15	0.84	0.40	-	-	-	-	-	-
						R	-0.18	-0.99	0.62	-0.45	0.65	-	-	-	-	-	-
VSRT_STS	Des	Rep	Lrn	Rcl	1	L	0.28	-0.53	1.08	0.67	0.50	-	-	-	-	-	-
						R	-0.06	-0.86	0.74	-0.15	0.88	-	-	-	-	-	-

Supplementary Table 4. Meta-analytic results of the presurgical minus postsurgical difference in performance on individual test measures for left- and right-sided TLR patients.

Test_measure	Stimulus	Learning	Delay	Format	*k*	*Hem*	*d*	*CI_lo*	*CI_up*	*z*	*p*	*Q*	*Q_p*	I^2	I^2_B	I^2_W	*Nfs*
VMI_WMSR_VMQ	N/A	N/A	N/A	N/A	1	L	0.03	-0.39	0.46	0.15	0.88	-	-	-	-	-	-
						R	0.06	-0.43	0.55	0.24	0.81	-	-	-	-	-	-
VSLT_Lrn_Rcl_Tr1_5	Des	Rep	Dly	Rcl	1	L	0.22	-0.24	0.67	0.93	0.35	-	-	-	-	-	-
						R	0.38	-0.13	0.88	1.46	0.14	-	-	-	-	-	-
VSLT_Pc_Ret	Des	Rep	Dly	Rcl	1	L	0.04	-0.41	0.49	0.19	0.85	-	-	-	-	-	-
						R	0.01	-0.48	0.50	0.04	0.97	-	-	-	-	-	-

*** p < .001, ** p < .01, * p < .05, ^ p < .10. Negative *d* values indicate worse postsurgical than presurgical performance. Asterisks next to test measure names indicate that left TLR and/or right TLR groups showed significant pre-postsurgical differences.

Tests: 724_SLT: 7/24 Spatial Learning Test; AFT: Alsterdorfer Faces Test; AggFLT: Aggie Figure Learning Test; AustMZ: Austin Maze; BFLTE: Biber Figure Learning Test - Extended; BLT: Brown Location Test; BVMTR: Brief Visuospatial Memory Test - Revised; BVRT: Benton Visual Retention Test; CVMT: Continuous Visual Memory Test; DCS/DCSI: Diagnostikum für Cerebralschädigung; DCSM: Diagnostikum für Cerebralschädigung (Modified); DCSR: Diagnostikum für Cerebralschädigung (Revised); Des_WMS4: Designs - WMS-IV; Des_AMIPB: Design Learning - Adult Memory and Information Processing Battery; Doors_DandP: Doors test - Doors & People test; Dade_FacLT: Dade Face Learning Test; Denman_FacLT: Denman Facial Recognition Test; Faces_WMS3: Faces - WMS-III; Warr_Fac_Rcg: Warrington Recognition Memory Test for Faces; FamPic_WMS3: Family Pictures - WMS-III; Fig_AMIPB: Figure Learning - Adult Memory and Information Processing Battery; GHFacMT: Graduate Hospital Facial Memory Test; LGT-3: Lern- und Gedächtnistest-3; NVLT: Nonverbal Learning Test; NVMem_RCF_VR2_WMS-R: average of Rey Complex Figure test (Delay) and VR-II, WMS-R version; NVSRT: Nonverbal Selective Reminding Test; PMQ_WMS1: Performance Memory Quotient - WMS-I; RCF: Rey Complex Figure test; RCF_AggFLT_Avg: Rey Complex Figure test and/or Aggie Figure Learning Test; ReccFig: Recurring Figures Learning Test; Route_RBMT: Remembering a new route - Rivermead Behavioural Memory Test; RouteLT: Route Learning Test; RULIT: Ruff-Light Trail Learning Test; RVDLT: Rey Visual Design Learning Test; RVDT: Rey Visual Design Test; Shapes_DandP: Shapes test - Doors & People test; TopogRMT_CAM: Topographical Recognition Memory Test - Camden Memory Test battery; VDI_WMS3: Visual Delayed memory Index (Faces II & Family Pictures II); VDLT: Visual Design Learning Test; VGT: Visual Gestalt Test; VII_WMS3: Visual Immediate memory Index (Faces I & Family Pictures II); VII_WMS3_SP: Visual Immediate memory Index - Standardization Protocol; VM_FACT: composite measure made up of Warrington Faces (total score) & Rey Visual Design Learning Test (Sum of Learning Trials 1 to 5) & Spatial Conditional Associative Learning Task (total trials to criterion); VMI_MAS: composite measure from VR_MAS and VRecog_MAS; VMI_WMSR: Visual Memory quotient from WMS-R (Figural Memory, Visual Paired Associates I, & Visual Reproduction I); VMI_WMSR_VMQ: Visual Memory Index - WMS-R (Visual Memory Quotient);VMI_WMS4: Visual Memory Index – WMS-IV (Designs I and II & Visual Reproduction I and II); VPA_WMSR: Visual Paired Associates - WMS-R; VR_MAS: Visual Reproduction - Memory Assessment Scale version; VR_WMS1: Visual Reproduction - WMS-I; VR_WMS1_RUS: Visual Reproduction - WMS-I (Russell Revision); VR_WMS3: Visual Reproduction - WMS-III; VR_WMSR: Visual Reproduction - WMS-R; VRecog_MAS: Visual Recognition test - Memory Assessment Scale; VSLT: Visual Spatial Learning Test; VSRT: Visual Selective Reminding Test (precursor test to version in TOMAL-2 battery).

Test measures: Im: Immediate; Lrn: Learning; Dly: Delayed; Rcg: Recognition; Rcl: Recall; Pc: Percent; Ret: Retention; Cor: Correct; Er: Error; No: Number (of); Tot: Total; Tr: Trial(s); 1_5: 1 to 5; Cue: Cued; R eprd: Reproduction; Cap: Capacity; Discrmn: Discrimination; Exp: Exposure; Corctd: Corrected; CorrMinEr: Correct minus errors; CLTR: Continuous Long-Term Retrieval; STS: Short Term Storage.

Moderators: *Stimulus.* Des: Designs; Spa: Spatial; Fac: Facial; Assoc: Associative. *Learning.* Sin: Single trial; Rep: Repeated trials; *Delay*. Lrn: Learning phase; Dly: Delay phase. *Format.* Rcl: Recall; Rcg: Recognition.

Statistics: *k*: number of studies; *n*: number of patients; *d*: pooled estimate of effect size (Cohen's *d*); *CI_lo*: lower bound of 95% confidence interval; *CI_up*: upper bound of 95% confidence interval; *z*: *z*-test for significance of effect size; *p*: *p*-value for *z*-test; *Q*: test for heterogeneity; *Q_p*: significance of test for heterogeneity; Q_M: test of significance of moderators; I^2: percent of total variability explained by heterogeneity; I^2_B: percent of total variability explained by heterogeneity between papers; I^2_W: percent of total variability explained by heterogeneity within papers; N_{fs}: fail-safe N.

Supplementary Table 5. Comparison of presurgical minus postsurgical difference in performance on individual test measures for left- and right-sided patients, for individual test measures.

Test_measure	k	MD_{LAT}	CI_lo_{LAT}	CI_up_{LAT}	t_{LAT}	p_{LAT}
RCF_Dly	18	-0.02	-0.17	0.13	-0.24	0.81
VR_WMS1_Im_Rcl	11	-0.13	-0.34	0.08	-1.19	0.25
VR_WMS1_Dly_Rcl	10	-0.11	-0.31	0.09	-1.09	0.29
Warr_Fac_Rcg**	**7**	**-0.53**	**-0.83**	**-0.22**	**-3.42**	**0.004**
VR_WMSR_Dly_Rcl	7	-0.17	-0.43	0.08	-1.32	0.21
BVRT_Im_Rcg_Cor	5	-0.11	-0.44	0.21	-0.69	0.51
DCS_Lrn_Tr1_5	5	-0.24	-0.58	0.10	-1.37	0.20
VR_WMSR_Im_Rcl	5	-0.08	-0.35	0.18	-0.62	0.55
RCF_Im	4	-0.20	-0.70	0.30	-0.78	0.46
DCS_Rcg_CorrMinEr	3	-0.24	-0.63	0.15	-1.20	0.28
Des_AMIPB_Lrn_Tr1_5	3	0.01	-0.30	0.32	0.06	0.95
DCS_LrnCap	2	-0.15	-0.58	0.28	-0.69	0.53
Fac_WMS3_Dly_Rcg	2	-0.24	-0.97	0.50	-0.63	0.56
Fac_WMS3_Im_Rcg	2	-0.21	-0.94	0.53	-0.55	0.61
GHFMT	2	-0.37	-0.95	0.21	-1.25	0.28
RVDLT_Dly	2	-0.15	-0.38	0.08	-1.31	0.26
VR_WMS1_Pc_Ret	2	0.00	-0.68	0.68	0.00	1.00
724SLT_Long_Dly_Rcl	1	-0.07	-0.58	0.44	-0.27	0.81
724SLT_Tot_Lrn_Rcl	1	-0.02	-0.53	0.49	-0.08	0.95
BVMT_Dly_Rcl	1	0.11	-0.70	0.92	0.27	0.82
BVRT_Im_Rcg_Er	1	-0.08	-0.94	0.78	-0.19	0.87
CVMT_Dl_Rcg	1	-1.21	-2.37	-0.05	-2.05	0.18
Fig_AMIPB_Dly_Rcl	1	0.77	-0.59	2.13	1.11	0.38
FL_AMIPB_Im	1	0.82	-0.54	2.18	1.18	0.36
Fig_AMIPB_Pc_Ret	1	0.96	-0.44	2.35	1.35	0.31
NVSRT_Dly	1	-0.62	-1.26	0.02	-1.91	0.20
RCF_Pc	1	-0.16	-1.02	0.70	-0.37	0.75
ReccFLT_LrnRcg	1	-0.33	-1.28	0.62	-0.68	0.57
RVDLT_Lrn	1	0.05	-0.69	0.79	0.13	0.91
RVDLT_Rcg	1	-0.31	-0.71	0.09	-1.53	0.27
VR_WMSR_Pc_Ret	1	-0.43	-1.10	0.23	-1.28	0.33
VR_WMS3_Im_Rcl	1	1.08	-0.31	2.47	1.53	0.27
VR_WMS3_Dly_Rcl	1	1.00	-0.41	2.40	1.39	0.30
VR_WMS4_Dly_Rcl	1	0.24	-0.53	1.00	0.60	0.61
VSRT_CLTR	1	-0.53	-1.67	0.61	-0.91	0.46
VSRT_STS	1	-0.34	-1.47	0.80	-0.58	0.62
VDI_WMS3_Dly	3	-0.18	-0.45	0.09	-1.30	0.24
VII_WMS3_Lrn	2	-0.19	-0.57	0.19	-0.98	0.38
VMI_WMSR	4	-0.02	-0.36	0.32	-0.11	0.91
VMI_WMSR_VMQ	1	0.03	-0.62	0.68	0.09	0.94
VSLT_Lrn_Rcl_Tr1_5	1	0.16	-0.52	0.84	0.46	0.69
VSLT_Pc_Ret	1	-0.03	-0.70	0.64	-0.09	0.94

*** $p < .001$, ** $p < .01$, * $p < .05$, ^ $p < .10$. Negative MD values indicate that for RTLE patients the pre-postsurgical decline in performance was of greater magnitude than the decline for LTLE patients.
Tests: 724_SLT: 7/24 Spatial Learning Test; AFT: Alsterdorfer Faces Test; AggFLT: Aggie Figure Learning Test; AustMZ: Austin Maze; BFLTE: Biber Figure Learning Test - Extended; BLT: Brown Location Test; BVMTR:

Brief Visuospatial Memory Test - Revised; BVRT: Benton Visual Retention Test; CVMT: Continuous Visual Memory Test; DCS/DCSI: Diagnostikum für Cerebralschädigung; DCSM: Diagnostikum für Cerebralschädigung (Modified); DCSR: Diagnostikum für Cerebralschädigung (Revised); Des_WMS4: Designs - WMS-IV; Des_AMIPB: Design Learning - Adult Memory and Information Processing Battery; Doors_DandP: Doors test - Doors & People test; Dade_FacLT: Dade Face Learning Test; Denman_FacLT: Denman Facial Recognition Test; Faces_WMS3: Faces - WMS-III; Warr_Fac_Rcg: Warrington Recognition Memory Test for Faces; FamPic_WMS3: Family Pictures - WMS-III; Fig_AMIPB: Figure Learning - Adult Memory and Information Processing Battery; GHFacMT: Graduate Hospital Facial Memory Test; LGT-3: Lern- und Gedächtnistest-3; NVLT: Nonverbal Learning Test; NVMem_RCF_VR2_WMS-R: average of Rey Complex Figure test (Delay) and VR-II, WMS-R version; NVSRT: Nonverbal Selective Reminding Test; PMQ_WMS1: Performance Memory Quotient - WMS-I; RCF: Rey Complex Figure test; RCF_AggFLT_Avg: Rey Complex Figure test and/or Aggie Figure Learning Test; ReccFig: Recurring Figures Learning Test; Route_RBMT: Remembering a new route - Rivermead Behavioural Memory Test; RouteLT: Route Learning Test; RULIT: Ruff-Light Trail Learning Test; RVDLT: Rey Visual Design Learning Test; RVDT: Rey Visual Design Test; Shapes_DandP: Shapes test - Doors & People test; TopogRMT_CAM: Topographical Recognition Memory Test - Camden Memory Test battery; VDI_WMS3: Visual Delayed memory Index (Faces II & Family Pictures II); VDLT: Visual Design Learning Test; VGT: Visual Gestalt Test; VII_WMS3: Visual Immediate memory Index (Faces I & Family Pictures II); VII_WMS3_SP: Visual Immediate memory Index - Standardization Protocol; VM_FACT: composite measure made up of Warrington Faces (total score) & Rey Visual Design Learning Test (Sum of Learning Trials 1 to 5) & Spatial Conditional Associative Learning Task (total trials to criterion); VMI_MAS: composite measure from VR_MAS and VRecog_MAS; VMI_WMSR: Visual Memory quotient from WMS-R (Figural Memory, Visual Paired Associates I, & Visual Reproduction I); VMI_WMSR_VMQ: Visual Memory Index - WMS-R (Visual Memory Quotient);VMI_WMS4: Visual Memory Index – WMS-IV (Designs I and II & Visual Reproduction I and II); VPA_WMSR: Visual Paired Associates - WMS-R; VR_MAS: Visual Reproduction - Memory Assessment Scale version; VR_WMS1: Visual Reproduction - WMS-I; VR_WMS1_RUS: Visual Reproduction - WMS-I (Russell Revision); VR_WMS3: Visual Reproduction - WMS-III; VR_WMSR: Visual Reproduction - WMS-R; VRecog_MAS: Visual Recognition test - Memory Assessment Scale; VSLT: Visual Spatial Learning Test; VSRT: Visual Selective Reminding Test (precursor test to version in TOMAL-2 battery).
Test measures: Im: Immediate; Lrn: Learning; Dly: Delayed; Rcg: Recognition; Rcl: Recall; Pc: Percent; Ret: Retention; Cor: Correct; Er: Error; No: Number (of); Tot: Total; Tr: Trial(s); 1_5: 1 to 5; Cue: Cued; Reprd: Reproduction; Cap: Capacity; Discrmn: Discrimination; Exp: Exposure; Corctd: Corrected; CorrMinEr: Corre ct minus errors; CLTR: Continuous Long-Term Retrieval; STS: Short Term Storage.
Statistics: *k*: number of studies; *MD*: mean difference in pooled estimate of effect size (Cohen's *d*); *CI_lo*: lower bound of 95% confidence interval; *CI_up*: upper bound of 95% confidence interval; *t*: *t*-test for significance of MD; *p*: *p*-value for *t*-test.

Supplementary Table 6. Paper, row and n counts by patient type, moderator levels and interactive moderator sublevels.

	Presurgical				Postsurgical				Postsurgical change			
	k	*rows*	*n_L*	*n_R*	*k*	*rows*	*n_L*	*n_R*	*k*	*rows*	*n_L*	*n_R*
Des	103	243	3581	3345	63	133	2066	2046	49	98	1735	1719
DesSin	79	172	2767	2623	50	100	1576	1589	36	72	1245	1262
DesRep	37	71	1420	1315	20	33	900	850	19	26	874	816
DesLrn	84	114	2759	2560	49	64	1522	1518	39	49	1279	1265
DesDly	82	128	2762	2638	47	68	1488	1497	35	48	1184	1193
DesRcl	96	211	3309	3114	60	117	1981	1965	45	86	1624	1604
DesRcg	24	32	785	772	12	14	407	422	11	12	399	407
DesSinLrn	63	69	2228	2102	37	40	1059	1082	27	28	816	829
DesSinDly	71	102	2539	2392	44	59	1425	1428	33	43	1147	1158
DesRepLrn	34	45	1178	1088	17	24	658	626	16	21	632	592
DesRepDly	16	26	658	631	6	9	413	383	5	5	387	349
DesSinRcl	73	157	2579	2447	47	90	1478	1485	33	66	1147	1158
DesSinRcg	11	15	281	273	6	8	152	176	5	6	144	161
DesRepRcl	33	54	1289	1200	18	27	874	814	17	20	848	780
DesRepRcg	13	17	504	499	6	6	255	246	6	6	255	246
DesLrnRcl	75	91	2442	2265	45	51	1405	1391	34	38	1136	1104
DesDlyRcl	80	119	2738	2615	46	65	1474	1486	34	47	1170	1182
DesLrnRcg	19	23	674	637	11	12	393	411	10	11	385	396
DesDlyRcg	6	9	121	147	2	2	22	26	1	1	14	11
DesSinLrnRcl	49	55	1605	1502	32	32	915	921	22	22	672	668
DesSinDlyRcl	71	101	2539	2392	44	57	1425	1428	33	43	1147	1158
DesRepLrnRcl	31	36	1061	984	16	19	646	601	15	16	620	567
DesRepDlyRcl	14	18	634	608	5	8	399	372	4	4	373	338
DesSinLrnRcg	10	14	273	267	6	7	152	176	5	6	144	161
DesSinDlyRcg	1	1	8	6	1	1	8	15	0	0	0	0
DesRepLrnRcg	9	9	401	370	5	5	241	235	5	5	241	235
DesRepDlyRcg	5	8	113	141	1	1	14	11	1	1	14	11
Fac	26	37	737	665	15	21	338	341	10	15	227	233
FacSin	26	36	737	665	15	21	338	341	10	15	227	233
FacRep	1	1	19	17	0	0	0	0	0	0	0	0
FacLrn	25	28	728	657	15	16	338	341	10	11	227	233
FacDly	8	9	206	182	4	5	115	117	3	4	59	66
FacRcg	26	37	737	665	15	21	338	341	10	15	227	233
FacSinLrn	25	27	728	657	15	16	338	341	10	11	227	233
FacSinDly	8	9	206	182	4	5	115	117	3	4	59	66
FacSinRcg	26	36	737	665	15	21	338	341	10	15	227	233
FacRepLrn	1	1	19	17	0	0	0	0	10	11	227	233
FacRepRcg	1	1	19	17	0	0	0	0	0	0	0	0
FacLrnRcg	25	28	728	657	15	16	338	341	0	0	0	0
FacDlyRcg	8	9	206	182	4	5	115	117	3	4	59	66
FacSinLrnRcg	25	27	728	657	15	16	338	341	10	11	227	233
FacRepLrnRcg	1	1	19	17	0	0	0	0	0	0	0	0
FacSinDlyRcg	8	9	206	182	4	5	115	117	3	4	59	66
FacSinDlyRcg	8	9	206	182	4	5	115	117	3	4	59	66
Spa	7	15	217	213	4	10	109	127	2	3	92	103
SpaSin	2	3	40	38	1	2	8	15	0	0	0	0
SpaRep	6	12	193	193	3	8	101	83	2	3	92	59
SpaLrn	6	9	183	169	3	4	75	83	1	1	58	59
SpaDly	5	6	181	175	4	6	109	127	2	2	92	103

Supplementary Table 6. Paper, row and n counts by patient type, moderator levels and interactive moderator sublevels.

	Presurgical				Postsurgical				Postsurgical change			
	k	*rows*	*n_L*	*n_R*	*k*	*rows*	*n_L*	*n_R*	*k*	*rows*	*n_L*	*n_R*
SpaRcl	6	14	197	193	4	9	109	127	2	3	92	103
SpaRcg	0	0	0	0	1	1	9	9	0	0	0	0
SpaSinLrn	2	2	40	38	1	1	8	15	0	0	0	0
SpaSinDly	1	1	24	20	1	1	8	15	0	0	0	0
SpaRepLrn	5	7	159	149	2	3	67	68	1	1	58	59
SpaRepDly	4	5	157	155	3	5	101	112	2	2	92	103
SpaSinRcl	2	3	40	38	1	2	8	15	0	0	0	0
SpaRepRcl	5	11	173	173	3	7	101	112	2	3	92	103
SpaRepRcg	0	0	0	0	1	1	9	9	0	0	0	0
SpaLrnRcl	5	8	163	149	3	4	75	83	1	1	58	59
SpaDlyRcl	5	6	181	175	4	5	109	9	2	2	92	103
SpaDlyRcg	0	0	0	0	1	1	9	9	0	0	0	0
SpaSinLrnRcl	2	2	40	38	1	1	8	15	0	0	0	0
SpaSinDlyRcl	1	1	24	20	1	1	8	15	0	0	0	0
SpaRepLrnRcl	4	6	139	129	2	3	67	68	1	1	58	59
SpaRepDlyRcl	4	5	157	155	3	4	101	112	2	2	92	103
SpaRepDlyRcg	0	0	0	0	1	1	9	9	0	0	0	0
Scene	6	10	185	129	3	6	78	74	1	2	7	8
SceneSin	6	10	185	129	3	6	78	74	1	2	7	8
SceneLrn	5	5	168	117	3	3	78	74	1	1	7	8
SceneDly	5	5	176	124	3	3	78	74	1	1	7	8
SceneRcl	5	9	176	124	3	6	78	74	1	2	7	8
SceneRcg	1	1	9	5	0	0	0	0	0	0	0	0
SceneSinLrn	5	5	168	117	3	3	78	74	1	1	7	8
SceneSinDly	5	5	176	124	3	3	78	74	1	1	7	8
SceneSinRcl	5	9	176	124	3	6	78	74	1	2	7	8
SceneLrnRcl	4	4	159	112	3	3	78	74	1	1	7	8
SceneDlyRcl	5	5	176	124	3	3	78	74	1	1	7	8
SceneSinRcg	1	1	9	5	0	0	0	0	0	0	0	0
SceneLrnRcg	1	1	9	5	0	0	0	0	0	0	0	0
SceneSinLrnRcl	4	4	159	112	3	3	78	74	1	1	7	8
SceneSinDlyRcl	5	5	176	124	3	3	78	74	1	1	7	8
SceneSinLrnRcg	1	1	9	5	0	0	0	0	0	0	0	0
Assoc	3	6	148	128	0	0	0	0	0	0	0	0
AssocSin	3	6	148	128	0	0	0	0	0	0	0	0
AssocLrn	3	3	148	128	0	0	0	0	0	0	0	0
AssocDly	3	3	148	128	0	0	0	0	0	0	0	0
AssocRcg	3	6	148	128	0	0	0	0	0	0	0	0
AssocSinLrn	3	3	148	128	0	0	0	0	0	0	0	0
AssocSinDly	3	3	148	128	0	0	0	0	0	0	0	0
AssocSinRcg	3	6	148	128	0	0	0	0	0	0	0	0
AssocLrnRcg	3	3	148	128	0	0	0	0	0	0	0	0
AssocDlyRcg	3	3	148	128	0	0	0	0	0	0	0	0
AssocSinLrnRcg	3	3	148	128	0	0	0	0	0	0	0	0
AssocSinDlyRcg	3	3	148	128	0	0	0	0	0	0	0	0
Object	0	0	0	0	1	1	24	23	0	0	0	0
ObjectSin	0	0	0	0	1	1	24	23	0	0	0	0
ObjectLrn	0	0	0	0	1	1	24	23	0	0	0	0
ObjectRcg	0	0	0	0	1	1	24	23	0	0	0	0

Supplementary Table 6. Paper, row and n counts by patient type, moderator levels and interactive moderator sublevels.

	Presurgical				Postsurgical				Postsurgical change			
	k	*rows*	*n_L*	*n_R*	*k*	*rows*	*n_L*	*n_R*	*k*	*rows*	*n_L*	*n_R*
ObjectSinLrn	0	0	0	0	1	1	24	23	0	0	0	0
ObjectSinRcg	0	0	0	0	1	1	24	23	0	0	0	0
ObjectLrnRcg	0	0	0	0	1	1	24	23	0	0	0	0
ObjectSinLrnRcg	0	0	0	0	1	1	24	23	0	0	0	0
Idx	26	32	921	818	15	21	526	486	9	10	403	382
IdxSin	11	17	473	413	8	13	319	318	4	5	229	221
IdxLrn	5	7	277	238	6	6	214	198	2	2	110	105
IdxDly	8	8	358	295	6	7	231	222	3	3	149	140
IdxRcl	3	5	87	83	1	1	9	15	1	1	9	15
IdxRcg	1	1	51	50	5	5	192	187	2	2	110	105
IdxSinLrn	5	7	277	238	0	0	0	0	0	0	0	0
IdxSinDly	8	8	358	295	6	7	231	222	3	3	149	140
IdxSinRcl	3	5	87	83	1	1	9	15	1	1	9	15
IdxLrnRcl	1	2	51	50	0	0	0	0	0	0	0	0
IdxSinRcg	1	1	51	50	0	0	0	0	0	0	0	0
IdxDlyRcl	3	3	87	83	1	1	9	15	1	1	9	15
IdxLrnRcg	1	1	51	50	0	0	0	0	0	0	0	0
IdxSinLrnRcl	1	2	51	50	0	0	0	0	0	0	0	0
IdxSinDlyRcl	3	3	87	83	1	1	9	15	1	1	9	15
IdxSinLrnRcg	1	1	51	50	0	0	0	0	0	0	0	0
Sin	105	243	3624	3409	63	143	2017	2014	45	94	1601	1603
Rep	44	84	1632	1525	23	41	1001	962	21	29	966	919
Lrn	110	166	3655	3398	67	94	1986	1973	48	64	1564	1542
Dly	98	158	3428	3213	54	89	1732	1747	38	58	1339	1350
Rcl	108	238	3788	3528	62	133	2062	2048	45	92	1640	1627
Rcg	52	77	1675	1582	27	37	750	755	19	27	598	600
SinLrn	80	113	2575	2429	52	66	1436	1452	36	42	1069	1077
SinDly	83	127	2960	2737	50	75	1643	1643	36	51	1283	1291
RepLrn	40	53	1356	1254	19	27	725	694	17	22	690	651
RepDly	20	31	815	786	9	14	514	495	7	7	479	452
SinRcl	83	173	2904	2713	48	99	1534	1536	33	69	1147	1158
SinRcg	40	59	1184	1108	21	30	499	525	14	21	356	379
RepRcl	39	65	1567	1466	21	34	975	926	19	23	940	883
RepRcg	14	18	523	516	7	7	264	255	6	6	255	246
LrnRcl	86	105	2920	2669	50	58	1550	1533	36	40	1203	1169
DlyRcl	90	132	3238	3035	48	74	1556	1572	34	51	1189	1206
LrnRcg	45	56	1531	1407	25	29	727	735	18	22	584	589
DlyRcg	17	21	475	457	7	8	146	152	4	5	73	77
SinLrnRcl	56	63	1855	1702	35	36	993	995	23	23	679	676
SinDlyRcl	77	109	2794	2582	45	62	1481	1479	33	45	1147	1158
RepLrnRcl	35	42	1200	1113	18	22	713	669	16	17	678	626
RepDlyRcl	18	23	791	763	8	12	500	484	6	6	465	441
SinLrnRcg	37	46	1143	1062	47	24	499	525	14	17	356	379
SinDlyRcg	12	13	362	316	5	6	123	132	3	4	59	66
RepLrnRcg	10	10	420	387	5	5	241	235	5	5	241	235
RepDlyRcg	5	8	113	141	2	2	23	20	1	1	14	11

n: number of patients, divided by left-sided (n_L) and right-sided (n_R) TLE.

Supplementary Table 6. Paper, row and n counts by patient type, moderator levels and interactive moderator sublevels.

	Presurgical				Postsurgical				Postsurgical change			
	k	*rows*	*n_L*	*n_R*	*k*	*rows*	*n_L*	*n_R*	*k*	*rows*	*n_L*	*n_R*

[a] index measures are composites of other individual tests, usually involving the Wechsler Memory Scale index scores, and are mixtures of different kinds of nonverbal materials, repetition demands, testing delays and testing formats.

[b] spatial category of materials also include navigational or route finding tests.
Moderators: *Stimulus.* Des: Designs; Spa: Spatial; Fac: Facial; Assoc: Associative. *Learning.* Sin: Single trial; Rep: Repeated trials; *Delay*. Lrn: Learning phase; Dly: Delay phase. *Format.* Rcl: Recall; Rcg: Recognition.
Statistics: *k*: number of studies; *rows:* number of datapoints; *n*: number of patients.

Supplementary Table 7. Meta-regression models used to test moderators and their interactions*.

Patient type	Model type	Model terms
Presurgical		
	Additive:	S + L + D + F
	Interactive:	S + L + D + F + (S x D) + (L x D) + (L x F) + (D x F) + (L x D x F)
Postsurgical		
	Additive:	S^ + L + D + F
	Interactive:	L + D + F + (L x D) + (L x F) + (D x F)
Postsurgical change		
	Additive:	S^ + L + D + F
	Interactive:	L + D + F + (L x D) + (L x F)

*Additive and interactive terms were included based on a requirement for k ≥ 5 for each within-moderator level

S: Stimulus; L: Learning Format; D: Delay; F: Test Format

^ Stimulus moderator run with Designs and Faces only, otherwise moderators contained the following terms: Stimulus (Designs, Faces, Spatial), Learning Format (Single, Repeat), Test Delay (Learning, Delay), Test Format (Recall, Recognition)

Supplementary Table 8. Full statistical results for Figure 2 (overall analyses).

Patient group	*d*	*95%_lo*	*95%_up*	*k*	*Z*	*p*	*Q*	*Q_p*	I^2	I^2_B	I^2_W	N_{fs}
Presurgical* **	-0.16	-0.21	-0.10	137	-5.72	**<.0001**	569.57	**<.0001**	52%	51%	1%	2034
Postsurgical* **	-0.26	-0.33	-0.20	82	-8.30	**<.0001**	290.36	**<.0001**	38%	38%	0%	2089
Postsurgical change												
LTLR* **	0.11	0.06	0.15	60	4.29	**<.0001**	110.29	.84	9%	9%	0%	577
RTLR	-0.01	-0.07	0.04	60	-0.49	.62	109.92	.85	17%	17%	0%	

Statistics: *k*: number of studies; *n*: number of patients; *d*: pooled estimate of effect size (Cohen's *d*); *CI_lo*: lower bound of 95% confidence interval; *CI_up*: upper bound of 95% confidence interval; *z*: *z*-test for significance of effect size; *p*: *p*-value for *z*-test; *Q*: test for heterogeneity; *Q_p*: significance of test for heterogeneity; Q_M: test of significance of moderators; I^2: percent of total variability explained by heterogeneity; I^2_B: percent of total variability explained by heterogeneity between papers; I^2_W: percent of total variability explained by heterogeneity within papers; N_{fs}: fail-safe N.

Supplementary Table 9. Full statistical results for Figure 3 (meta-regression and moderator-level results for all levels of each moderator, presurgical group).

A. Additive model: S + L + D + F Q_M = 4.12, *p* = .53

Moderator	Moderator level	*d*	*95%_lo*	*95%_up*	*k*	*Z*	*p*	*Q*	*Q_p*	I^2	I^2_B	I^2_W	N_{fs}
Intercept***	DesSinLrnRcl	-0.18	-0.26	-0.11	121	-4.58	<.0001	476.72	<.0001	52%	51%	1%	2057
Stimulus (overall: Q_M = 1.59, *p* = .45)		**0.05**	**-0.04**	**0.14**	**121**	**1.02**	**.31**						
	Fac vs Des	-0.01	-0.19	0.17	121	-0.12	.91						
	Spa vs Des	0.14	-0.08	0.35	121	1.25	.21						
Learning		0.05	-0.05	0.14	121	0.98	.33						
Delay		0.02	-0.05	0.08	121	0.48	.63						
Format		0.01	-0.11	0.14	121	0.23	.82						

B. Interactive model: S + L + D + F + (S x D) + (L x D) + (L x F) + (D x F) + (L x D x F) Q_M = 9.63, *p* = .56

Moderator	Moderator level	*d*	*95%_lo*	*95%_up*	*k*	*Z*	*p*	*Q*	*Q_p*	I^2	I^2_B	I^2_W	N_{fs}
Intercept***	DesSinLrnRcl***	-0.15	-0.24	-0.06	121	-3.28	.001	470.4	<.0001	53%	53%	0%	1687
Stimulus (overall: Q_M = 2.22, *p* = .33)		0.08	-0.04	0.19	121	1.26	.21						
	Fac vs Des	-0.01	-0.24	0.22	121	-0.08	.94						
	Spa vs Des	0.20	-0.06	0.47	121	1.48	.14						
Learning		-0.03	-0.16	0.10	121	-0.41	.69						
Delay		-0.03	-0.11	0.05	121	-0.69	.49						
Format		-0.04	-0.25	0.17	121	-0.38	.71						
S x D (overall: Q_M = 0.51, *p* = .78)		-0.06	-0.22	0.09	121	-0.79	.43						
	S^{Fac} x D	0.33	-0.87	1.53	121	0.54	.59						
	S^{Spa} x D	-0.17	-0.49	0.15	121	-1.02	.31						
L x D^		0.16	-0.01	0.32	121	1.82	.07						
L x F		0.06	-0.22	0.35	121	0.45	.66						
D x F		-0.18	-1.35	1.00	121	-0.30	.77						
L x D x F		0.19	-1.03	1.41	121	0.31	.76						

C. Moderator levels

Moderator	Moderator level	*d*	*95%_lo*	*95%_up*	*k*	*Z*	*p*	*Q*	*Q_p*	I^2	I^2_B	I^2_W	N_{fs}
Stimulus	**Des*** **	**-0.15**	**-0.20**	**-0.09**	**103**	**-4.84**	**<.0001**	394.21	**<.0001**	49%	46%	3%	1399
	Fac**	**-0.21**	**-0.35**	**-0.07**	**26**	**-2.97**	**.003**	56.49	**0.02**	45%	45%	0%	524
	Spa	-0.09	-0.40	0.23	6	-0.53	.59	26.65	**<.0001**	63%	63%	0%	

Learning	**Sin*** **	**-0.14**	**-0.20**	**-0.08**	**98**	**-4.65**	**<.0001**	311.93	**<.0001**	45%	45%	0%	1292
	Rep* **	**-0.17**	**-0.29**	**-0.06**	**43**	**-3.09**	**.002**	168.87	**<.0001**	58%	58%	0%	709
Delay	**Lrn*** **	**-0.16**	**-0.23**	**-0.10**	**103**	**-4.75**	**<.0001**	310.78	**<.0001**	51%	51%	0%	1545
	Dly **	**-0.12**	**-0.18**	**-0.06**	**88**	**-3.92**	**<.0001**	227.68	**<.0001**	40%	24%	16%	972
Format	**Rcl*** **	**-0.14**	**-0.21**	**-0.08**	**99**	**-4.49**	**<.0001**	368.44	**<.0001**	52%	49%	3%	1332
	Rcg* **	**-0.15**	**-0.25**	**-0.05**	**46**	**-2.86**	**.0043**	111.28	**7E-04**	46%	46%	0%	625

Q_M: Chi-square test of moderators. *** $p < .001$, ** $p < .01$, * $p < .05$, ^ $p < .10$.

S: stimulus type; L: learning format; D: test delay; F: test format.
Intercept refers to the model when all moderators are at the reference level, representing the moderator combinations as shown (DesDlyLrnRcl: Stimulus = Designs, Learning = Single; Delay = Learning; Format = Recall)
Statistics: *k*: number of studies; *n*: number of patients; *d*: pooled estimate of effect size (Cohen's *d*); *CI_lo*: lower bound of 95% confidence interval; *CI_up*: upper bound of 95% confidence interval; *z*: *z*-test for significance of effect size; *p*: *p*-value for *z*-test; *Q*: test for heterogeneity; *Q_p*: significance of test for heterogeneity; Q_M: test of significance of moderators; I^2: percent of total variability explained by heterogeneity; I^2_B: percent of total variability explained by heterogeneity between papers; I^2_W: percent of total variability explained by heterogeneity within papers; N_{fs}: fail-safe N.

Supplementary Table 10. Full statistical results for Figure 4 (meta-regression and moderator-level results for all levels each of each moderator, postsurgical group).

A. Additive model: S^ + L + D + F — QM = 19.44, p = .0006.

Analysis type	Moderator	Moderator level	*d*	*95%_up*	*95%_lo*	*k*	*Z*	*p*	*Q*	*Q_p*	I^2	I^2_B	I^2_W	N_{fs}
1. Meta-regression	Intercept	DesSinLrnRcl***	-0.19	-0.10	-0.28	72	-4.14	<.0001	184.3	.01	26%	26%	0%	1281
	Stimulus[a]**		**-0.33**	**-0.12**	**-0.549**	**72**	**-3.01**	**.003**						2323
	Learning		-0.03	0.08	-0.14	72	-0.55	.59						
	Delay		0.00	0.09	-0.10	72	-0.09	.93						
	Format		-0.03	0.13	-0.20	72	-0.42	.67						

B. Interactive model: L + D + F + (L x D) + (L x F) + (D x F) — QM = 10.45, p = .11.

	Moderator	Moderator level	*d*	*95%_up*	*95%_lo*	*k*	*Z*	*p*	*Q*	*Q_p*	I^2	I^2_B	I^2_W	N_{fs}
Meta-regression	Intercept	SinLrnRcl***	-0.20	-0.09	-0.31	72	-3.70	.0002	195.65	.002	26%	26%	0%	1367
	Learning		0.01	0.17	-0.15	72	0.14	.89						
	Delay		-0.01	0.11	-0.12	72	-0.11	.91						
	Format **		**-0.23**	**-0.05**	**-0.40**	**72**	**-2.58**	**.01**						1552
	L x D		-0.04	0.17	-0.25	72	-0.37	.71						
	L x F		0.07	0.35	-0.20	72	0.53	.60						
	D x F		0.04	0.34	-0.25	72	0.28	.78						

C. Moderator levels

	Moderator	**Moderator level**	***d***	***95%_up***	***95%_lo***	***k***	***Z***	***p***	*Q*	*Q_p*	I^2	I^2_B	I^2_W	N_{fs}
	Stimulus	**Des*** **	**-0.20**	**-0.14**	**-0.26**	**64**	**-6.60**	**<.0001**	**167.66**	**.009**	24%	24%	0%	1235
		Fac* **	**-0.55**	**-0.42**	**-0.68**	**15**	**-8.28**	**<.0001**	16.98	.65	0%	0%	0%	811
	Learning	**Sin*** **	**-0.24**	**-0.17**	**-0.31**	**59**	**-6.45**	**<.0001**	**159.1**	**.004**	34%	34%	0%	1357
		Rep* **	**-0.22**	**-0.11**	**-0.32**	**20**	**-4.11**	**<.0001**	**53.13**	**.01**	36%	5%	31%	416
	Delay	**Lrn*** **	**-0.26**	**-0.19**	**-0.34**	**59**	**-6.96**	**<.0001**	**111.9**	**.007**	28%	8%	19%	1492
		Dly **	**-0.22**	**-0.14**	**-0.30**	**50**	**-5.39**	**<.0001**	**99.11**	**.01**	30%	30%	0%	1060
	Format	**Rcl*** **	**-0.21**	**-0.14**	**-0.27**	**60**	**-6.20**	**<.0001**	**150.1**	**.01**	27%	27%	0%	1180
		Rcg* **	**-0.38**	**-0.26**	**-0.50**	**25**	**-6.37**	**<.0001**	48.66	.05	25%	25%	0%	930

D. Contrasts	Moderator	Moderator levels	*MD*	*95%_up*	*95%_lo*	*k*	*t*	*p*	*p_Bonf*
	Recognition*	**Faces - Designs**	**-0.36**	**-0.17**	**-0.54**	**12**	**-3.76**	**0.0009**	0.0250
	Designs	Recognition - Recall	0.01	0.16	-0.13	12	0.18	0.8609	

$Q_{M:}$ Chi-square test of moderators. a Stimulus moderator run with Designs and Faces only. *** $p < .001$, ** $p < .01$, * $p < .05$, ^ $p < .10$.
S: stimulus type; L: learning format; D: test delay; F: test format.
Intercept refers to the model when all moderators are at the reference level, representing the moderator combinations as shown (for example, DesSinLrnRcl: Stimulus = Designs, Learning = Single; Delay = Learning; Format = Recall)
p_Bonf: Bonferroni-corrected threshold for p-value for additional contrasts (i.e., p = .05/2 = 0.025).
Statistics: *k*: number of studies; *n*: number of patients; *d*: pooled estimate of effect size (Cohen's *d*); *CI_lo*: lower bound of 95% confidence interval; *CI_up*: upper bound of 95% confidence interval; *z*: *z*-test for significance of effect size; *p*: *p*-value for *z*-test; *Q*: test for heterogeneity; *Q_p*: significance of test for heterogeneity; Q_M: test of significance of moderators; I^2: percent of total variability explained by heterogeneity; I^2_B: percent of total variability explained by heterogeneity between papers; I^2_W: percent of total variability explained by heterogeneity within papers; N_{fs}: fail-safe N.

Supplementary Table 11. Full statistical results for Figure 5 (meta-regression and moderator-level results for all levels each of each moderator, postsurgical change groups (left TLR)).

A. Additive model: S + L + D + F QM = 9.95, p = .04

Analysis type	Moderator	Moderator level	*d*	*95% CI low*	*95% CI upp*	*k*	*Z*	*p*	*Q*	*Q_p*	I^2	I^2_B	I^2_W	N_{fs}
Meta-regression	Intercept	DesSinLrnRcl	0.02	-0.08	0.11	55	0.33	.74	90.44	.84	12%	12%	0%	
	Stimulus[a]		0.19	-0.04	0.42	55	1.62	.11						
	Learning		0.06	-0.05	0.17	55	1.03	.31						
	Delay		0.07	-0.04	0.17	55	1.22	.22						
	Format		0.10	-0.06	0.26	55	1.17	.24						

B. Interactive model: L + D + F + (L x D) + (L x F) QM: = 9.87, p = .08

	Moderator	Moderator level	*d*	*95%_up*	*95%_lo*	*k*	*Z*	*p*	*Q*	*Q_p*	I^2	I^2_B	I^2_W	N_{fs}
Meta-regression	Intercept	SinLrnRcl	0.07	-0.04	0.18	55	1.26	.21	90.20	.83	11%	11%	0%	
	Learning		-0.06	-0.22	0.10	55	-0.78	.43						
	Delay		0.01	-0.11	0.14	55	0.24	.81						
	Format		0.12	-0.05	0.28	55	1.38	.17						
	L x D		0.17	-0.05	0.39	55	1.51	.13						
	L x F		0.14	-0.13	0.41	55	1.03	.30						

C. Moderator levels			*d*	*95%_up*	*95%_lo*	*k*	*Z*	*p*	*Q*	*Q_p*	I^2	I^2_B	I^2_W	N_{fs}
	Stimulus	**Des****	**0.08**	**0.03**	**0.14**	**49**	**2.94**	**.003**	87.28	.67	8%	8%	0%	349
		Fac* (FacRcg)**	**0.32**	**0.16**	**0.47**	**10**	**3.89**	**.0001**	5.00	.99	0%	0%	0%	306
	Learning	**Sin*****	**0.12**	**0.05**	**0.18**	**43**	**3.37**	**.0008**	73.08	.77	15%	15%	0%	453
		Rep	0.08	-0.02	0.18	19	1.64	.10	26.73	.37	16%	16%	0%	
	Delay	**Lrn****	**0.10**	**0.04**	**0.17**	**45**	**3.19**	**.001**	48.65	.83	0%	0%	0%	417
		Dly**	**0.11**	**0.04**	**0.18**	**37**	**3.20**	**.001**	51.15	.39	8%	6%	2%	381
	Format	**Rcl** (DesRcl)**	**0.08**	**0.03**	**0.13**	**45**	**2.93**	**.003**	65.63	.91	3%	3%	0%	306
		Rcg**	**0.21**	**0.08**	**0.33**	**19**	**3.24**	**.001**	28.39	.34	20%	20%	0%	371

Moderator combinations

		Moderator level	*d*	*95%_up*	*95%_lo*	*k*	*Z*	*p*	*Q*	*Q_p*	I^2	I^2_B	I^2_W	N_{fs}
		DesRcg	0.12	-0.08	0.31	11	1.17	.24	20.81	.04	44%	44%	0%	

Contrasts

	Moderator	Moderator levels	*MD*	*95%_lo*	*95%_up*	*k1*	*k2*	*t*	*p*	*p_Bonf*
	Recognition	Faces - Designs	0.20	-0.05	0.45	10	11	1.55	0.14	0.03
	Designs	Recognition - Recall	0.04	-0.16	0.24	11	45	0.37	0.71	

Q_M: Chi-square test of moderators. a Stimulus moderator run with Designs and Faces only. *** $p < .001$, ** $p < .01$, * $p < .05$, ^ $p < .10$.

S: stimulus type; L: learning format; D: test delay; F: test format.
Intercept refers to the model when all moderators are at the reference level, representing the moderator combinations as shown (for example, DesSinLrnRcl: Stimulus = Designs, Learning = Single; Delay = Learning; Format = Recall)

p_Bonf: Bonferroni-corrected threshold for p-value for additional contrasts (i.e., p = .05/2 = 0.025).
Statistics: *k*: number of studies; *n*: number of patients; *d*: pooled estimate of effect size (Cohen's *d*); *CI_lo*: lower bound of 95% confidence interval; *CI_up*: upper bound of 95% confidence interval; *z*: *z*-test for significance of effect size; *p*: *p*-value for *z*-test; *Q*: test for heterogeneity; *Q_p*: significance of test for heterogeneity; Q_M: test of significance of moderators; I^2: percent of total variability explained by heterogeneity; I^2_B: percent of total variability explained by heterogeneity between papers; I^2_W: percent of total variability explained by heterogeneity within papers; N_{fs}: fail-safe N.

Supplementary table 12. Full statistics for Figure 6 (meta-regression and moderator-level results for all levels each of each moderator, postsurgical change groups (right TLR)).

A. Additive model: S + L + D + F $Q_M = 6.45$, $p = .17$

Analysis type	Moderator	Moderator level	*d*	*95%_lo*	*95%_up*	*k*	*Z*	*p*	*Q*	*Q_p*	I^2	I^2_B	I^2_W	N_{fs}
Meta-regression	Intercept	DesSinLrnRcl	0.00	-0.09	0.10	55	0.04	.97	91.53	.82	13%	13%	0%	
	Stimulus[a]		-0.08	-0.31	0.14	55	-0.71	.48						
	Learning		-0.06	-0.17	0.05	55	-1.06	.29						
	Delay		0.05	-0.06	0.15	55	0.88	.38						
	Format		-0.06	-0.22	0.10	55	-0.75	.45						

B. Interactive model: L + D + F + (L x D) + (L x F) $Q_M = 7.98$, $p = .16$

	Moderator	Moderator level	*d*	*95%_lo*	*95%_up*	*k*	*Z*	*p*	*Q*	*Q_p*	I^2	I^2_B	I^2_W	N_{fs}
Meta-regression	Intercept	DesSinLrnRcl***	0.03	-0.08	0.14	55	0.56	.58	90.01	.83	13%	13%	0%	
	Learning		-0.12	-0.29	0.04	55	-1.45	.15						
	Delay		0.02	-0.10	0.14	55	0.32	.75						
	Format*		**-0.17**	**-0.33**	**-0.01**	**55**	**-2.04**	**.04**						877
	L x D		0.08	-0.15	0.31	55	0.65	.51						
	L x F		0.20	-0.07	0.47	55	1.42	.16						

C. Moderator levels

		Moderator level	*d*	*95%_lo*	*95%_up*	*k*	*Z*	*p*	*Q*	*Q_p*	I^2	I^2_B	I^2_W	N_{fs}
	Stimulus	Des	0.00	-0.06	0.06	49	-0.04	.97	84.79	.74	16%	16%	0%	
		Fac (same as FacRcg)	-0.13	-0.29	0.04	10	-1.49	.14	12.10	.60	8%	8%	0%	
	Learning	Sin	0.01	-0.05	0.08	43	0.45	.65	73.84	.75	12%	12%	0%	
		Rep	-0.09	-0.20	0.02	19	-1.57	.12	23.02	.58	24%	24%	0%	
	Delay	Lrn	-0.06	-0.14	0.01	45	-1.66	.10	54.29	.65	12%	12%	0%	
		Dly	0.03	-0.03	0.09	37	1.03	.30	40.04	.82	0%	0%	0%	
	Format	Rcl (same as DesRcl)	0.01	-0.04	0.07	45	0.48	.63	71.91	.78	6%	6%	0%	
		Rcg*	**-0.12**	**-0.23**	**0.00**	**19**	**-2.03**	**.04**	22.61	.66	15%	15%	0%	295

D. Moderator combinations

		Moderator level	*d*	*95%_lo*	*95%_up*	*k*	*Z*	*p*	*Q*	*Q_p*	I^2	I^2_B	I^2_W	N_{fs}
		DesRcg	-0.12	-0.27	0.04	11	-1.50	.13	10.50	.49	19%	19%	0%	

D. Contrasts

	Moderator	Moderator levels	*MD*	*95%_lo*	*95%_up*	*k1*	*k2*	*t*	*p*	*p_Bonf*
	Recognition	Faces - Designs	-0.01	-0.23	0.22	10	11.00	-0.07	0.95	0.017
	Designs	Recognition - Recall	-0.13	-0.30	0.03	11	45.00	-1.57	0.12	

Q_M: Chi-square test of moderators. a Stimulus moderator run with Designs and Faces only. *** *p* < .001*,* ** *p* < .01*,* * *p* < .05, ^ *p* < .10.

S: stimulus type; L: learning format; D: test delay; F: test format.
Intercept refers to the model when all moderators are at the reference level, representing the moderator combinations as shown (for example, DesSinLrnRcl: Stimulus = Designs, Learning = Single; Delay = Learning; Format = Recall)

p_Bonf: Bonferroni-corrected threshold for p-value for additional contrasts (i.e., p = .05/2 = 0.025).
Statistics: *k*: number of studies; *n*: number of patients; *d*: pooled estimate of effect size (Cohen's *d*); *CI_lo*: lower bound of 95% confidence interval; *CI_up*: upper bound of 95% confidence interval; *z*: *z*-test for significance of effect size; *p*: *p*-value for *z*-test; *Q*: test for heterogeneity; *Q_p*: significance of test for heterogeneity; Q_M: test of significance of moderators; I^2: percent of total variability explained by heterogeneity; I^2_B: percent of total variability explained by heterogeneity between papers; I^2_W: percent of total variability explained by heterogeneity within papers; N_{fs}: fail-safe N.

Supplementary Table 13. Full statistics for Figure 6 (comparison of postsurgical change for left and right TLR by moderators).

A. Additive model: S + L + D + F

Analysis type	Moderator	Moderator level	*MD (R - L)*	*95%_lo*	*95%_up*	*k*	*t*	*p*
Meta-regression	Intercept	DesSinLrnRcl	-0.01	-0.15	0.12	55	-0.20	0.84
	Stimulus[a]		-0.27	-0.59	0.05	55	-1.65	0.10
	Learning		-0.12	-0.28	0.04	55	-1.48	0.14
	Delay		-0.02	-0.17	0.13	55	-0.23	0.82
	Format		-0.16	-0.39	0.07	55	-1.36	0.18

B. Interactive model: L + D + F + (L x D) + (L x F)

	Moderator	Moderator level	*MD (R - L)*	*95%_lo*	*95%_up*	*k*	*t*	*p*
Meta-regression	Intercept	SinLrnRcl	-0.04	-0.20	0.12	55	-0.49	0.62
	Learning		-0.06	-0.29	0.17	55	-0.50	0.62
	Delay		0.01	-0.17	0.18	55	0.06	0.95
	Format*		**-0.29**	**-0.52**	**-0.05**	**55**	**-2.41**	**0.02**
	L x D		-0.09	-0.41	0.22	55	-0.58	0.56
	L x F		0.06	-0.33	0.44	55	0.29	0.77

C. Moderator levels		Moderator level	MD (R - L)	*95%_lo*	*95%_up*	k	t	p
	Stimulus	**Des***	**-0.08**	**-0.16**	**0.00**	**49**	**-1.98**	**0.050**

	Fac (FacRcg)**	**-0.44**	**-0.67**	**-0.21**	**10**	**-3.77**	**0.00**
Learning	**Sin***	**-0.10**	**-0.19**	**-0.01**	**43**	**-2.14**	**0.04**
	Rep*	**-0.17**	**-0.31**	**-0.02**	**19**	**-2.27**	**0.030**
Delay	**Lrn****	**-0.16**	**-0.26**	**-0.07**	**45**	**-3.34**	**0.00**
	Dly^	-0.08	-0.17	0.01	37	-1.73	0.09
Format	Rcl^ (DesRcl)	-0.06	-0.14	0.01	45	-1.66	0.10
	Rcg***	**-0.32**	**-0.49**	**-0.15**	**27**	**-3.75**	**0.0006**

C. Moderator combinations

	MD (R - L)	*95%_lo*	*95%_up*	*k*	*t*	*p*
DesRcg^	-0.23	-0.48	0.01	11	-1.85	0.0789

D. Contrasts

Moderator	Moderator levels	*MD*	*95%_lo*	*95%_up*	*k1*	*k2*	*t*	*p*	*p_Bonf*
Recognition	Faces - Designs**	-0.21	-0.54	0.13	10	11	-1.20	0.25	0.025
Designs	Recognition - Recall*	-0.17	-0.43	0.09	11	45	-1.28	0.21	

Q_M: Chi-square test of moderators. a Stimulus moderator run with Designs and Faces only. *** $p < .001$, ** $p < .01$, * $p < .05$, ^ $p < .10$.

S: stimulus type; L: learning format; D: test delay; F: test format.

Intercept refers to the model when all moderators are at the reference level, representing the moderator combinations as shown (for example, DesSinLrnRcl: Stimulus = Designs, Learning = Single; Delay = Learning; Format = Recall)

p_Bonf: Bonferroni-corrected threshold for p-value for additional contrasts (i.e., p = .05/2 = 0.025).

Statistics: *k*: number of studies; *n*: number of patients; *d*: pooled estimate of effect size (Cohen's *d*); *CI_lo*: lower bound of 95% confidence interval; *CI_up*: upper bound of 95% confidence interval; *z*: *z*-test for significance of effect size; *p*: *p*-value for *z*-test; *Q*: test for heterogeneity; *Q_p*: significance of test for heterogeneity; Q_M: test of significance of moderators; I^2: percent of total variability explained by heterogeneity; I^2_B: percent of total variability explained by heterogeneity between papers; I^2_W: percent of total variability explained by heterogeneity within papers; N_{fs}: fail-safe N.