Memory deficits after resection from left or right anterior temporal lobe in humans: a meta-analytic review

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Authors' objectives
To provide a quantitative evaluation of memory deficits after unilateral resection from a temporal lobe.

Searching
PsycLIT and MEDLINE databases were searched from January 1966 to June 2000, for articles on temporal lobectomy and cognitive functions in adults. The citations in the identified articles were also examined for further studies.

Study selection

Study designs of evaluations included in the review
The authors do not state explicit criteria relating to study design. The only relevant criterion stated that studies had to measure memory performance before and after surgery.

Specific interventions included in the review
The use of resection from the anterior temporal lobe (ATL), or the surgical removal or excision of temporal structures, as a primary surgical procedure. Resection from the ATL is used for nonlesional, intractable medial temporal lobe epilepsy (TLE).

Participants included in the review
Only adults with left cerebral dominance for language, as determined by the intracarotid amobarbital procedure, were included.

Outcomes assessed in the review
Memory performance within 24 months of surgery was measured using explicit verbal or nonverbal tests of memory (Logical Memory and Visual Reproduction subtests from the Wechsler Memory Scale).

How were decisions on the relevance of primary studies made?
The authors do not state how the papers were selected for the review, or how many of the reviewers performed the selection.

Assessment of study quality
All of the studies were assessed using a threats-to-validity method. This provides a numeric rating of the degree to which a specific study design controls for the seven threats to internal validity, as proposed by Cook and Campbell (see Other Publications of Related interest nos. 1-2): history; maturation; testing; instrumentation; statistical regression; selection; and mortality.

For each study, the degree of control for each of the seven threats to internal validity was rated on a 3-point Likert scale; the scoring ranged from 0 (no control) to 2 (full control). Studies were included if they achieved an overall internal validity score (a summation of all seven scores) of at least 4 and obtained a score of at least 1 for history and maturation.

In stage two of the data evaluation, the studies that qualified in stage one were further screened according to two criteria: (1) two Wechsler Memory Scale subtests (Logical memory and Visual Reproduction) were the most frequently used measures of verbal and nonverbal memory, respectively; and (2) the study provided sufficient data for calculating the treatment effect size (either means and standard deviations, significance test results, or level of significance).

Twenty-five per cent of the studies were randomly selected and rated on the threats to validity by a second rater. Reliability was expressed as the percentage agreement of the ratings of these two raters.
Data extraction
The authors do not state how the data were extracted for the review, or how many of the reviewers performed the data extraction.

The data were extracted into the following categories: participants with resection of the left lobe; participants with resection of the right lobe; gender; age; the mean time difference between pre- and post-operative memory assessment; the mean age at seizure onset; the mean duration of seizures; the mean years of education; the mean pre-operative IQ scores for patients with resection from the left ATL; and the mean pre-operative IQ scores for patients with resection from the right ATL.

Methods of synthesis
How were the studies combined?
The studies were combined using a vote-counting procedure and by comparison of the effect sizes (ESs).

The vote-counting procedure was used to identify the general trend of results on the effects of surgery and the side of the epileptic seizures on verbal and nonverbal memory. The probabilities of obtaining outcomes in support of the a priori hypothesis were calculated. The a priori hypothesis was that, relative to right TLE patients, left TLE patients would perform worse on measures of verbal memory (both before and after surgery) and would decline in their verbal memory, but would increase in their nonverbal memory post-operatively. In contrast, right TLE patients would perform worse on measures of nonverbal memory (both before and after surgery) and would show the corresponding opposite patterns in memory post-operatively.

The ESs were compared using the unbiased effects size estimator, ’Index d’ (8 studies qualified for this analysis). Analysis of variance procedures following a fixed-effect model (see Other Publications of Related Interest no.1) were used for hypothesis testing. The individual ESs obtained from each study were pooled with the seven other studies to formulate an average ES estimate.

How were differences between studies investigated?
No formal test of heterogeneity was undertaken.

Results of the review
Thirty-three studies with a total of 1,852 participants were eligible for inclusion, based on the quality assessed by the threat-to-validity criteria. Of these, 8 studies (309 participants) reported means and standard deviations for each subgroup and memory measures, according to stage two of the data evaluation.

The agreement between the two raters on each of the seven threats to validity ranged from 75 to 88%. The vote-counting approach produced results ranging from 0.00 to 1.00.

Left versus right: verbal measure.
The ES for the difference between left and right TLE patients was 0.19 (statistical significance: =1.62, p<0.10) for immediate verbal memory, and 0.38 ( =3.66, p<0.001) for delayed verbal memory. The ESs for post-operative difference between left and right TLE on immediate (ES 0.79) and delayed (ES 0.69) verbal memory were statistically significant ( =6.59, p<0.001 and =5.39, p<0.001, respectively).

Left versus right: nonverbal measure.
The ESs for the difference between left and right TLE patients on immediate (ES -0.004) and delayed (ES -0.29) nonverbal memory were not statistically significant ( = -0.03, p=0.97 and = -1.78, p=0.07, respectively). The ESs for the post-operative difference between both left and right TLE patients on immediate (ES 0.19) and delayed (ES 0.13) nonverbal memory were also not statistically significant ( =1.48, p=0.13 and =0.84, p=0.40, respectively).

Post-operative change: left TLE.
The ES for the difference between pre- and post-operative memory was significant for immediate verbal memory (ES 0.44, Z=3.81, p<0.001), but not for delayed verbal memory (ES 0.14, =0.56, p=0.57). The ESs for the differences between pre- and post-operative memory, in terms of both immediate (ES 0.07) and delayed (ES 0.24) nonverbal memory, were not statistically significant (Z=0.54, p=0.59 and =1.57, p=0.12, respectively). 

Post-operative change: right TLE.

The ESs for the differences between pre- and post-operative memory, in terms of both immediate (ES 0.09) and delayed (ES 0.19) nonverbal memory, were not statistically significant ( =0.68, p=0.50 and =1.16, p=0.25, respectively). They were also not statistically significant for immediate (ES 0.21) and delayed (ES 0.17) verbal memory ( =1.80, p=0.07 and =1.14, p=0.15, respectively).

The results of the probability analysis for the a priori hypothesis were also reported for each subgroup.

Authors' conclusions
The review's findings suggest that the side of the epileptic seizure, and surgical resection from a temporal lobe, affect verbal memory functions. The relationships between the laterality of epileptic seizure, surgical resection from temporal lobe, and nonverbal memory are to be verified by further research.

CRD commentary
The review question was clear. However, the search was restricted to two databases (PsycLIT and MEDLINE) and few details were given of attempts to identify further studies. It was also unclear whether any language restrictions were applied. The study selection criteria could have been described more clearly under the appropriate section; in the 'Discussion' section, there is further elaboration as to why some studies were excluded. For example, we discover that studies which included patients with bilateral cerebral dominance or coexisting neurologic pathology not incurred by epilepsy, or the analysis of left and right TLE patient groups together rather than as separate groups, were excluded. No details were provided of the study designs, and there were very few details of the included studies, e.g. the characteristics of the patients.

Generally, no details were provided of the methods used for the review process; the exception was that 25% of the studies were randomly selected to be rated on the threats to validity by 'a second rater'. The description of the statistical tests employed seem appropriate, although no tests for heterogeneity were reported. Also, publication bias was not explored.

The authors' conclusions seem appropriately cautious given their findings.

Implications of the review for practice and research
Practice: The authors state that their results highlight the weaknesses of using the Wechsler Memory Scale tests for clinical diagnosis and prognosis for epilepsy, and that their findings suggest avenues for growth. The use of tasks that include learning as well as retention measures, and in which the measures of verbal performance are more purely verbal and therefore readily distinguished from nonverbal tasks, may be more successful at detecting focal dysfunction and pre- to post- surgical changes.

Research: The authors recommend the development and validation of construct-sensitive memory instruments. In addition, further research is needed to verify the relationships between the laterality of epileptic seizure, surgical resection from temporal lobe, and nonverbal memory.

Bibliographic details

PubMedID
Other publications of related interest
2. Wortman PM. Judging research quality. In: Cooper H, Hedges LV, editors. The handbook of research synthesis. New 

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MeSH
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This is a critical abstract of a systematic review that meets the criteria for inclusion on DARE. Each critical abstract 
contains a brief summary of the review methods, results and conclusions followed by a detailed critical assessment on 
the reliability of the review and the conclusions drawn.