



AOTA Critically Appraised Topics and Papers Series
Traumatic Brain Injury

**A product of the American Occupational Therapy Association's
Evidence-Based Literature Review Project*

CRITICALLY APPRAISED PAPER (CAP)

Focused Question

What is the evidence for the effect of interventions to address cognitive/perceptual functions (attention, memory, executive functions) on the occupational performance for persons with traumatic brain injury (TBI)?

.....
Kessels, R. P. C., & de Haan, E. H. F. (2003). Implicit learning in memory rehabilitation: A meta-analysis on errorless learning and vanishing cue methods. *Journal of Clinical and Experimental Neuropsychology*, 25, 805–814.

PROBLEM STATEMENT (JUSTIFICATION OF THE NEED FOR THE STUDY)

State the problem the authors are investigating in this study.

Cognitive memory training programs have been developed, consisting of extensive and repetitive practice on memory tasks using computers for administering, scoring, and giving feedback. Although they produce improvements on trained tasks, there is little to no generalization to other memory tests or to memory functions for daily life. Other approaches use internal strategy training (mnemonics) or external aids to overcome disability. Research on these training methods has suggested only limited success. Amnesia does not include all aspects of human memory and some aspects are commonly spared. While explicit memory may be impaired, often implicit memory is not, even in patients with severe deficits. Two approaches to memory training utilize implicit learning: vanishing cues (based on shaping and backward chaining) and errorless learning (prevents errors so that errors do not become stored in memory).

RESEARCH OBJECTIVE(S)

List study objectives.

Quantitatively investigate the effects of vanishing cues and errorless learning in amnesics and to discuss the outcome and applicability to memory rehabilitation.

Describe how the research objectives address the focused question.

Occupational therapists use teaching methods to help persons with amnesia (memory loss) after traumatic brain injury (TBI) to recover independence in occupational performance. Knowledge of which teaching method is effective with this population would contribute to improved effectiveness of occupational therapy to improve occupational performance in patients post-TBI.

Because this is a meta-analysis review, much of this worksheet cannot be completed (sections noted with *). However, see Results, Conclusions, and Clinical Implications for discussion of how this review contributes to the evidence-based review question.

DESIGN TYPE:

Meta-analysis

Level of Evidence:

I

Limitations (appropriateness of study design):

Was the study design type appropriate for the knowledge level about this topic? *If no, explain.*

Yes

No

SAMPLE SELECTION

How were subjects selected to participate? Please describe.

Literature search in PsychInfo (1887–2002) and MedLine (1996–2002) using the keywords memory, cognitive rehabilitation, errorless learning, and vanishing cues. Additional studies identified from reference lists of identified studies.

Inclusion Criteria

Journal article; written in English; paper reported original data (not same subjects used in another study); memory rehabilitation was studied in patients with memory dysfunction; control condition or control group was used; exact scores were presented for both conditions or groups (mean and standard deviation) or the exact p values, t values, or F values were given.

Exclusion Criteria

NR

NR = Not reported

* Sample Selection Biases: If yes, explain.

Volunteers/Referrals

Yes

No

Attention

Yes

No

Others (list and explain):

*** SAMPLE CHARACTERISTICS**

$N = 27$ studies that focused on errorless learning or vanishing cues; 13 of these did not include a control condition or group or applied a single-case design which makes it impossible to compute the effect size statistic. Three other studies applied a between group design and were excluded. Final $N = 11$ studies.

% Dropouts

(%) Male

(%) Female

Ethnicity

Disease/disability diagnosis Patients with amnesia post-TBI

Check appropriate group:

<20/study group	20–50/study group	51–100/study group	101–149/study group	150–200/study group
-----------------	-------------------	--------------------	---------------------	---------------------

Sample Characteristics Bias: *If no, explain.*

If there is more than one study group, was there a similarity between the groups?

Yes

No

Were the reasons for the dropouts reported?

Yes

No

* **INTERVENTION(S)**—Included are only those interventions relevant to answering the evidence-based question.

All papers using the vanishing cues method used the procedures introduced by Glinksy, Schacter, and Tulving (1986)¹. Generally, the patient is taught complex material using a fading cueing technique. Each step is incrementally presented and cues to enable success are offered. Subsequently the cues are faded (removed) bit by bit. The vanishing cues method is time consuming and requires many learning trials.

All papers using the errorless learning method used the procedure outlined by Baddeley and Wilson (1994)². Errorless learning does not rely on explicit attentional resources. The basic assumption of errorless learning is that errors produced during learning interfere with correct responses. There is evidence that these errors are stored in memory through intact implicit memory. Normally, errors are corrected by explicit memory processes, but since these are impaired in amnesic subjects, errors may actually be consolidated in this patient group. In this approach, the making of errors is prevented. The correct performance is told to the patient and with his or her attempt, the correct response is reinforced. Cues are given in subsequent trials to avoid the occurrence of errors.

Subjects in all control conditions were prompted to guess the correct answer and were given feedback on whether the answer was correct or not, eventually followed by the correct answer (trial-and-error).

Add groups if necessary

Group 1

Brief Description	
Setting	
Who Delivered?	
Frequency?	
Duration?	

Intervention Biases: *Explain, if needed.*

Contamination

Yes

No

¹ Glinksy, E. L., Schacter, D. L., & Tulving, E. (1986). Learning and retention of computer-related vocabulary in memory-impaired patients: Method of vanishing cues. *Journal of Clinical and Experimental Neuropsychology*, 8, 292–312.

² Baddeley, A., & Wilson, B. A. (1994). When implicit learning fails: Amnesia and the problem of error elimination. *Neuropsychologia*, 32, 53–68.

Co-intervention

Yes

No

Timing

Yes

No

Site

Yes

No

Use of different therapists to provide intervention

Yes

No

* **MEASURES AND OUTCOMES**—Included are measures relevant to answering the focused question.

Name of measure:

Effect size, g.

Outcome(s) measured (what was measured?):

Strength of relationship between the independent variable (type of treatment) and dependent variable (learning)

Is the measure reliable (as reported in article)?

Yes

No

NR

Is the measure valid (as reported in article)?

Yes

No

NR

How frequently was the measure used for each group in the study?

NA

Measurement Biases

Were the evaluators blinded to treatment status? *If no, explain.*

Yes

No

Recall or memory bias *If yes, explain.*

Yes

No

Others (list and explain):

Limitations (appropriateness of outcomes and measures) *If no, explain.*

Did the measures adequately measure the outcome(s)?

Yes

No

RESULTS

Effect size g , the difference between intervention and control performance divided by the pooled standard deviation. The effect size was weighted for sample size. The heterogeneity (Q) of the studies was determined, as well as 95% confidence interval on the basis of standard error. The z value and exact level of significance were determined. All calculated using the statistical package, MetaWin.

List results of outcomes relevant to answering the focused question

Include statistical significance where appropriate ($p < 0.05$)

Include effect size if reported.

Overall effect sizes for errorless learning or vanishing cues compared to errorful learning or standard anticipation (control conditions) was 0.59 (a moderate effect), $z = 2.27$, $p = 0.012$.

Effect size for errorless learning compared to trial-and-error learning was 0.87 (large effect), $z = 2.42$, $p = 0.008$.

Effect size for vanishing cues compared to trial-and-error learning was 0.27 (small effect), $z = 0.38$, NS.

The heterogeneity statistic (Q) was not significant in all analyses (all studies were homogenous and can be combined for calculating overall effect size).

Was this study adequately powered (large enough to show a difference)? *If no, explain.*

Yes

No N/A

Were appropriate analytic methods used? *If no, explain.*

Yes

No

Were statistics appropriately reported (in written or table format)? *If no, explain.*

Yes

No

CONCLUSIONS

State the authors' conclusions that are applicable to answering the evidence-based question.

The results clearly show that amnesic patients benefit most from an errorless learning approach. The learning resulted in a higher number of recalled items. The findings do not address the problem of generalization. Two studies indicate that errorless learning can be applied to the clinical situation, beyond well-controlled laboratory tasks. The errorless learning principle is most effective in situations where implicit learning is possible (e.g., recovery of habits of self-care). This meta-analysis demonstrated that errorless learning has been effective in treatment memory dysfunction and can be applied in clinical settings. Errorless learning must be regarded as a principle rather than a strict set of specific techniques.

Were the conclusions appropriate for the study design (level of evidence)? *If no, explain.*

Yes

No

Were the conclusions appropriate for the statistical results? *If no, explain.*

Yes

No

Were the conclusions appropriate given the study limitation and biases? *If no, explain.*

Yes

No

IMPLICATIONS FOR OCCUPATIONAL THERAPY

This section provides guidance about clinical practice, program development, and other implications of the study findings as they relate to the focused question.

This meta-analysis suggests that the use of the principle of errorless learning in the relearning of habitual occupational performance tasks would be an effective method of teaching amnesic patients. Because the material to be learned in the studies of this meta-analysis was a list of names and other laboratory tasks, further research by occupational therapists is needed using habitual occupational tasks as the material to be learned.

This work is based on the evidence-based literature review completed by Catherine Trombly, ScD, OTR/L, FAOTA.

CAP Worksheet adapted from: Critical Review Form – Quantitative Studies ©Law, M., Stewart, D., Pollack, N., Letts, L., Bosch, J., & Westmorland, M., 1998, McMaster University. Used with permission.

For more information about the Evidence-Based Literature Review Project, contact the American Occupational Therapy Association, 301-652-6611, x 2052.



Copyright 2007 American Occupational Therapy Association, Inc. All rights reserved.
For personal or educational use only. All other uses require permission from AOTA.
Contact: copyright@aota.org