

# Errors, Error Detection, Error Correction and Medial Temporal Lobe Amnesia: Evidence from Patient H.M.

Donald G. MacKay & Laura W. Johnson

Psychology Department, University of California, Los Angeles

## Abstract

This poster reviews evidence for a link between error detection, error correction and medial temporal lobe (MTL) amnesia. The core evidence comes from ten studies with H.M., an amnesic with MTL and cerebellar damage but virtually no neocortical damage. The task in three studies was to detect errors experimentally “planted” in sentences, e.g., “I helped themselves to the birthday cake”, and complex visual scenes, e.g., a bird flying in a fish bowl in a school classroom. In all three studies, H.M. detected reliably fewer errors than carefully matched memory-normal controls. Other studies examined the correction of self-produced errors in spoken discourse, object naming, and reading aloud. In these studies H.M. corrected reliably fewer errors than memory-normal and cerebellar controls, and two consistent features characterized H.M.’s uncorrected errors: omission and anomaly. For example, H.M.’s uncorrected errors in speech involved omission of one or more words and rendered his sentences anomalous (incoherent, incomplete or ungrammatical) reliably more often than the errors of controls. These idiosyncratic features of H.M.’s uncorrected errors suggested a simple theoretical account for explaining his error detection deficits, his error correction deficits, his retrograde amnesia for familiar episodic and semantic information, his anterograde amnesia for novel episodic and semantic information and his deficits in visual cognition, sentence comprehension, sentence production, sentence reading, object naming, and reading isolated low frequency words aloud.

## Memory-Normal Control Participants

Carefully matched with H.M. for:

- Age
- IQ: verbal and performance
- Educational degree
- Background
- Native language

## Control Procedures

Control procedures rule out deficits due to:

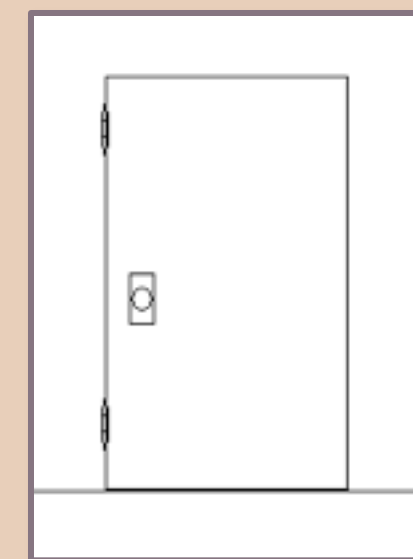
- explicit or declarative memory problems
- excessive memory load in the tasks
- failure to comprehend or recall the instructions
- poor visual acuity, motoric slowing or insufficient time to respond
- lack of motivation or interest in the tasks
- deficits in visual scanning or in the allocation of attention
- inability to keep track of prior responses when processing sentences and visual scenes

## Results: Error Detection Deficits

### Visual Error Detection

**Task:** to detect experimentally-planted visual errors or erroneous objects in images of visual scenes containing over 100 objects

**Example stimuli:**



**Results:**

Correctly circled erroneous objects  
H.M.: 48%  
controls: 70%  
2.38 SD deficit for H.M. vs. controls

### Sentence Error Detection

**Task:** to respond “yes” if sentence is error-free, “no” otherwise

**Example stimuli:**

Error-free: I helped myself to the cake.  
Erroneous: I helped themselves to the cake.

**Results:**

2.13 SD fewer correct answers for H.M. compared to controls

## Results: Error Correction Deficits

### Error Correction Deficits in Spoken Discourse

**Examples of uncorrected errors in H.M.’s spoken discourse:**

“I [O] like some [O] her.” [I would like some of what she had.]  
“He liked the new position because of being, being [R] [O] a passenger line.”  
“Uh, just [O]. . . uh . . . was a private kindergarten, and being [A] on Burnside Avenue”  
“I think it’s, uh, [O] probably, straw... long and short ones [O].”  
“He’s talking on the [O] to somebody.”

### Error Correction Deficits in Reading Aloud

**Example stimuli:**

The boys who ate hot dogs got stomach aches.

I tell you, Edith, it’s not easy raising the dead.

**H.M.’s responses:**

“The boys [O] ate hot dogs got stomach aches.”  
“I tell [O] Edith, it’s not... easy, the- [A] raising the dead.”

### Error Correction Deficits in Object Naming

**Example stimuli:**



**H.M.’s responses:**

easel → “window”  
performance graph → “mountains”

## Types of Errors

H.M. consistently produced two types of uncorrected errors:

### Omission

Omission of one or more words or phrases in sentences and features of objects in novel visual scenes were relatively more common than other types of errors for H.M vs. controls.

### Anomaly

H.M.’s errors caused his sentences to become incoherent or ungrammatical reliably more often than errors of control participants.

## Binding Theory Principle [1]

*MTL lesions like H.M.’s impair ability to form complete and coherent internal representations for:*

- Novel (not-previously-encountered) information
- Relations between familiar concepts and their novel (unfamiliar) sentence, scene, and episodic (space-time) contexts.

Under principle [1], H.M. cannot detect or correct errors in sentences because he cannot form a complete and coherent sentence plan to compare with his output. Similarly, he cannot detect erroneous objects or correct object identification errors because he cannot form a complete and coherent internal representation of the visual scene to compare with his output.

## Conclusions

- H.M. showed error detection and error correction deficits in visual cognition, sentence production, reading sentences aloud, and sentence comprehension.
- The link between error detection and error correction deficits and MTL amnesia is readily explained by binding theory.

## References

- MacKay, D. G. & James, L. E. (2009). Visual cognition in amnesic H.M.: Selective deficits on the What’s-Wrong-Here and Hidden-Figure tasks. *Journal of Experimental and Clinical Neuropsychology*, 31, 769-789.
- MacKay, D. G., James, L. E., Hadley, C. & Fogler, K. A. (2011). Speech errors of amnesic H.M.: Unlike everyday slips-of-the-tongue. *Cortex*, 47, 377-408.