

# Human Memory

## Volume 1

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# HUMAN MEMORY

## VOLUME I

*Cases of Memory Impairment*

Edited by  
Chris J. A. Boulton



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# HUMAN MEMORY

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**Chris J.A. Moulin** is a cognitive neuropsychologist. His research interests focus on neuropsychological impairments of memory. In particular, he is interested in the interaction of executive function, consciousness and long-term memory. He was the founding director of the Memory and its Disorders Masters Degree Programme at the University of Leeds. He is on the editorial boards of the journals *Memory*; *Learning and Perception*; and the *International Journal of Psychology*. Dr Moulin has been very involved in researching and making people aware of *déjà vécu*, a rare disorder of memory, similar to persistent *déjà vu*.

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Fig. 1. Raster plots and peristimulus time histograms (PSTH) (100-ms bin size) of a single neuron in the right hippocampus that responded selectively to a picture of the patient's brother. Pictures are covered for privacy. The different presentation durations are shown with the light red bars at the bottom of the PSTH plots. Trials where the pictures were (were not) recognized are displayed in blue (red). Note that responses changed dramatically depending on whether the picture was recognized or not and far outlasted the stimulus presentation duration. Reprinted with permission from the author.

Fig. 2. Raster plots and PSTH of a single neuron in the right entorhinal cortex that fired selectively to pictures of the World Trade Center. Note the striking difference in the responses to presentations when the picture was recognized (in blue) and when it was not (in red). Reprinted with permission from the author.

Fig. 3. Raster plots and PSTH of a single neuron in the right hippocampus that responded selectively to pictures of the actress Whoopi Goldberg. In this case the patient reported to recognize all picture presentations of Whoopi Goldberg (in blue), even for the 33-ms presentations. Reprinted with permission from the author.

Fig. 4. Raster plots and PSTH of a single unit in the left hippocampus that responded to a picture of Elvis Presley and a picture of Ronald Reagan. Note again the lack of responses in the nonrecognized trials. Reprinted with permission from the author.

Fig. 5. Normalized average responses of all neurons for the different presentation durations, separated into recognized and nonrecognized trials. The horizontal dashed lines mark the mean baseline activity, and the bands show the SEM. Three effects can be seen. (i) a striking difference in amplitude and variability between recognized and nonrecognized conditions. (ii) A far longer neuronal response than stimulus presentation duration. (iii) A largely “unitary” response shape with only marginal changes with stimulus durations. Reprinted with permission from the author.

Fig. 6. Normalized average responses of the cases in which the same duration elicited equal number of recognized and nonrecognized trials. The horizontal dashed lines mark the mean baseline activity and the bands show the SEM. Note that for the same stimulus and the same duration, i.e., exactly the same visual inputs, there was a significantly higher response for the trials in which the pictures were recognized, according to the subjects’ reports ( $T$  test,  $P_{10\_6}$ ). Reprinted with permission from the author.

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# Editor's Introduction: Human Memory

*Chris J.A. Moulin*

Life is all memory, except for the one present moment that goes by you so quickly you hardly catch it going.

– Tennessee Williams

## What Is Memory?

**M**emory is a fundamental psychological entity. It can be thought of as a personal record of experience. After the here-and-now of perception, sensation, emotion or reflection, if there is any lasting influence of that process, it must be because the material or thought is retained in some manner. Loosely speaking, any such retention is a form of memory. Contemporary views of cognition as information processing thus see memory as a central feature of human thought. These volumes will show how this is a view which is of utility in understanding neurological and psychiatric conditions, and has applications to real-world issues such as eyewitness testimony. Memory is a topic which has its foundations in learning processes and the very beginnings of experimental psychology; again, this theme is apparent from the articles selected here.

Memory, then, is the sum of all experience and knowledge stored in an accessible form. This idea is captured in Tennessee Williams' quote. From this viewpoint, it is a difficult task to condense this vast topic matter into four volumes. One begins to sense that all skills, thoughts, habits, predilections, and tastes are the products of memory-based processing. And indeed these volumes feature scientific accounts of memory for topics as diverse as psychotherapy, alien abduction, and the brains of taxi drivers. This broad view of memory explains its dominance in contemporary syllabi and the composition of University departments all around the world. But it is possibly at odds with non-technical views of what memory is. Lay conceptions of memory centre on storage and retrieval. Popular analogues of human memory are libraries, notebooks, and hard-drives. These are not really any different from classical Greek views of memory which compared it to a block of wax which can be carved. The idea was that the experience of an event literally left an impression. This idea has proved hard to shift: nowadays even foam mattresses are



described as having 'memory'. These volumes will describe areas where the science of memory is in keeping with this lay concept of memory but also outline areas where memory is briefer, more nebulous and less accurate than imagined by the uninformed.

For the psychologist, memory is not merely akin to an impression left on wax, a passive store of experience. Modern views see it as simultaneously a process and a store (e.g. see 20, 29, 48). Memory is thought of as a reconstructive process – and the subtle embellishments, errors and shifts in perspective shown in many of the articles here are evidence that memory is not simply based on an impression of what was left behind. Central to the idea of memory being reconstructive are the many studies examining false memories. These show that human memory is prone to biases which are systematic and part of the healthy mind (see 64). It is not that a veridical impression of the real event is merely carved into the mind at the time it is experienced only to be reproduced verbatim later on. If memory were a passive block of wax, it would make the study of memory dull and one-dimensional, and memory disorders would simply be a sad, irritating malady of forgetfulness. Instead, it will be shown that memory disorders affect the core of human experience: selfhood and conscious experience. And often they include errors of commission – remembering things that didn't happen, rather than forgetting things that did.

Memory research now transcends beyond the veridical (e.g. confabulation, 10, 14, 15). Memories can quite readily be full of errors and inconsistencies even in the most healthy and intelligent minds because they are reconstructions of representations made at the point of retrieval. They will undoubtedly correspond to previous events, but rather than being a replica from some nebulous store, they are a recapitulation of a previous representation. In this sense memories are formed by a process, are the result of processing, and are a process in themselves. The classic example of this idea comes from the Levels of Processing framework (48). This is an effect whereby materials which are processed deeply (e.g. where a person judges the pleasantness of a word) are better remembered than materials which are processed shallowly (e.g. merely counting the number of vowels in a word). This effect occurs regardless of whether or not people are told to remember the materials they are processing. Memory can thus be thought of as a by-product of processing. Whenever the mind carries out a meaningful task, it is registered in memory – whether desired or not.

## **A Metaphor for Memory**

An appropriate metaphor for memory might therefore be something like a whiskey distillery. Distillation is a process which derives from the manipulation of stored liquids. Each stage of distilling results in products to be stored, and each storage itself is a process. Whiskey is aged in barrels. The storage