

# The Janus face of Mnemosyne

Memory: some systems in the brain may be better equipped to handle the future than the past.

Yadin Dudai and Mary Carruthers

“Time present and time past / Are both perhaps present in time future, / And time future contained in time past.” Neuroscientists studying memory today might find T. S. Eliot’s pairing in *Burnt Norton* of time past with time present easier to comprehend than his metaphysical linkage of times past and future. Modern research considers memory as a trace of past experience and, despite being equipped with the marvels of cellular biology and functional neuroimaging, most investigators are still looking for the brain equivalent of Plato’s etched-wax tablet. But memory has not always been viewed in this way. It may prove useful to refresh our collective memory and reconsider a different view of memory — that which focuses on time future.

Shaped by the dominant reductionist paradigm, the term ‘memory’ in current neuroscience literature refers to processes ranging from modified reflexes in slugs to the recollection of Shakespeare’s verses in humans. Furthermore, the terms ‘neural plasticity’ and ‘memory’ are often treated interchangeably, although the first reflects general hardware mechanisms that enable brains to adapt to change and the latter reflects specific use-dependent information subserved by that hardware. In this essay, ‘memory’ refers only to that faculty known in lay terms as ‘recollection’, and in slightly more professional vocabulary as ‘episodic memory’ or ‘mental time travel’.

We all know from personal experience and introspection (research tools once cherished and now mostly disrespected) that mental excursions can be made not only to the past, but also to the future. It was even speculated (for example, by Endel Tulving) that the ability to contemplate future scenarios was a driving force in the evolution of episodic memory. This proposed selection-for-imagination might even be blamed for the inherent fallibility of our recollective faculty. Despite this, attempts to liken imagination to memory are still considered shaky by many; the latter is considered factual data (which it is not), the former the subject matter of poets and an unsubstantiated, inferior form of knowledge.

In ancient Greek mythology, Memory (Mnemosyne) was the mother of all the muses. In the mortal world, Aristotle, Galen, and their medieval Arab commentators, emphasized the role of memory in the ethical virtue of ‘prudence’, the ability to make wise

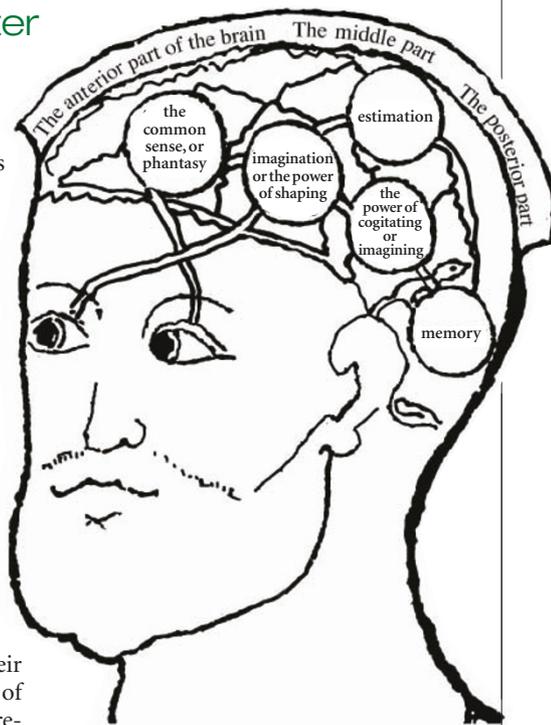
judgments and plan effectively. The word used by these scholars for concepts was ‘phantasms’ (in Greek, *phantasiai*; in Latin, *imagines*). Memory was also associated with prophetic writing, as in the Book of Ezekiel, whose prophecy consisted in recreating imaginatively the dimensions of the destroyed Temple in Jerusalem to envision and motivate the future — in this case, the Jews’ return from captivity. Important in this planning effort is not accuracy of reproduction, but the act of imaginative recreation itself as a totally sensed and felt experience.

Reproduced to the right is a fourteenth-century analysis of the production of thought images, in which there is a central role for imagination. In this, memories are not direct signature-traces that past experiences leave in the brain. Their function is not to provide an accurate trace of things past, but to provide materials for creative thinking. In medieval analysis, data from all the senses came through various channels into the brain and were received in the ‘phantasy’ or ‘common sense’ area. The impressions were simultaneously collected and formed into images by the activity of ‘making forms’. The experience also was ‘estimated’ emotionally as benign or hurtful, a gut reaction part of the mental *imago*. The resulting ‘phantasm’ was thus both a product of imagination and also had definite emotional colour; there was no such thing as a fully neutral or objective conception, and virtually all thoughts were formed as complete mental episodes.

Thought (‘cogitation’) was also an imaginative activity, and the activity of memory inventoried these products in a way that made them accessible to the recreative, investigative action of remembering. As there is a two-way relation between thinking and remembering, a kind of mental valve, the *vermis*, was thought to regulate the traffic. Many people lower their heads when thinking (as in Auguste Rodin’s *The Thinker*) and raise them skyward when trying to recall a memory — this was considered to be engaging the action of the *vermis*.

Of course, it is not our aim to promote the erroneous brain biology of times past. But we do wish to revitalize the intuition and insight of scholars who didn’t have powerful tools such as functional magnetic resonance imaging, and yet still wisely contemplated the global picture of the human mind. Their insights belong not only to the history of ideas, but are also relevant to neuroscience today.

Considering memory solely as a brain imprint of the past might limit the creativity



Medieval thoughts on the working of the brain.

of research programmes and bias the interpretation of their outcome. For example, experiences are correlated with changes at multiple levels of brain organization. Should such changes be considered solely as the impression of past experience, or also as the creation of the capacity to prepare for the future? Or another example: according to textbook accounts, memories consolidate into stable items shortly after their encoding. But do episodic memories ever really consolidate, given that our mind reshuffles them in playing and replaying past and future scenarios? Jean-Baptiste Molière would have been pleased to learn that some memory scientists may have spoken ‘imagination-ish’ all their life without even knowing it. Whether in the classroom or the lab, it is worth remembering that Mnemosyne has a Janus face, looking to both time past and time future. ■

Yadin Dudai is in the Department of Neurobiology at the Weizmann Institute of Science, Rehovot 76100, Israel, and a visiting Global Distinguished Professor of Neuroscience at New York University, New York 10003, USA. Mary Carruthers is at the Faculties of English, History and Religious Studies, New York University, New York 10003, USA.

## FURTHER READING

Bolzoni, L. *The Gallery of Memory* (Univ. Toronto, 2001).  
Carruthers, M. *The Book of Memory* (Cambridge Univ. Press, 1990).  
Dudai, Y. *Memory from A to Z* (Oxford Univ. Press, 2002).  
Tulving, E. in *The Missing Link in Cognition* (eds Terrace, H. S. & Metcalfe, J.) 3–56 (Oxford Univ. Press, 2005).