Memory: Process & Mechanism

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Abstract

Philosophical and scientific approaches have long considered memory to be a concept lacking any coherence and unity. Remembering a fact is so different from remembering a skill that it appears obvious that they represent distinct mental capacities. The existence of various types of memory raises questions about how the sciences of memory should classify their objects of study. The unity of memory presents a unique conceptual puzzle as our relation to the past plays a fundamental role in explaining the nature of cognition.

In this dissertation, I examine the possibility that memory has a unifying characterization. I evaluate a classical view in the sciences of memory, according to which memory can be characterized as a neurocognitive capacity for encoding, storage, and retrieval. The transitions between these stages, i.e., how memory is acquired and eventually stored, are explained in neuroscience by a mechanism responsible for changes in synaptic strength between neurons. By showing how this account avoids major criticisms I aim to clarify the explanatory role this characterization plays in the sciences of memory.

Each part of the dissertation considers a different challenge to this characterization. The first part discusses the standard view in neuroscience, according to which there are multiple memory systems in the brain. Philosophers and psychologists rely on this idea to argue that procedural memory, the system responsible for skill, is not a cognitive capacity, and therefore memory is not a unitary construct. By considering several case studies in which appeal to stored content and retrieval processes is required to explain procedural memory, I argue that characterizing memory as a neurocognitive capacity for encoding, storage, and retrieval can be a unifying description of memory.

The second part deals with neuroscientific explanations of memory. Philosophers have argued that memory has different underlying neural mechanisms, and thus there is reason to believe that memory has no unifying biological explanation. I evaluate these views and argue that they mischaracterize the explanatory power of changes in synaptic strength. Due to the

assumptions about mechanistic explanation, namely that explaining a mechanism involves situating it in a multi-level hierarchy, these views unjustifiably narrow down the explanatory reach of changes in synaptic strength.

The third part is concerned with the challenge posed by optogenetics, novel molecular tools that allow the manipulation of neurons with light, to the study of memory storage. Following the application of optogenetics, neuroscientists claim that synaptic strength is not responsible for memory storage but only for retrieval. In contrast, I argue that this interpretation conflates the concepts of accessibility and retrievability. The inability to access the medium holding the memory is not exclusive to retrieval and can result from the integrity of information stored in that medium. Additionally, because optogenetic studies reveal that memory traces do persist but the information they carry changes over time and experience, I argue that to reconcile optogenetic studies, philosophical views about memory storage need to accommodate their commitments regarding what constitutes a single memory trace.

Describing the ways in which this characterization guides mechanistic research of mnemic phenomena establishes the idea that describing memory as a neurocognitive capacity to encode, store, and retrieve information can potentially serve as the basis for a unitary construct. This opens the possibility of understanding the roles that various types of memory play in a unified mnemic system and provides a shared conceptual framework for the sciences of memory.