Introduction

Memory is involved in a bewildering variety of activities that differ on numerous dimensions, each with their own special conditions and characteristics, and is presumed to underpin nearly all forms of human activity. In dealing with the complexity of memory and its uses, investigators have carved memory into various systems understood as serving two basic functions; that of remembering specific past experiences and the control of performance through the use of general knowledge and habituated action patterns.[1] Of the many systems that have been proposed and the functions they serve, recent philosophical investigations of memory have disproportionately focused on episodic memory.

The relative lack of research on semantic memory in the philosophy of memory may be due in part to the influence of a widely accepted, yet seldom thoroughly analyzed view of semantic memory. This orthodox view of semantic memory throughout the philosophy of mind holds that semantic memory is a dedicated *storage space* of facts, containing such things as the meanings and use of words, languages, and information about the world or a given situation as well as personal information. It is furthermore, assumed to be the product of a chronic, unconscious mechanism of abstraction and generalization, likely taking place during periods of inactivity, or at encoding.[2]

Indeed, if the orthodox view were correct, there would be relatively little to say about semantic memory for philosophers. But acceptance of the orthodox view belies fundamental issues with its conception. For instance, sustained issues surrounding the nature of abstraction and generalization mechanisms, neuroanatomical structure, location, and existence of memory storage systems have persisted despite continued research predicated on their existence.[3] Moreover, the most widely accepted view of mnemonic traces as distributed and superpositional storage of memories have been

[1] Whittlesea 1997 pg.1; Rowlands 2009 pg.336
[2] Dudai 2015 pg.25
[3] See; Klein 2013, Klein 2015, Duff et al. 2019; See also Whittlesea 1997, Leboe & Whittlesea 2013

shown to be in tension with a contentful conception of traces,[4] thus undermining the orthodox view of semantic memory as a storage space of explicit facts. Recent developments such as these in the philosophy of mind and cognitive science, as well as the apparent role of semantic memory in nearly all cognitive endeavors such as future oriented thought, counterfactual future thinking, and imagination, open an important space for an analysis of semantic memory.

The storage space model of semantic memory that presupposes unconsciously abstracted and generalized knowledge about the world attributable to the operation of a chronic abstraction mechanism taking place at encoding, or periods of inactivity is a mistake. Instead I propose a non-storage based, contentless memory trace framework. I argue for a proceduralist view of semantic memory that incorporates aspects of multi-trace memory frameworks, and burgeoning enactive approaches. This approach provides a framework for semantic memory that smoothly integrates multiple bodies of research and provides us with new tools for tackling long standing conceptual issues of semantic memory and opens new avenues for discussion.

Semantic Memory and the Multiple Trace Approach

As early as (1923) Richard Semon used the metaphor of homophony to describe a state when two or more memory traces are cued simultaneously. In his characterizations Semon suggested two types of homophony that differ in their output; that of differentiating homophony and non-differentiating homophony.[5] Of interest here is the non-differentiating homophony which resulted when “similarities among engrams[6] are emphasized by mutual reinforcement of their common properties and mutual interference of their distinguishing ones.” Semon described "non-differentiating homophony” as the more “stable state and more usual state” and suggested that though multiple traces

[4] Michaelian & Sant’Anna 2019; Perrin 2018 pg.35; Robins 2016
[5] Schacter et al. 1978
[6] Semon uses the term “engram” (indeed he originated the term) while there are subtle differences between the terms “trace” and “engram”, they are generally used interchangeably in the literature. Semon 1923, p.248

are nearly always retrieved, output from the memory system nonetheless could be in the form of separate traces, or some amalgam of the separate traces via homophony.[7]

While Semon never explicitly discussed homophony in regards to semantic memory non-differentiating homophony provides us a characterization of abstract and/or general knowledge as one that not need to be stored, but rather is constructed at the time of retrieval. This idea was also at the heart of the multi-trace theories of memory that emerged during the 1980's as an alternative to the multi-system theories. Initially proposed as single systems containing exemplars of semantic categories, this idea eventually gave way to the concept of traces of specific experiences.[8] Later, making use of Tulving's reintroduction into the literature of Semon's synergistic ecphory, Hintzman developed the Minerva 2 model which demonstrated that contrary to arguments in favor of multiple memory systems, "memory schema" *did not need* to be stored, but rather could be an emergent phenomenon of a single system of storage.[9] This was further reinforced by experimental studies conducted by Whittlesea (1987) who showed that general and abstract knowledge "cannot be accounted for by stable, general encoding routines interacting with the object structure of the category."[10] General knowledge is instead constructed in response to the demands of particular tasks.

Older frameworks such as those proposed by Hintzman[11] supposed that memory traces are specific to each experience, and therefore independent. This is problematic as, on the currently most widely accepted view, mnemonic traces are understood to be superpositional - that is, the same network of neurons are encoded with multiple traces.[12] Traces therefore cannot be individually located within the network and thus the causal path from experience to memory is blurred.[13] But multi-trace models are not incompatible with the idea of blended traces as recent multi-trace frameworks highlight the dynamic

[7] Hintzman 1984; Semon 1923
[8] Versace et al. 2014 pg.281; see Hintzman, 1986; Whittlesea, 1987
[9] Yee & McRae 2017 pg.341
[10] Whittlesea 1987 pg.15
[11] Hintzman 1986
[12] Robins 2016
[13] Versace 2009 pg.524; see also (Robins) 2016

and superpositional nature of traces as a key feature. For instance, the Act-In framework highlights integration of traces, understood as a dynamic mechanism.[14] According to Versace et al. (2014), trace activations occur continuously in parallel with the determination of similarities. Because traces are superpositional, each new trace modifies all traces in the neuronal structures both proactively and retroactively. This dynamical integration results in a constant reorganization of trace content through "subject activity associated with environmental constraints."[15]

Proceduralism About Memory Causality

The process outlined above is in stark contrast to the often presupposed store of automatically, and unconsciously abstracted and generalized knowledge about the world attributable to the operation of a chronic abstraction mechanism taking place at encoding that characterizes most semantic memory theories. Multi-trace theory, though, proposes a general operating principle of memory that can conceivably be implemented into various architectures.[16] So, it is unclear what the constructive processes operate on, or how they operate. On the multi-trace approach to semantic memory there is no content to abstract until trace activation, there are therefore no stored concepts, schema, scripts etc. Semantic memory, then, is not retrieval of stored content, rather, it is construction of semantic knowledge.

Often, memory content is understood in componential terms, that is, in terms of the elements in virtue of which a memory is experienced in a certain way.[17] For instance, as one remembers the camping trip to the mountains their memory will include various bits of information, such as "camping," "tent" and "campfire" that determine at least in part how the memory is experienced. On the componential

[14] Versace et al. 2014
[15] Interestingly, the dynamical integration of the Act-In framework is equivalent to a continuous activation of reconsolidation taking place in everyday life. For more on the likelihood of this taking place see; Dudai 2004
[16] Versace et al. 2009 pg.524
[17] Michaelian & Sant'Anna 2019 pg.15

view the causal link necessary for a genuine occurrence of memory to take place relies on a stored pattern of connections between nodes (corresponding to such things as concepts and event features) in a network. Recently it has been argued that the connections between nodes in the network amount to discrete packets of content to be transmitted from initial experience to retrieved representation, and so, at least within distributed network accounts of memory, traces do not provide a way to track the causal history of memories for particular past events, as each new memory involving those event features will change the connection strengths of each memory involving that event feature.[18] As Michaelian and Sant'Anna recently put it, "as far as the nature of memory traces is concerned, [combining a distributed conception of traces with the contentful conception of traces, is] incoherent."[19]

Alternatively, we can account for the causality at play in genuine occurrences of remembering in terms of the procedural features displayed in the reconstruction of a memory. Perrin uses an analogy with a jigsaw puzzle to help illustrate:

> Let's imagine you have two copies of one and the same puzzle. The pieces are exactly the same in number, forms, and pictures in each box. Obviously, however alike the pieces are, as one makes one of the two puzzles one does not use the pieces of the other. In other terms, the two series of construction operations apply respectively to causally unrelated (though similar) bits of representation. But at the same time—this is a crucial point to my argument—these construction operations themselves can be causally related. For instance, if you make the two puzzles one after the other, you will possibly perform the second time better than the first time. And should you repeat the operations further, the enhancement will probably get ever clearer.

[18] Robins 2016 pg.17

[19] Michaelian & Sant'Anna 2019 pg.18; this is an important point, as while semantic memory is not stored content but rather the dynamic construction of knowledge, if Perrin is right, episodic memory is likewise not stored content.

So arguably, an earlier series of construction operations can get a later series enhanced, while the manipulated sets of pieces are distinct and causally unrelated. (Perrin 2018)[20]

On this view, causal relations are operative between the perceptual processes that construct the initial experience and the processes that (re)construct the memory of the experience. Just as causally connected operations can bring together causally unrelated sets of puzzle pieces into distinct copies of the same picture, causally connected constructive processes can bring about similar phenomenal experiences from causally unrelated bits of information. For instance, when I episodically remember pushing my son on the swing at Bryant Park its reconstruction displays distinct procedural features which reflect the previously constructed experience. What is retained on Perrin's view of connectionism (if retention can be used in this context) is not a deposited representation of reality in the network, but rather dispositions to react through procedural abilities to construct representations.[21] This view receives theoretical and empirical support from a multi-trace framework outlined in (Whittlesea 1997) called SCAPE.[22] On this framework, memory does not store information about what things are, instead it "preserves records of OPERATING (original emphasis) on stimuli, constructing cognitive events."[23] Memory should, then, be understood in procedural terms, and according to Whittlesea, it is the widely differing constructive processes (depending on such things as the broad diversity of contexts, availability of similar prior experiences, and current needs) that contribute to the multifarious kinds of knowledge typically attributed to multiple memory systems.[24]

One might worry though that Perrin's puzzle analogy only repackages componential content as procedural skills. Afterall, the puzzle consists of component pieces the content of which is used to

[20] Perrin 2018 pg.37
[21] Perrin 2018 pg.40
[22] Whittlesea 1997; see also Whittlesea 2013 (Selective Construction and Preservation of Experience)
[23] Whittlesea 1997 pg.3
[24] Whittlesea 1997 pg.5

assemble the overall puzzle. Imagine assembling a puzzle of a space shuttle lifting off. While various techniques will be used to assemble the puzzle correctly each relies on the content of the puzzle piece itself - think of matching up the right side of one piece containing the top of the rocket booster, with the left side of another piece containing the nose of the space shuttle, or matching up the tail of the shuttle with the blast beneath it. In other words, Perrin's analogy implies that procedural causality develops the process through which discrete packets of content are (re)constructed, and therefore merely adds an additional layer to the componential view.

Procedural causality, though, views causal relations as operative between the *processes* that constructed the initial experience and the processes that (re)construct the memory of the experience. Content on this view is not reassembled out of components, but rather generated at the time of construction of the memory. I propose then that instead of puzzle pieces we imagine the procedural operations in question as the folding and sculpting techniques one uses in origami. Let's imagine that you set out to construct an origami crane from a blank sheet of paper. Performing the constructive operations on a sheet of paper to create the origami crane will enhance your ability to do so again the next time you construct a crane, and moreover, will enhance your ability to construct any origami figure involving those techniques. Importantly, unlike Perrin's previous puzzle piece analogy, the origami analogy allows us to envision causal relations whose operativity does not presuppose the identity of componential blocks implicated at each stage of construction. Rather, it is the constructive operations themselves (the folding and sculpting techniques) that create the content, and only after they have been completed are the various components of the crane - for instance the wing or the neck - produced.

Mnemonic Effort and Mnemonic Habit

As noted above, much semantic memory seems to take place automatically and without conscious use.[25] I have thus far argued, though, that semantic memory is constructed in response to the demands of particular tasks and guided by the conscious use of prior experience and current thought. Consider, though, what procedural causality teaches us about causal relations in memory, namely, that they are operative between constructive processes, and not between components. Importantly, while focus thus far has been on the causal relations between the constructive processes involved in perception and the (re)constructive processes involved in memory these causal relations extend too *from* the (re)constructive processes of memory *to* the exploratory and constructive processes of perception. Versace et al. (2014), for instance argues that perception and memory result from the same types of activity and operate simultaneously. Storage and retrieval cannot then be considered as separate processes.[26]

I thus propose that through the exploratory and constructive activities of perception and memory certain of the behaviors that we engage in during the constructive processes of perception become causally connected to our memory processes.[27] This creates reusable embodied processes that enact knowledge through skillful operation of body schema.[28] These embodied processes are habituated uses of mnemonic content and can be understood as on the one hand automatic certainties (or mnemonic habits - more on this below), and on the other hand as contributions to the construction of memory as a result of a coupling between the recovery situation and traces containing reusable processes activated on the basis of their similarity to the characteristics of the current circumstances of

[25] See section; introduction for more
[26] Versace et al. 2014 pg. 292-293; The authors argue for a "horizontal" view of perception in which perceptual and memory systems are structurally coupled.
[27] Izquierdo-Torres & Harvey (2006); Moyal-Sharrock 2009 pg.220
[28] Pulvermuller et al.2013; The term used by researchers for this is "motor schema," I have opted for body schema to describe the phenomenon in terms in line with Merleau-Ponty. See; Halak (2018)

recovery. This view finds support from experimental studies highlighting the role of actions in the construction of memories.[29]

This illustrates two distinct (but interrelated) ways of expressing semantic memory.[30] On the one hand there is the effortful expression of knowledge, the construction of which is guided by applicable prior experiences (*mnemonic efforts*),[31] and on the other hand there is knowledge expressed through habituated uses of mnemonic content (*mnemonic habits)*.[32]

Mnemonic efforts are the effortful expression of semantic knowledge through the conscious use of prior experience to guide current thought and behavior.[33] In some cases mnemonic effort takes the form of active attempts to recall through the use of such things as creative tactics or concentration.[34] Imagine, for instance, a young child attempting to remember their numbers. Often the child must actively work to recall the next number. Needing to run back through the string of numbers in order to remember that twelve comes after eleven. In other cases, mnemonic efforts involve the effortful use of prior experiences to guide current thought and behavior. In the case of mnemonic efforts what is achieved through engaging with the world is noetic awareness, but the means by which it is attained requires a conscious use of prior experience to guide current thought and behavior.[35]

Some general knowledge, though, is not regularly taken from memory, but rather from fluent use of our procedural abilities that were once in service to mnemonic efforts. For example, were I prompted to give my name my response would take place without the conscious awareness that I know

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[29] see also (Christman, et al. 2003; Brunye 2009; Brouillet et al. 2015; Brouillet et al. 2016; Brouillet et al. 2017; Brouillet 2020; Camus 2018)

[30] While I discuss two ways of expressing semantic knowledge, I do not rule out the possibility of more ways in which it can be expressed.

[31] In some cases the applicable prior episodes may amount to one or even multiple episodes synthesized to produce some general information

[32] Moyal-Sharrock 2009 pg.220-225; While making use of the broad distinction of habit/effort discussed in Moyal-Sharrock (2009) the above differs in that I am discussing habits that develop from the use of semantic memory and conceptualized as fluency of the memorial content.

[33] Moyal-Sharrock 2009 pg.226

[34] This understanding of mnemonic effort follows closely with Moyal-Sharrocks explication of mnemonic effort

[35] Moyal-Sharrock 2009 pg.226

my name. Likewise, my knowledge of what a bicycle looks like, and being able to correctly identify it from amongst various different transportation vehicles, often takes place without my need to attend to whether or not the object in front of me is a bicycle. Just as a young child may start out needing to put in effort to recall the next number, so too their ability to count will eventually become habitual - if enough time is spent with counting to habituate. Their familiarity with numbers will increase and thus their fluency. These are of course things that *can* be experienced as *known*, but that is not how we typically relate to them. Our relationship to them is one of automatic certainty. That is, this sort of semantic knowledge is one of habituated use, and our awareness of the knowledge is liminal. Perhaps at one point we needed to actively recall such things as our name, or how a bicycle looks, thus rendering them products of mnemonic effort, but in the course of everyday life, such facts cease to be the products of recall. Instead they reflect what Moyal-Sharrock terms *non cognitive certainties*[36], and Wittgenstein considered "hinges," in *On Certainty*.[37]

How we come to acquire these mnemonic habits can be illustrated through Rowlands (2017) proposed Rilkean memory named after the poet Rainer Maria Rilke who described some memories as having become 'nameless' and 'forgotten' and changed into our 'blood' and 'glance and gesture.'[38] Rilkean memories are episodic memories that have lost their memory content but retained the act of remembering through acquired bodily dispositions, or affect. So the *act* of remembering has split from what is *remembered*, leaving Rilkean memory as an act of remembering without the original mental content. These bodily dispositions, behavioral affect, and sensations are thus constitutive of what remains of the original memory. As Rowlands puts it "A Rilkean memory arises when the act of

[36] It is important to note, as Moyal-Sharrock points out, that while habits can be such things as motor movements etc. the term "non cognitive" does not necessarily denote non neuronal.
[37] Moyal-Sharrock 2009 pg.222; On Certainty 341 & 343; While I point to Wittgenstein's "hinges" I hesitate slightly from committing to ungrounded hinges in this case as, while I find the idea of mnemonic habits are in good company with ungrounded hinges, the concept I build here is perhaps more broad than typically discussed in the literature on Wittgenstein.
[38] Rowlands 2017 pg. 53 -54

remembering becomes divorced from what is remembered—because what is remembered has been lost."[39]

Conclusion

To sum up, as opposed to the standard conception of semantic memory as a storage space for knowledge structures, I instead proposed a proceduralist view of semantic memory that incorporates aspects of multi-trace memory frameworks, and burgeoning enactive memory approaches. Semantic memory is not a product of a dedicated system of storage, or the conscious awareness that accompanies the retrieval. Following Whittlesea (1997), we can understand memory as procedural knowledge driving performance in our interactions with the world. Thus, it is the way in which knowledge is constructed and subsequently used that determines its status as semantic memory.

[39] Ibid pg.73

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