Breaking from the Past: Bartlett's Role in Rethinking Memory: *Remembering: A Study in Experimental and Social Psychology* , Frederic Bartlett

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most books written by scientists and aimed at a specialist audience rarely stay in print for long. They summarize the state of the art at that moment, with the experiments they report losing their immediacy and centrality after a few years and the consensus they attempt to capture shifting over time. One needs an update every 10 years or so. But there are exceptions to this rule, books that timelessly serve as a lodestone for a scientific discipline. When it comes to the experimental study of memory, Frederic Bartlett's *Remembering: A Study in Experimental and Social Psychology* is such a book. Published in 1932, it is still going strong. According to Google Scholar, the book has been cited 24,657 times.

It has taken a long while for the field of experimental psychology to appreciate the groundbreaking character of the book. Since Plato, if not before, scholars have viewed memory as a storehouse. Traces of experiences are stored away somewhere in the brain, waiting to be retrieved at some later point. Computer memory certainly works this way in many instances. Input is encoded, often in 1s and 0s, and is literally stored in a specific location on a hard drive, where

it sits waiting to be retrieved at the desired moment. One could access the hard drive and eliminate one or two memories without doing damage to others.

The language of experimental psychologists—and indeed the lay public—largely reflects the dominance of this way of thinking about memory. It is not uncommon to talk about encoding and retrieving memories, of memory traces, and the biological basis for "storing memories." There is the widely held notion that remembering involves "shining a spotlight on a stored picture" of the past, to use the felicitous phrasing of Dan Schacter (1996, 61).

Bartlett's *Remembering* matters because it departed substantially from this dominant mode of thinking, arguing forcefully against treating remembering as "shining a spotlight." In doing so, it not only offered an alternative to storehouse models of memory, but also, I believe, substantially redirected the way psychologists think about memory. For Bartlett, memories are not "stored away," waiting to "reappear in the footlights of consciousness," but are reconstructed on the run. Bartlett suggested that one should think about memories of past events much as one might think about memories of motor skills. Consider the act of a tennis player swinging their racket to hit an approaching ball. The stroke is clearly a product of past experience, in that tennis is an acquired skill. However, few would argue that the tennis player is retrieving a memory of a previously executed stroke. If the stroke were stored away in a repository of tennis strokes, the repository would have to store away a different stroke for every possible occasion. Such an arrangement would demand an impossibly large capacity and the notion that each stroke is a recapitulation of a previous stroke. But each stroke is unique and depends not just on whatever is represented internally as a consequence of past experience, but also on a host of contextual factors such as the position of the sun, the speed of the ball, the attitude of the player, the time of day, and much more. For Bartlett, and probably most scholars, the tennis stroke must be constructed in the present, out of situational factors, current attitudes, and the accumulated knowledge formed

from past experience, which Bartlett referred to as the *schemata*. From this perspective, a replica of a particular tennis stroke is nowhere to be found in the head of the individual. The stroke does not "reappear," but rather is produced in the context of the tennis match.

In a similar manner, memories of past events are reconstructed on the run out of past experience and present situational factors. Rather than being retrieved from a storehouse, the memory is literally built anew each time it comes to mind. Past experience shapes remembering only because it shapes schemata, and schemata, in turn, guide the reconstruction. In some contemporary discussions of Bartlett schemata are described as if they are simply static, organized representations of learned knowledge. Bartlett's view was quite different. He considered schemata as dynamic, constantly in flux, as they are transformed by the flow of new experiences. In this way, they are Heraclitian rivers, impossible to fix at any moment. Rather than sitting passively, waiting to be called into play, they are constantly reconfiguring themselves.

It is not by accident that Bartlett titled his book *Remembering*. Memories are not objects to be pointed to and studied. Unlike an input stored in a computer, one cannot easily locate a memory in the brain and erase it. Brain damage might erase many memories, leaving one with a severe retrograde amnesia, but it does not erase single memories. For Bartlett, rather than discuss memories, one should focus on the processes that produce memories, by which he meant the images that come to mind and are frequently verbalized. Without an act of reconstruction, there are, for Bartlett, no memories, only schemata, which are best thought of as the potential to remember rather than a memory per se.

Bartlett was driven to this perspective, in part, because of a series of experiments he reported in his book. In the struggle between theory and data, theory clearly wins out in *Remembering*. The studies Bartlett reported would never pass muster in today's preference for preregistered, carefully conducted, analyzed, and replicated experiments. In his best-known study, Bartlett asked Cambridge University

students to read the Native American folktale *The War of the Ghosts*. Whenever he would see any of these students, whether a few days or a few years later, crossing the campus quad, he would spontane-ously stop them and ask them what they remembered of the story. Al-though nowadays we might call this methodology sloppy, the studies replicated nicely when they were redone in a more rigorous fashion (Bergman and Roediger 1999). What fascinated Bartlett in his *War of the Ghosts* studies was not just the errors of omission he found in the recountings of his Cambridge students. These errors would be consistent with a storehouse model of memory. What interested Bartlett were the errors of commission. His students remembered things that were not in the original story. For example, although there were mentions of rivers and canoes in the story, there was no mention that the tale took place on an island, but many participants incorrectly recalled that it did.

Bartlett had difficulty understanding how these errors of commission could occur as frequently as they did if the past was stored in a repository in the head and then "retrieved." The memories his Cambridge students produced seemed more about their understanding of how a Western story should unfold and how to make sense of the seemingly disjointed nature of the original *War of the Ghosts* story. Bartlett averred that his students appeared to be "rationalizing" the story. For example, the story ends with a cryptic reference to "something black" coming out of one of the protagonists. Bartlett's students often transformed this "something black" into something that made more sense, such as "foaming at the mouth" or "vomiting." What was remembered reflected this rationalization rather than what was actually written. How does the language of encoding and retrieval capture this disconnect between the original material and the subsequent memory? For Bartlett, it made more sense to view a memory as a reconstruction rather than a retrieved trace.

The subtitle of his book is also important, in that it emphasizes that the study of remembering is in part a social-psychological undertaking. As the tennis example illustrates, memories grow out of

an interaction between internal schemata and situationally specific features of the outside world. To this end, Bartlett traveled to Africa to study how acts of remembering occur in different cultures. In one observation offered in *Remembering*, he described how well Bantu cow herders remember the results of a cattle auction, emphasizing that their "terrific" memory is often treated as characteristic of people from oral cultures. But Bartlett then went on to show that the memories of Bantu cow herders are no better than those of his Cambridge students. Remembering, Bartlett concluded, is a social phenomenon. Indeed, he labeled one section of his book "Social Recall." He wanted psychologists to appreciate that remembering occurs within a social, indeed communicative context. What cognitive tools are provided by culture? How do they differ across cultures? And how do the demands of communication shape remembering? When I recount my day to someone, how, for instance, does the content of that recounting change as the audience changes? Moreover, do these variations in recounting alter the way I subsequently remember my day, thereby making my memory a product of the people I interact with as much as the way I thought about an experience in the first place? Questions such as these are rarely studied in the cold, unnatural environment of an experimental testing room. They naturally arise, however, when one looks at remembering "in the wild."

Bartlett's work in *Remembering* has been extremely influential. Ulric Neisser made it the center of his discussion of memory in his groundbreaking, field-defining 1967 opus *Cognitive Psychology.* Of course, one might rebut claims about the importance of *Remembering* by insisting that everyone knows that memory is unreliable. But as I stated, it is theory, not data, that speaks loudly in *Remembering.* Bartlett argued incisively that the dominant way of thinking about memory had for centuries been wrong. Not surprisingly, it has been hard for many to abandon that dominant perspective. The language of encoding and retrieval is still very much present. And many neuroscientists are still in search of the engram. But various advances in the fields of both cognitive science and neuroscience have made more

palatable to many the notion that memories are the product of reconstruction rather than a copy of the past stored in the brain.

A good example of this movement forward can be found in the work of David Rumelhart. Early on, Rumelhart and his colleague Andrew Ortony (1977) sought to describe how memories might be organized in the mind—for instance, through different forms of semantic and conceptual associations. Rumelhart and Ortony's aim seemed to be to articulate the organization of memory representation in a manner in which there was an identifiable connection between an event and its mnemonic representation. Thus, the experience of John breaking a window would be represented as a network in which the action "break" was at the center, with associations to an agent (John) and an object (window). In building such networks, Rumelhart and Ortony took seriously Bartlett's claim that schemata are organized representations of the past, but still wanted them to be the conceptually graspable representation of a single experience or piece of knowledge.

In subsequent work, Rumelhart and colleagues abandoned this need for a conceptual connection between experience and its mnemonic representation (McClelland 1995). In doing so, they built on their work on neural nets. What could it possibly mean for a memory to be built on the run? To be not a retrieved trace of the past, but a reconstruction? A neural net consists of a network of nodes with weighted connections. One might have a layer of nodes corresponding to inputs, such as a retrieval cue, and another layer of nodes corresponding to outputs, such as a desired memory. In the middle are "hidden layers" that mediate input and output. One can conceive of hidden nodes as neurons that, if sufficiently stimulated, will "fire" and transmit "energy" to connected nodes, which, in turn—if sufficiently stimulated by incoming energy—will also fire. The weights assigned to each connection determine the degree to which the energy emerging from one node will be transmitted to connected nodes. The total energy received by a node is a function of the energy received from all connected nodes. One can vary the network by changing the con-

figuration of connections, by altering the way in which a node "sums" incoming energy, and by reassigning the values of the weights.

Rumelhart and his colleagues (1986, 7–57) devised algorithms for reconfiguring the weights so that, after multiple iterations, a network can learn that a particular input (e.g., a memory cue) can lead to a desired output (the memory). The success of such algorithms, what is now called *deep learning*, led to a resurgent interest in AI.

What makes these neural nets a good model for Bartlettian schemata is that, in a neural net, an experience is not internally represented in a manner that reflects conceptually the original experience. Nor is this "trace" retrieved, as a book might be in a library. Rather, the entire network, with its configurations of nodes and weighted connections, constitutes the memory. And new experience does not lay down a "trace," but changes the weights in a network. Inasmuch as no node in the network corresponds to a particular memory, the mnemonic representation is best thought of as *distributed* across the network. There is no way to spotlight a particular node or even groups of nodes and say "that is the memory of John breaking a window." When an appropriate retrieval cue, along with appropriate situational and environmental factors, serves as input, activation simply spreads across the network, moderated by the extant weights, to produce the desired output—in this case, the memory of John's misdeed. This neural network model substitutes Bartlett's vague description of schemata with programmable processes and representations that are not localized, but distributed. The vague notion of schemata becomes precisely realized without assuming that memories are localized (in a network or a brain) or that one can only understand mnemonic representations as capturing a conceptual correspondence between the experience and the memory.

Recent work on reconsolidation has made Bartlett's approach not only more precise but also necessary. According to many biological theories of memory, engrams are set down in the brain through consolidation, a neuroscientific equivalent of encoding. Recently, neuroscientists have discovered that when memories are retrieved,

activated neurons are susceptible to change, that is, the "engram" can be reconfigured and reconsolidated. This reconsolidation process fits nicely into Bartlett's claim that schemata are ever changing. Memories do not rest in a storehouse where they can be retrieved over and over again while maintaining their form, as a book in a library. Rath-er every act of remembering brings with it an act of reconsolidation. What could be more Bartlettian than that?

Finally, psychologists have recently been questioning how seriously to take the computer metaphor that dominated the early work of cognitive psychologists. In his book *Mental Models* (1983), the preeminent cognitive scientist Philip Johnson-Laird stated boldly that the mind *is* a Turing machine. But many psychologists, despite their penchant for methodological individualism, have begun to put in the foreground the social nature of humans, echoing Bartlett's insistence that the study of remembering is, in part, a social-psychological undertaking. Unlike Turing machines, humans are social creatures. More critical to the present discussion, their minds—the way they see, think, and remember—reflect this social nature. There is now a burgeoning field exploring the social aspects of memory and the psychology of collective memory (Hirst and Merck forthcoming; Hirst, Yamashiro, and Coman 2018). This work underscores that a memory embodies not necessarily what was originally experienced, but to a large degree the social environment in which this original experience and subsequent remembering took place. This new line of research insists on studying how the many acts of social interaction unfolding between an initial experience and a present act of remembering shape the emergent memory. The act of remembering is not just a social phenomenon, but also a social-historical one.

Bartlett matters, then, because, to a large extent, he got it right. Psychologists are rushing to catch up. They are trying to better understand what the distributed representations captured by neural nets might mean for how memory functions; they are trying to appreciate the boundary conditions and implications of reconsolidation; and they are taking the social nature of memory seriously, even fit-

ting two or more people in fMRI machines to see how their brains link up under different social conditions.

The theme of this special issue of the journal is books that matter not just to intellectual disciplines but also to individuals. Bartlett matters to me because he taught me to think about memory outside the box of the individual and the constraints of the computer metaphor. More than anyone else, he made me realize how important it is to see remembering as both an act of reconstruction and a social-psychological phenomenon. Indeed, because of Bartlett, I have come to realize that human memory is first and foremost an exquisitely designed social organ. Human memory's unreliability and malleability—features Bartlett stressed when underscoring its reconstructive nature—are not weaknesses, but strengths. Its susceptibility to social influence means, in part, that people from similar social settings remember the past in similar, albeit occasionally erroneous, ways. This mnemonic convergence allows people to function well in the groups they identify with and call their own. To be sure, at times these shared memories can prove problematic, especially when they conflict with the memory claims of other social groups. Nevertheless, they are no doubt adaptive for creatures as social and group-oriented as humans unquestionably are.

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