Models of Memory: Award Address by Richard M. Shiffrin

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In his William James Fellow Award address at the APS 19th Annual Convention, APS Fellow and Charter Member Richard M. Shiffrin spoke about the development of models of memory throughout his career and the research he and his colleagues conducted that allowed these models to become increasingly comprehensive. “Progress has been signposted,” Shiffrin said, “by a continually evolving series of models designed to capture the essence of the most important processes involved in storage and retrieval.”

The William James Fellow Award honors APS Members for their lifetime of significant intellectual contributions to the basic science of psychology. Shiffrin was awarded the James Fellow award in recognition of his decades of research on human cognition. In addition to many other honors, Shiffrin was elected to the National Academy of Sciences in 1995 and the American Academy of Arts and Sciences in 1996.

Shiffrin, who is the Luther Dana Waterman Professor of Psychology at Indiana University, began by discussing the modal model of memory he developed in 1968 with APS Fellow and Charter Member Richard Atkinson. Their model posited a temporary short-term store and a “permanent” long-term store. The focus of this model was on the attentive and strategic processes termed “control processes” — memory as a process rather than as a library. The model assumed that memory traces in both short- and long-term stores are functionally separate, with retrieval of “permanent” long-term memories based on their similarity to cues. It asserts that long-term forgetting is due to retrieval failure, not true loss of the memory. “According to this view,” Shiffrin explained, “memories are at least theoretically recoverable, through use of the best cues, and sufficiently extended memory search, if one could only produce the needed cues.”

Building on this work, Shiffrin and Jeroen G.W. Raaijmakers developed the Search of Associative Memory (SAM) model in the early 1980s, which delineated the way cues combine to govern retrieval. SAM is still the standard model for recall today. In 1984, Gary Gillund and Shiffrin extended SAM to recognition. “Superficially, we conceive of recall as a sequential search for particular traces, sometimes finding the desired one, and conceive of recognition as a judgment of a general feeling of familiarity,” Shiffrin said. “In our models these are closely linked,” but are distinguished by the tasks and processes involved.

Shiffrin also discussed the Retrieving Effectively From Memory (REM) model, developed in 1997 with Mark Steyvers. This model retains all of the benefits of the SAM model in its ability to account for recall, but also suggests that much of memory is a form of inference. “Given that traces are stored incompletely and with error, how would retrieval operate so as to produce the best possible recognition performance?” Shiffrin asked. The REM model improves on SAM in several other ways as well: It explicitly incorporates similarity; it has a natural zero point for decision making, so that a new criterion

need not be determined for every retrieval event; and it incorporates differentiation automatically.

The REM model also provides a link between episodic memory and knowledge. “Storage of an event produces an incomplete and error-prone episodic trace, but also causes information to be added to the studied item’s lexical trace,” said Shiffrin. “In REM, the added information is mostly restricted to new information not already in the knowledge trace, such as the new and unique context of the study situation.” This concept is used to explain how priming of retrieval of knowledge is facilitated by a recent episode.

Shiffrin concluded his address with an overview of his current research and the most recent model of memory he has developed. This new model, an extension of REM, is designed to explain the co-evolution of episodic memory and knowledge. “Prior knowledge helps us to interpret the world and determines perception, coding, and storage of episodes. Conversely, an episode produces addition to knowledge,” he explained, “but how does this system get bootstrapped into existence?”

Shiffrin’s current research, in the Memory and Perception Lab he directs at Indiana, suggests that we encode and store what features co-occur with each other, sometimes incorrectly augmenting the counts of co-occurrences as they happen. The new model “captures the idea that our knowledge of any item incorporates knowledge of items in nearby contexts.”

“The exciting part of this new avenue of research,” Shiffrin said, “is the way the theory makes clear the tight link between event memory and knowledge, and the way it provides an easy-to-implement and -understand mechanism by which the two co-evolve over development.”