

# Semantic, Episodic and Procedural Memory in the Recommendation Architecture Cognitive Model

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The recommendation architecture is a cognitive model for the human brain constructed in terms of the information handling capabilities of neurons. The model is in general terms connectionist, but architecture and device algorithms have major qualitative differences from other connectionist models. The model has the advantages that complex cognitive behaviour can be bootstrapped from experience with minimal and plausible a priori (i.e. genetic) guidance, and structures in the recommendation architecture can be mapped into human brain physiology.

Theoretical arguments can be made that any system which must learn a large number of interacting features will be forced into the recommendation architecture form if information handling resources are not unlimited [Coward 2000]. An electronic system with the recommendation architecture has been implemented and shown to exhibit the types of mechanisms required for cognitive development and processing. Phenomena analogous with learning to identify categories, learning to behave appropriately in response to groups of objects, learning to generate appropriate mental images in response to words, and learning to generate associative mental images have been demonstrated [Coward 2001]. There are strong resemblances between the types of physical structures in the recommendation architecture and in human brain physiology [Coward 1990; 2000].

In the paper, the ways in which information can be recorded and accessed in the recommendation architecture are described. Information can only be recorded in two ways: permanent recording of an information condition which actually occurs within the information available to the system, and change to the weight associating a recorded condition with one of the behaviours recommended by the detection of the condition. Permanent recording of conditions results in a substantial part of system resources being applied to ensuring that recorded conditions are as behaviourally useful as possible, and the total number of recorded conditions is not excessive. Permanent recording also means that the interactions which are the basis for complex cognitive behaviour take place within active populations of perceptually, cognitively and behaviourally ambiguous conditions.

Information can be accessed in four ways: activation of a condition because it occurs within the information available to the system (in particular, within sensory inputs); activation of a condition because it has often been active in the past at the same time as many currently active conditions; activation of a condition because it was recorded in the past at the same time as many currently active conditions (or shortly before or after such recording); and selection of a behaviour by comparison of the recommendation weights of all the behaviours recommended by all currently active conditions.

Activation of information on the basis of frequent past simultaneous activity accounts for the results of semantic memory experiments including measurements of recall and forgetting; sentence and category verification; and tip of the tongue experiments. Activation of information on the basis of past simultaneous condition recording accounts for the phenomena of episodic memory including targeted, cued, or involuntary recall; autobiographical memory; dating of events and establishing a temporal order; memory for major events, with the particular cases of eyewitness and flashbulb memories; and creation of false memories. The modulation of recommendation weights accounts for the phenomena of skill acquisition.

These mechanisms also account for the deficits resulting from damage which demonstrate dissociations between different types of memory. For example, the hippocampus system of the patient H.M. [Corkin 2002] was damaged in an operation. HM shows global semantic and episodic anterograde amnesia, but his comprehension and use of language is relatively undisturbed. Acquisition of new words is impaired, but vocabulary acquired prior to damage is retained. He also exhibits a retrograde amnesia back to 11 years prior to damage. However, he retains a good capability to learn new motor skills and exhibits almost normal perceptual priming. An account for these observations in the recommendation architecture model is provided on the basis that the hippocampus system manages the assignment of resources required for new condition recording.

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