

NSCI 483- Module 2: General Introduction to Multiple Memory Systems

video transcript

The neuroscientist Larry Squire proposed an influential framework of the multiple types of memory. He did this by synthesizing work from patients and nonhuman primates with brain lesions. As we progress through the remaining modules of this course, we will use Larry Squire's model as a kind of scaffolding upon which the modules will be based.

At the bottom is the selection of key brain areas relevant for each type of learning and memory that you will learn about through the course. In response to a sensory event, there's a very brief sensory memory, maybe less than half a second. It will vanish unless you attend to this event so that it can enter a short-term working memory. Once in working memory, an event may or may not get consolidated into long-term memory storage. Working memory is also used when we retrieve long-term memories for use in integration with new information. We will first learn about working memory in Module 3.

When we think about memory, we often imagine our memory of a previous event, an episodic memory. Or you might think of a fact that you memorized for an exam. This would be more like a semantic memory. These types of memories are considered declarative memory because you can declare or articulate them to someone else. They're also sometimes referred to as explicit forms of memory. However, lots of things that you have learnt, you're not really very conscious of at all, or at least you cannot articulate those things very easily to others. Nonetheless these memories are reflected by changes in our behaviour. We call this implicit or non-declarative memory. In Module 4, we'll examine these implicit forms of memory.

After learning about some basic mechanisms of synaptic plasticity, you will then learn how neurons change with simple non-associative and associative learning in memory including habituation, sensitization and classical conditioning. The dotted line from sensory memory is there just to reflect that it's not really clear you have to go through working memory for some of these to operate. In Module 5, we will then discuss motor skill learning or procedural learning. Recall that patient H.M. retained this form of learning and memory as it does not depend on the medial temporal lobe, which he was missing. Motor skill learning also relies on another form of associative learning called operant conditioning, which includes reward based learning.

Finally we will discuss models and neural mechanisms of long-term memory encoding, consolidation and retrieval in Module 6 and 7. This will include a detailed look at the function of the hippocampus and the nature of the memory engram. As you'll come to see these categories can become blurry as our memories are combinations of several types. For example, having been attacked by a dog as a child can lead to both an unconscious, long-lasting fear response towards dogs in the future. This is an implicit memory. And also an explicit episodic memory of the time and place when the event occurred that could be recalled and described to others.

So to try to synthesize this altogether, let's imagine these types of learning and memory in the context of a night out on the town. You leave the quiet of your home and meet up with your friends at a dance club. Loud music and flashing lights assaulting your nervous system. Over time your sensory system adjusts to accommodate for this new environment, through an implicit learning process, habituation. Sometime during the night, your friend who has successfully quit smoking more than a year ago, bemoans how he hasn't thought about smoking in weeks, but suddenly he's craving a cigarette ever since arriving at the night club. This is an example of a conditioned response because previously smoking had been paired with going to a night club. And so now being at the night club brings out the memory of smoking.

On the dance floor your friend teaches you a new dance move and after some practice you get the hang of it. And this would be an example of motor skill learning.

Maybe later you run into an old acquaintance and you joke about the time you last met and what you did. This would be a jointly retrieved episodic memory.

She tells you her new phone number and you try to keep it in mind by rehearsing it until you can plug it into your phone, which is sort of what we now use as an offloading of our memory. And this rehearsal is an example of something you do within your working memory. She always tells you the address of a restaurant she might be at later.

And then later on you leave the club and you think you might go try to find your friend, but you can't remember the name and the address of the restaurant. And that's an example of failure to encode into long-term memory. And now your phone's out of power. Your backup memory storage is gone so you can't even call her. So you just navigate home using a process that requires spatial memory. And that is depend on your hippocampus.

And so I look forward to learning and exploring these different types of learning and memory through -- with you as we progress through the course and I hope you enjoy it.