

# PSYC3241 – PSYCHOBIOLOGY OF MEMORY AND MOTIVATION

## Rick Richardson Lectures – Memory Intro + Types of Memory

### General Overview (of RR's lectures)

1. Memory – what is it?
  - a. memory consolidation and reconsolidation
  - b. memory modification: amnesia and enhancement
2. Types of memory (e.g., fear, spatial)
  - a. comparative analysis
  - b. developmental analysis
  - c. neuroanatomical analysis

### LECTURE 1 – MEMORY – WHAT IS IT?

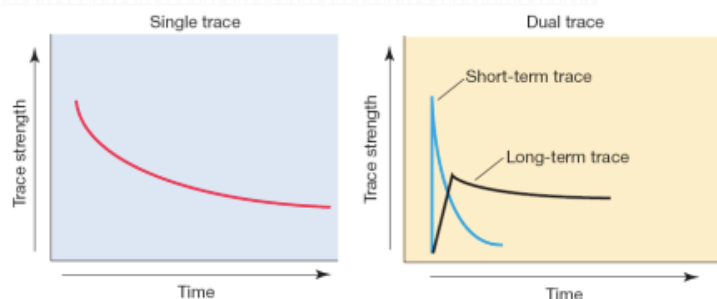
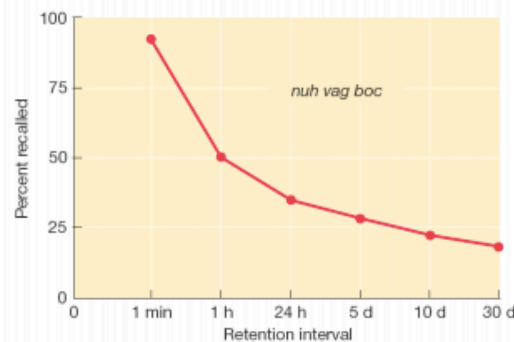
#### Lecture 1 Outline

1. General memory processes
2. Temporal gradient of retrograde amnesia
  - Duncan – reverberatory circuit
  - passive avoidance

Scientific study of memory started about 130 years ago (Ebbinghaus). He started doing experiments on himself. He invented nonsense syllables.

**FIGURE 1.2**

Ebbinghaus documented the first forgetting curve. Note that substantial forgetting occurs in the first hour after learning, but thereafter recall is fairly stable.



**FIGURE 1.3**

The single-trace theory explains Ebbinghaus's forgetting curve by assuming that the strength of a single memory trace declines monotonically as a function of time between learning and the retention test. The dual-trace theory explains that the forgetting curve results from two memory traces whose strength decays at different rates.

From Rudy 2008

He found that forgetting is an exponential function. You forget pretty quickly after an event.

The single-trace theory – when you have a learning experience there is a structural/functional change which decays over time. There is one memory for each event.

The dual trace theory states that when there is an event, two memories are formed. One memory is short term which decays very quickly – it was transient. Whereas, other changes are long-term. When you add them together it results in an exponential curve.

### How do we improve our memory?

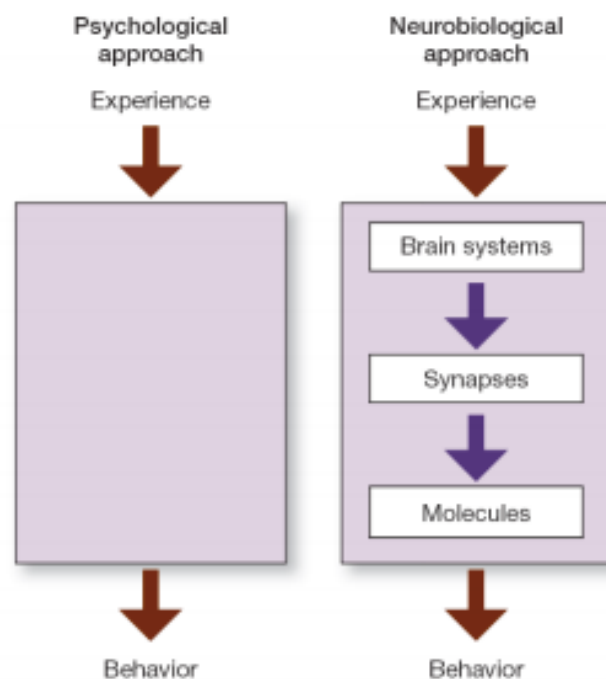
- Rehearsal
- “Stress” – stress-enhanced memory might not always be good. Stress will increase accuracy and longevity of a memory (Medieval practice).
  - Sometimes stress results in clinical disorders – PTSD

We will be exploring a variety of issues, both practical and theoretical, pertaining to memory in this course

Our discussions will focus primarily on research with non-human animals. Some practical reasons for this focus – control, accessible, easy to manipulate.

#### FIGURE 1.4

Psychologists study only the relationship between experience and behavior. Neurobiologists study how experience influences memory-dependent behavior by its influences on brain systems, synapses, and molecules.

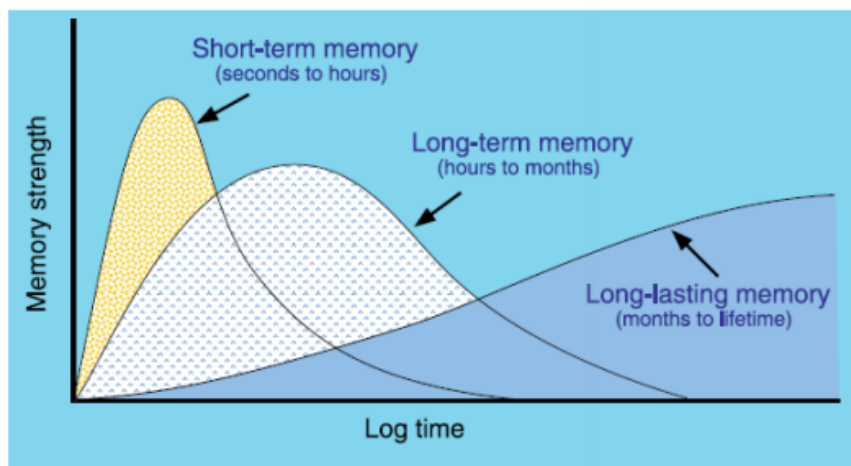


But will often tie back to human memory issues – explicitly or at least implicitly.

### Things important in Experiments

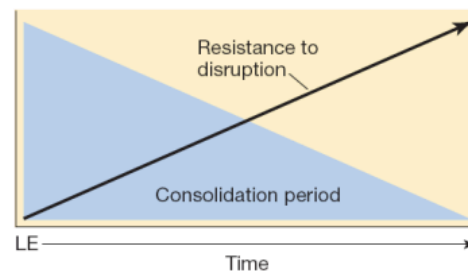
- What did they do?
- What did they find?
- How did they interpret what they found? What did they say they found?

## Types of Memory (McGaugh, 2000)



During the period of rehearsal, they are consolidating the memory. If we disrupt that post-event consolidation – there is no memory.

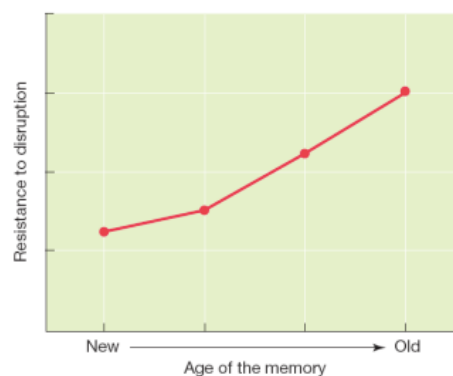
When an animal learns something (learning event), over time the memory consolidates. Initially, the memory hasn't been consolidated and therefore can be modified. Over time, the memory consolidates. It takes time for a memory to consolidate because there is either a structural or functional change – which takes time.



**FIGURE 7.5**

The concept of memory consolidation. Following a learning experience (LE), a memory trace is vulnerable to disruption. With the passage of time, resistance to memory disruption increases and the trace becomes more stable. The term memory consolidation is used to describe this change from vulnerable to less vulnerable. The term consolidation processes is used to designate processes that stabilize the memory trace. The term consolidation period refers to the time it takes to stabilize the memory trace.

**Theodule Ribot (1890)** – observed what happened to some of his patients with head injuries. Newer memories are more affected by brain injuries. He came up with **Ribot's Law** which stated that older memories are harder to disrupt.



**FIGURE 1.5**

Ribot proposed that older memories are more resistant to disruption by traumatic events than newer memories. This hypothesis is called Ribot's Law.

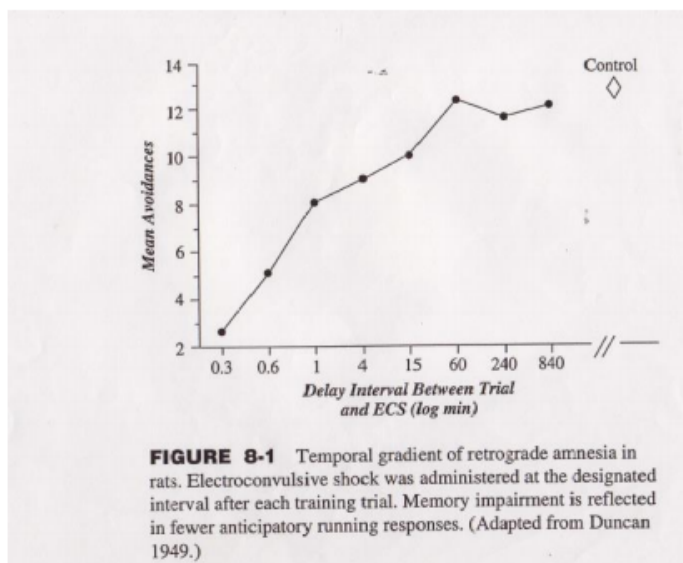
Cognitive scientists rarely talk about consolidation (1 in every 379 papers on memory).  
Neuroscientist study consolidation 1 in every 14 papers in memory.

### Experimental Evidence for this idea of “Memory Consolidation”

Retrograde amnesia – the loss of memory of something that happened before an amnesic event. E.g. the event is getting hit in the head with a hammer. You forget things that happen before.

**Duncan, 1949** – trained rats on an active avoidance procedure which involved animals being placed in a chamber with two compartments with a door in between. The animals are put in the left-side of the chamber and shocked after a few seconds – mildly painful electric shock. They continue being shocked until they go to the right side of the door. After 10 seconds, they get placed on the left side again and get shocked. Then, they run to the right side. This happens a lot of times called escape trials. The animals learn to avoid the shock. This is called active avoidance and is a critical component of all anxiety disorders.

After the animal made an avoidance response, Duncan (1949) gives the animal an electroconvulsive shock – causing convulsions. He then tests their memory the next day. If they give ECS immediately then the memory may not have enough time to consolidate – this should result in amnesia. However, if ECS happens later then they shouldn't have amnesia.



Animals who got ECS immediately after training have gotten amnesia.

Animals who get ECS even an hour after still remember to avoid.

Duncan thought this amnesia was due to a disruption of memory consolidation ECS caused an “electrical storm” that disrupted the reverberatory circuit underlying memory.

Anterograde amnesia is when you forget things after the amnestic event.

However, there is a possible alternative explanation of these results is that the rat learns the left side is a bad place. It could be the case that there is no amnesia after ECS instead, it learns the association of the right side and the big shock which leads it to prefer the left side again. But if the ECS happens after an hour, it has probably forgotten the association.

This potential alternative account of those results led to the development of the passive avoidance procedure