Memory and All That Jazz

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Memory is a complex brain function involving widely distributed, but interconnected, areas of the brain.

Our focus will be on two of these areas.
The brain does just what scientist do – it creates a model of reality – It isn’t necessarily very accurate – but it doesn’t need to be!

The brain will make “predictions” based on previous experience; memory need be only “good enough” to be useful!
• A “recollected” of an event is only as good as the perception of the event itself (in fact, probably not even that good).

• It would not be efficient for the brain to take in ALL information each time and create a totally new paradigm; it needs to create a paradigm or model that works – most of the time!
What the brain needs to know: Is the present experience *similar enough* to some past experience (Should be reinforced?) or is the present experience *novel* (Should it be encoded)?
Two Major Types of Learning & Memory:

Adapted from Blumenfeld, 2010
– Non-Declarative (implicit) memory

• Memory for skills, habits and behaviors
• Operates without conscious awareness once learned
• Requires repetition and practice
• Less likely to be forgotten once learned
• Involves basal ganglia, cerebellum
• Allows many types of behavior to be on “auto-pilot”

• Emotional implicit memory involves amygdala
– Declarative (explicit) memory

• Memory of “facts”
  – Can be consciously recalled
  – Easy to acquire, easy to forget
  – Hippocampus plays a major role; L hippo words/facts, R hippo spatial memory

• Memory of “events” (episodic memory)
  – L Hippocampus – strings together these events (precious few at that) and “creates” an autobiography!

Adapted from Bear et al, 2007
• **Time lines of memory**

  – *Less than a second:* “attention to something”

  – *Seconds to minutes:* “working” memory

  – *Minutes to years:*
    • *Short-term and Long-term memory*
• **Immediate Memory**
  – Many different areas of the brain contribute to “attention”; these include cortical areas and also areas of the reticular formation – *all areas which contribute to “alertness, attention and awareness”*

*Adapted from Blumenfeld, 2010*
- **Working Memory**
  - Temporary and vulnerable to disruption
  - Very limited in capacity
  - Ability to hold some piece of information in “mind” for a short period
  - WM must constantly be “dumped”
  - Selected for in terms of evolution because it confers great advantage for planning behavior, etc. WM was NOT selected for to allow us to remember phone numbers!
  - Involves multiple areas primarily of the Prefrontal Cortex
• **Short-term Memory**
  
  – What we used as “students”!
    (good and bad)
  
  – Can potentially be consolidated into long-term memory
  
  – Involves **medial temporal lobe structures**, like the hippocampus and **medial diencephalic structures**, as well as a few cortical areas

*Adapted from Fix, 2008*
• **Long-term Memory**
  – The recollections of our lives
  – Involves *widespread areas of the cortex*
  – Can “fade”, but widespread loss is rare
• D. Schachter: *The Seven Sins of Memory*

• **Sins of Omission**
  – Transience
    • A weakening of memory over time; the past “recedes” as we have new experiences
    • Over time, the brain may retain the “gist” of the experience, without much detail
    • Bias affects this – we remember what “fits” with our paradigms and our “autobiography”
    • Increases with age, decreases with educational level
– Absent-mindedness

• Represents a breakdown between attention & memory
• Then again, how much DO we really notice???
• Note that many things we do – are automatic (non-conscious)
• Also note that we are effectively blind (literally and figuratively) to unattended objects – so no memory of the event occurs!
• But – the brain (particularly the reticular system) IS paying attention (😊)
– Blocking

• A fact, etc. that has been stored as a memory, but cannot be recalled when we WANT to recall it!
• Most often occurs with familiar facts – like names of people
• Thought to be due to a “loosening of associations”
• Note that a person’s name does NOT allow synonyms to be used, and that the name means nothing in itself
• **Sins of Commission**

– Misattribution

• Memory of events that never occurred!
• Believed to represent a misattribution of current perceptions and experiences onto past events
• Note that memory “glues together” aspects of our experience – if not glued together properly – misattribution occurs
• Our “imagination” also plays havoc with accurate memory and plays a role in misattribution
– Suggestibility

- Strong individual differences in vulnerability to suggestibility
- Particularly important in certain settings: police interrogation, interaction with children, psychotherapy
- An individual may “confess” to a crime they did not commit
- An individual can be made to believe something happened to them, i.e., alter their “autobiography”, which never happened
– Bias

• Re-scripting of past memories to fit with current view
• We remember ourselves in a more positive light (generally)
• We remember events consistent with our “autobiography” (or “self-schema”)
• Stereotypes strongly influence if we remember and what we remember
Persistence

- Intrusive memories of events you WANT to forget
- Can be mild to debilitating (think a song in your head vs. Post-Traumatic Stress Disorder [PTSD])
- Strong individual differences; linked to depression
- May be related to “self-schema” and to resilience
- In disorders like PTSD, strongly linked to abnormal amygdala activation
• What do these “sins” tell us about what memory IS or ISN’T?

– Memory results from some change in electrical activity of neurons– and as such is vulnerable to what has happened before – and what happens after

– It is, at best, fragmentary, and contains “just enough” information about what “actually” happened, to be useful most of the time
The brain cares mostly about the “gist” of things!

- Normal individuals remember the “gist” of what happened, details may or may not be correct
**RECALL OF DETAILED MEMORIES IN NORMAL, TEMPORAL LOBE-DAMAGED, AND AUTISTIC INDIVIDUALS**

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– Our past experiences, our biases, our temperaments influence IF and WHAT we “remember”
• Suggested additional readings:
  – Schachter, D. *The Seven Sins of Memory*. Houghton Mifflin Co., NY, 2001. (Other books by the same author as well.)
  – Squire, L. *Memory and the Brain*. Oxford, 1987. (Other books by this author.)