9.00 EXAM 2 NOTES
KOSSLYN CHAPTER 5 – *Memory: Living With Yesterday*

Memory Relies on 3 Fundamental Types of Processing:

1. ***Encoding***: the process of organizing and transforming incoming information so that it can be entered into memory, either to be stored or to be compared with previously stored information
2. ***Storage***: the process of retaining information in memory
3. ***Retrieval***: the process of accessing information stored in memory

ENCODING INFORMATION INTO MEMORY STORES: TIME AND SPACE ARE OF THE ESSENCE

Types of Memory Stores (sets of neurons that serve to retain information over time):

Sensory Memory → Short Term Memory → ← Long Term Memory
| ---Rehearsal--- |

Sensory Memory (SM): memory store that holds a large amount of perceptual input for a very brief time, typically less than 1 sec; lingering sensations

- Happens automatically, without effort
- Arises because stimulus activates perceptual areas of your brain

Sperling Study – sensory memory in vision

Participants saw sets of letters arranged in three rows. When the letters were flashed very quickly (for less than 0.25 sec), people were able to report around 4 or 5 letters, even though they claimed to briefly remember all of them.

In another part of the study, a high, medium, or low tone was presented immediately after the rows of letters were flashed. Participants reported the top row if the tone was high, the medium row if it was medium, and the bottom row if it was low. They could report the appropriate row almost perfectly, showing that they had briefly stored more than they could report aloud.

Iconic memory stores a large amount of information but it fades very quickly.

Short-Term Memory ***(STM)***: aka immediate memory; memory store that holds relatively little information (typically 5 or 9 items) for only a few seconds (but can be prolonged voluntarily, perhaps as long as 30 seconds)

- STM differs from SM in duration and capacity

Rehearsal: repeating information over and over to retain it in STM

STM can hold only about 7 ± 2 (ie: 5 – 9) items, organized into 4 **chunks** (unit of information… ex: digit, letter, word)

- Amount of information STM can hold depends on type of information
  - People spend more effort to mentally hold more complex patterns or concepts

You are conscious only of information that is present in STM, and you can typically access this information more quickly than information stored in LTM.

1. SM can retain information only very briefly, and so the relatively slow process of encoding information into STM doesn't have a chance to finish before the contents of SM have faded away.
2. Even if this weren't the case, STM can hold relatively little information, so not all of the information in SM can be fully transferred to STM.

Working Memory: the memory system that includes 2 specialized STMs (auditory loop and visuospatial sketchpad) and a central executive (the set of processes in WM that transforms

and interprets information into one or another of 2 specialized STMs during planning, reasoning, and problem solving) that operates on information in the STMs to plan, reason, or solve a problem

Long-Term Memory (LTM): memory store that holds a huge amount of information for a long time (from hours to years)

- Stores rules that can guide WM or overt behavior; information that specifies the meaning of pictures, words, and objects; encoded memories of everything you've ever done or learned
- Is almost limitless??
- Plays a central role in perception: you recognize and identify an object only after the appropriate information is activated in LTM

Information can be transferred from STM to LTM, and vice versa

Distinguishing between STM and LTM
Ebbinghaus → first solid evidence that STM and LTM are separate and operate differently
Serial position effect: the first and last items studied are more easily remembered than those in the middle… U-shaped memory curve!

Primacy effect: increased memory for the first few stimuli; occurs because we have more time to think about the earlier ones than the later ones… stored in LTM

Recency effect: increased memory for the last few stimuli; STM

Making Memories

Code: particular method for specifying information (ex: words / images)

- Ability to use different codes allows us to retain information more effectively than if we had only a single code.
    - Concrete words are remembered better than abstract words because you can visualize object named by concrete word and store that image along with the word itself (2 chances to find information in LTM later!!)
- This type of organizational processing occurs in the frontal lobes.
    - Degree of activation predicts how well it will be remembered later

Consolidation: process of converting information stored dynamically in LTM into a structural change in the brain

- Dynamic memory: when information first enters LTM; if it is not activated (ie: if you're not doing it), it is lost
- Structural memory: no longer depends on continuing neural activity; stored by connections among neurons

Reconsolidation → recalling information can cause memories to become vulnerable to change, so to be retained, the information must be *reconsolidated* / restabilized as a stored structure…

- Memories can be altered, disrupted, distorted during reconsolidation
- Requires different proteins than consolidation
- Is necessary some times but not others
    - Length of time information has been retained in memory, nature of task, degree to which information was effective stored and subsequently consolidated, correspondence between what is expected and what actually occurs help determine whether reconsolidation is needed

→ The more you think through the associations and implications of information, the better you will remember its meaning.

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Depth of Processing: the number and complexity of the operations involved in processing information, deeper processing occurs when more – or more complex – operations are used during encoding

- The greater the depth of processing when you first encode information, the greater the likelihood of remembering it later

The most effective processing is tailored to the reason the material is being learned:

- *Attention* – what you initially pay attention to determines what gets encoded
- *Comparability* – knowing the ways in which you will later use stored information is important for knowing the best way to encode it
    - Transfer appropriate processing: processing used to retrieve material that is the same type as was used when it was originally studied, which improves memory retrieval

Breadth of Processing: processing that organizes and integrates information into previously stored information, often by making associations

Elaborative encoding: strategies that produce great breadth of processing

- Ex: remembering someone's name – think of someone else with same first name, visualize face, etc.

It doesn't matter how much or how hard you try to learn something; what matters is how well you attend to, integrate, and organize the specific information you want to learn

Intentional Learning: learning that occurs as a result of trying to learn
Incidental Learning: learning that occurs without intention

Emotionally Charged Memories
Emotion boosts memory → *Why??*

- Noradrenaline released during strong emotion
- Hypothesis: activation of amygdala, which plays a key role in emotion and can cause more noradrenaline to be produced, which in turn enhances memory consolidation

Flashbulb Memories: an unusually vivid and detailed memory of a dramatic event

- Only events that have important consequences for a person are stored as flashbulb memories
- Become distorted over time… although people believe that they are always accurate

RETAINING INFORMATION: NOT JUST ONE LTM

***Modality-Specific Memory Stores*:** retain input from single perceptual system, such as vision or audition, or from a specific processing system, such as language; multimedia brain

Semantic memories: memories of the meaning of words (a pine is an evergreen tree with long needles), concepts (heat moves from a warmer object to a cooler one), and general facts about the world; for the most part, you don't remember when, where, or how you learned this kind of information

Episodic memories: memories of events that are associated with a particular context – a time, place, and circumstance

Explicit Memory: (aka declarative memory); memories that can be retrieved voluntarily and brought into STM

- Stored in either semantic or episodic memory
- Can occur in any modality
- Explicit memory is what is stored after cognitive learning occurs

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- When activated, explicit memories can be operated on in WM: You can think about the recalled information in different ways and for different purposes and build on it with new ideas.

Implicit Memory: (aka nondeclarative memory); memories that are unconscious and cannot be retrieved voluntarily and brought into STM but rather predispose a person to process information or behave in certain ways in the presence of specific stimuli

- Not stored in either semantic or episodic memory
- Can occur in any modality
- Not stored after cognitive learning occurs; arise from other types of learning
- Cannot be reinterpreted or otherwise operated upon in WM

H.M. – first hint that memories can be explicit or implicit

- Bilateral removal of hippocampus to lessen epileptic symptoms
- No explicit memories, but retained implicit memories

5 Types of Implicit Memories

- *Classically Conditioned Responses* – associative learning; neutral stimulus is paired with a unconditioned stimulus that produces an unconditioned response, which in turn leads the neutral stimulus to produce the same response as the unconditioned
    - Ex: almost falling (unconditioned response) over balcony (neutral stimulus), falling now associated with balcony, even if you don't realize it
- *Nonassociative Learning* – response to a stimulus itself changes, without any new associations between stimuli or between stimuli and responses being formed
    - Ex: during habituation, a behavior changes after a stimulus is repeated over and over
- *Habits* – aka procedural memories; well-learned response that is carried out automatically (without conscious thought) when the appropriate stimulus is present
- *Skills* – sets of habits that can be coordinated in a range of ways
    - 2 phases:
        - *Controlled processing*: requires paying attention to each step of a task and using working memory to coordinate the steps; relies on explicit memories
        - *Automatic processing*: allows you to carry out a sequence of steps without having to pay attention to each one or to the relations between the steps; relies on implicit memories
- *Priming* – occurs when having performed a task predisposes you to perform the same or an associated task again in the future (ex: if you see an ant, you will be more prone to noticing them in other places)
    - Repetition Priming: makes the same information more easily accessed in the future

Genetic Foundations of Memory

Evidence is emerging that different genes are used when we form different types of memories, which demonstrates further that these types are, in fact, distinct.

Knockout Mice – have a particular gene purposely taken out (ie: knocked out), so that we can trace the connection between a missing gene and an impaired type of memory

- Ex: some types of KO mice have normal episodic memory for spatial information, but impaired memory for conditioned fear
- Genes affect these types of memories in part by altering the functioning of specific parts of the brain and in part by altering the production and functioning of key proteins and neurotransmitters that are used when new memories are stored

→ This is easier said than done!!

= KO this can have multiple unexpected effects… removing a given gene can cause the animal to do poorly on a task for any number of reasons

Stressed Memories

Genes can also affect your memory by producing specific chemicals when you are stressed, which in turn leads your brain to send signals to your body to prepare it for the *fight-or-flight response*, which helps you cope with stressful stimuli.

- Increased production of cortisol… (long-term exposure to cortisol kills neurons in the hippocampus… disrupting memory)

Stress also disrupts other brain areas involved in storing and retrieving memories (ie: frontal lobe, amygdala).
When stress hormones disrupt storage processes in the hippocampus, they also disrupt them in a pathway connecting the amygdala and frontal lobes.

RETRIEVING INFORMATION FROM MEMORY: MORE THAN REACTIVATING THE PAST

Recall: the act of intentionally brining explicit information to awareness, which requires transferring the information from LTM to STM
Recognition: the act of successfully matching an encoded stimulus to information about that stimulus that was previously stored in memory

- Methods of assessing memory rely on either recall or recognition.
    - Questions that require recognition tend to be easier then those that demand recall.
    - Recognition is difficult if you have to discriminate between similar choices.
        - If the choices are similar, you have to access more stored details to recognize the correct answer.

Cues: stimuli, thoughts, or feelings that trigger or enhance remembering; reminders of an object or event

State-Dependent Retrieval: recall that is better if it occurs in the same psychological state that was present when the information was first encoded.

Ex: IF you are in a happy mood at the time you learn something, you may remember it better when you are feeling happy than when you are feeling sad.

Hypnosis: can sometimes improve memory of prior events; increases people's confidence in their recollections but not their accuracy; can implant beliefs, leading the hypnotized person to believe that suggested events happened

WHEN MEMORY GOES WRONG – AND WHAT TO DO ABOUT IT

False Memories: memories of events or situations that did not, in fact, occur
In general, we don't necessarily remember what actually happened but rather what we experience as having happened.
False memories can arise from inferences we draw and also can be directly implanted by other people.

Loftus – artificially implanted memories → story to children about getting lost in mall
Pezdek – some false memories are easier to create than others

Strong emotions make memories more vivid, so people intuitively expect that if a highly emotional event had actually happened, they would have a very vivid memory of it. (If they didn't have a vivid memory, it probably didn't happen.)

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Implications in court cases → faulty witness memories??

Distinguishing Fact from Fiction
- The hippocampus is activated when you recognize actual events as well as when you identify associated / imagined events that are not real.
- BUT differential activation in other brain locations can help you determine whether events actually happened.

Actual memories can also include stored information about the perceptual qualities of the encoded material. The presence of associated perceptual information is one way that actual and false memories can be distinguished.

Johnson et al. – people often confuse actually having seen something with having imagined seeing it.
- People with vivid mental images are more likely to believe they saw an event when they only read a description of it.

Reality monitoring: paying attention to characteristics that distinguish actually from imagined stimuli
- When people are asked to pay attention to the amount of perceptual detail in their memories (ie: texture of objects, environment, shadows), they are better able to distinguish actual memories from false memories

Forgetting

Forgetting Curve: by Ebbinghaus; graphic representation of the rate at which information is forgotten over time: Recent events are recalled better than more distant ones, but most forgetting occurs soon after learning.

People forget because: information was not well encoded in the first place
Encoding Failure: failure to process to-be-remembered information well enough to ensure that it is fully entered into LTM
- Information is lost shortly after learning → sharp drop in the forgetting curve

2 hypotheses of memories that are lost:
1. Memory decays and disappears
2. Memory remains in LTM, but cannot be "found"

Decay: loss of memories over time because the relevant connections between neurons are lost
- Some genes promotes stronger connections among neurons, while other genes prevent such connections and block memory

Interference: occurs when information disrupts encoding or retrieval of other information
- Probably occurs because the retrieval cues for various memories are similar, so a given cue may call up the wrong memory
- Retroactive Interference: new learning impairs memory for something learned earlier
- Proactive Interference: information already stored in memory makes it difficult to learn something new

Intentional Forgetting: Out of Mind, Out of Sight
- Relies on frontal lobes of brain (organize information during encoding and actively searches for stored memories during retrieval)
    - If you decide not to remember something immediately after you perceive it, your frontal lobe won't work as hard to encode the information as it does when you are trying to store it.

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Amnesia: loss of memory over an entire time span, not your usual forgetting!!

- *Organic amnesia:* arises after the brain has been damaged by stroke, injury, or disease
    - Typically impairs episodic memories, while leaving semantic memories almost entirely intact (information that has been fully consolidated)
    - Depending on the location of brain damage, organic amnesia could also have the opposite effect! (ex: hippocampus)
    - Can sometimes result from damage to cortical brain areas that serve as LTM stores (ex: Alzheimer's disease)
- *Functional amnesia*: arises after psychological trauma or extreme stress, there is no obvious problem in the brain itself
    - Difficult to study because it could be malingering (intentional faking of amnesia)

- ***Retrograde Amnesia****:* disrupts previous memories
    - *Infantile / Childhood Amnesia*: we don't remember much about our early childhood experiences
- ***Anterograde Amnesia:*** leaves consolidated memories intact, but prevents storing new facts

Repressed Memories: memories of actual events that were pushed into the unconscious because they are emotional threatening

Improving Memory: Tricks and Tools

Enhancing Encoding
Organize It! → chunking information; hierarchical organization… for integration
Process It! → depth and breath of processing; study in short session spread out over time
Mnemonic Devices: strategies that improve memory, typically by effectively organizing and integrating to-be-learned information

Enhanced Memory Retrieval
Remember the Context
Structure the environment
Focus
Keep Trying
Seize fragments

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