Chapter 8

Retrieval
Tip-of-the-Tongue Phenomenon
Brown and McNeil (1966)

- **Tip-of-the-Tongue (ToT) State:**
  - A feeling that one *knows* a response yet is unable to produce it

- **Brown and McNeil (1966) – Is the feeling of knowing an illusion?**
  - **Task:**
    - Retrieve the word corresponding to its provided definition
    - e.g. “A musical instrument comprising a frame holding a series of tubes struck by hammers”
  - Participants were asked to indicate if they were in a ToT state
    - If so, guess the number of syllables and any other information about the word (e.g. first letter)

- **Results:**
  - Participants are better at remembering associated information than they were at producing the actual word (e.g. XYLOPHONE)
Accessibility of Memories

- The feeling of knowing is generally a good indication that you do know it.

- Memory contains more information than we can access at any given moment
  - Providing hints (e.g. first letters of words) can dramatically improve recall
  - Being unable to remember something now doesn’t mean the memory is lost forever
The Retrieval Process

- **Retrieval**: A progression from one or more retrieval cues to a target memory trace through associative connections.
- **The aim is to make the target available to influence cognition.**

- **Content Addressable Memory**: The ability to locate and access a complete memory using only a subset of the target’s attributes as a cue.

- **Retrieval Cues**: Bits of information about the target memory that guide the search.

- **Target Memory Trace**: The particular memory we’re seeking.

- **Associations**: Bonds that link together items in memory.
  - Vary in strength.
Name the Seven Dwarfs
Is it easier with the picture?
A Recognition Task

Which of the following are names of the Seven Dwarfs?

- Goofy
- Bashful
- Sleepy
- Meanie
- Smarty
- Doc
- Scaredy
- Happy
- Dopey
- Angry
- Grumpy
- Sneezy
- Wheezy
- Crazy
Spreading Activation Model

- **Activation Level:**
  - The internal state of a memory, reflecting its level of excitement
  - Determines the accessibility of the item
  - Increases when:
    - Something related to the memory is encountered
  - Persists for some time before dissipating

- **Spreading Activation:**
  - The automatic transmission of “energy” from one memory to related items via their associations
  - Proportional to the strength of the connections
Factors Determining Retrieval Success

Factors are summarized in this diagram and explained in more detail in the slides that follow.
Factors Determining Retrieval Success

1. Attention to Cues

- Reduced attention to a cue impairs its ability to guide retrieval effectively.
  - Dividing attention by multi-tasking:
    - During retrieval: Reduces memory performance, especially if the secondary task is:
      - Related to the primary task (e.g. both deal with words).
      - Demands a lot of attention.
    - During encoding: Is even more disruptive than dividing attention during retrieval.
      - Retrieval can require less attention than does encoding.
      - Due to automatic spreading activation.

Failing to note what word (e.g. “WATER”) you’re supposed to translate into Spanish impairs your ability to recall (“AGUA”).
Dividing Attention

- **Task 1:**
  - Recall out loud (or recognize) lists of words presented auditorially

- **Task 2:**
  - Make judgments about visually presented items, which were either:
    - Words
    - Pictures
    - Numbers

- **Results:**
  - Completing Task 2 reduced Task 1 performance by 30–50%
    - Interference was greater when Task 2 items pertained to words
    - More interference when Task 1 tested recall instead of recognition
Retrieving words under divided attention negatively affects retrieval success, especially with distractor tasks (e.g. semantic or phonological) that are similar to the task of interest (in this case, recalling words). Data from Fernandes and Moscovitch (2000).
Factors Determining Retrieval Success

2. Relevance of Cues

- Retrieval cues are most effective when they are strongly related to the target.
- Encoding specificity principle:
  - Retrieval cues are most useful if they are:
    - Present at encoding
    - Explicitly encoded with the target
    - Maximally similar to the original cue available at encoding

The cue “EAU” isn’t useful in retrieving the Spanish translation, if you don’t know that “EAU” is French for “WATER.”
Factors Determining Retrieval Success

2. Relevance of Cues

- Having the right cues greatly enhances retrieval – the best cues are the ones present at encoding -- encoding specificity.

- Tulving and Osler (1968)
  - Task:
    - Participants had to learn weakly related cue–target pairings (e.g. GLUE–CHAIR)
    - They were then asked to recall the target either with or without its cue word
  - Results:
    - Having a cue word significantly increased target recall
    - Words related to the target but not presented during encoding (e.g. TABLE for CHAIR) were less effective than the original cue
Factors Determining Retrieval Success

3. Cue–Target Associative Strength

- Retrieval success depends on the strength of association between cue and target
  - This is jointly determined by the length of time and attention spent on encoding the relationship.
  - Encoding the cue and the target separately is unhelpful – the two need to be associated with each other as well.

Being only vaguely familiar with the link between “WATER” and “AGUA” (represented by the dotted arrow) limits its usefulness as a cue.
Factors Determining Retrieval Success

4. Number of Cues

- Access to additional, relevant cues facilitates retrieval, provided that both cues are attended.
  - Activation spreads from both cues, coalescing on the target, facilitating retrieval
- **Dual-coding**
  - Cueing multiple access routes to a target (extra cues) can provide a super-additive recall benefit – greater than the sum of cues.
  - Elaborative encoding maximizes the number of retrieval routes.
- E.g. Rubin and Wallace (1989) found that providing both semantic and rhyme cues boosts recall more than the combined effect of each cue alone.

An extra hint, like the first letter of the target word, facilitates retrieval.
Factors Determining Retrieval Success

5. Strength of the Target Memory

- Weakly encoded targets are more difficult to retrieve
  - The targets start at a lower activation level
    - Therefore, they require a greater boost in activation in order to be retrieved
  - Spreading activation helps explain the word frequency effect for recall:
    - More frequently encountered target words start with a higher activation level and thus are more easily retrieved

Having only a weak representation of “AGUA” limits your ability to retrieve it, even when presented with a strong cue.
Factors Determining Retrieval Success

6. Retrieval Strategy

- Retrieval success is increased by:
  - Taking advantage of the organization of the materials adopted at encoding.
  - Adopting a strategy that efficiently searches through memory.

- Anderson and Pritchert (1978):
  - Memory is influenced by the perspective taken at encoding and recall (homebuyer vs burglar).
  - The perspective provides a structure that constrains recall to schema-consistent items.
  - Adopting a new perspective can facilitate recall of different objects previously forgotten.

- Tip -- Try recalling from different perspectives.

Adopting the tactic of recalling all sorts of Spanish beverages until you stumble upon the target word wastes time and generates numerous, distracting responses, in addition to the target (“AGUA”).
Factors Determining Retrieval Success

7. Retrieval Mode

- **Retrieval Mode**: To recall, you need to be in a frame of mind conducive to interpreting environmental stimuli as episodic memory cues to guide subsequent retrieval.

- Herron and Wilding’s (2006) ERP study:
  - The *right frontal cortex* helps adopt the appropriate cognitive set for episodic retrieval.
  - Having multiple episodic tasks in a row gradually improves performance.
  - This suggests it takes time to fully adopt the retrieval mode.

Encountering a stimulus (e.g. by pouring water into a glass) without the intention to retrieve the target from memory, reduces the probability of eliciting the target.
## Context Cues

- **Context:**
  - The circumstances under which a stimulus was encoded

<table>
<thead>
<tr>
<th>Type of Contextual Cue</th>
<th>Definition</th>
<th>Example</th>
</tr>
</thead>
<tbody>
<tr>
<td>Spatio-Temporal</td>
<td>The physical surroundings and time cues during an event</td>
<td>Dawn by the beach; birds singing</td>
</tr>
<tr>
<td>Mood</td>
<td>The emotional state that one was in during an event</td>
<td>Sad</td>
</tr>
<tr>
<td>Physical</td>
<td>The pharmacological/physical state that one was in during an event</td>
<td>Drunk; tired</td>
</tr>
<tr>
<td>Cognitive</td>
<td>The collection of concepts that one has thought about around the event</td>
<td>Thinking about an upcoming exam</td>
</tr>
</tbody>
</table>
Retrieval Tasks

Direct/Explicit Memory Tests

- **Direct/Explicit Memory Tests:**
  - Ask people to recall particular experiences
  - Require context as a cue
  - Tap contextual representations in hippocampus
  - Reveal impaired performance in amnesics
Retrieval Tasks

Indirect/Implicit Memory Tests

- **Indirect/Implicit Memory Tests**: Measure the unconscious influence of experience *without* asking the subject to recall the past.

- **Repetition Priming**: Recent experience with the stimulus improves performance.

- **Cryptomnesia**: Unintentional plagiarism due to failed source memory.

- Context is *not* used intentionally as a cue.

- May involve a “cover story” about the experiment – an orienting task.

- Probably do not access the same memory traces as do explicit tests.

- Reveal normal performance in amnesics.
Kinds of Retrieval Tasks

<table>
<thead>
<tr>
<th>Test Category</th>
<th>Test Type</th>
<th>Example Retrieval Instructions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Free Recall</td>
<td>Direct/Explicit</td>
<td>&quot;Recall studied items in any order.&quot;</td>
</tr>
<tr>
<td>Cued Recall</td>
<td>Direct/Explicit</td>
<td>&quot;What word did you study together with LEAP?&quot;</td>
</tr>
<tr>
<td>Forced-Choice Recognition</td>
<td>Direct/Explicit</td>
<td>&quot;Which did you study: BALLET or MONK?&quot;</td>
</tr>
<tr>
<td>Yes/No Recognition</td>
<td>Direct/Explicit</td>
<td>&quot;Did you study: BALLET?&quot;</td>
</tr>
<tr>
<td>Lexical Decision*</td>
<td>Indirect/Implicit</td>
<td>&quot;Is BALLET a word?; Is MOKN a word?&quot;</td>
</tr>
<tr>
<td>Word Fragment Completion*</td>
<td>Indirect/Implicit</td>
<td>&quot;Fill in the missing letters to form a word: B_L_E_.&quot;</td>
</tr>
<tr>
<td>Word Stem Completion*</td>
<td>Indirect/Implicit</td>
<td>&quot;Fill in the missing letters with anything that fits: BAL_____.&quot;</td>
</tr>
<tr>
<td>Conceptual Fluency</td>
<td>Indirect/Implicit</td>
<td>&quot;Name all the dance types you can.&quot;</td>
</tr>
</tbody>
</table>

*Perceptually driven tests, focusing on the perceptual qualities of the stimulus*
Context-Dependent Memory

Environmental Context-Dependent Memory

- Reinstates the original encoding environment and facilitates retrieval

- Godden and Baddeley (1975)
  - Task:
    - Taught divers word pairs in one of two contexts: dry land or underwater
    - Tested their cued recall either in the same environment or the other one
  - Results:
    - Material is recalled best in the learning environment

Data from Godden and Baddeley (1975).
Smith and Vela (2001) concluded that:

- Incidental context effects are reduced if the participant focuses inward, rather than paying attention to the environment.
  - It is necessary to pay some attention to the physical environment during encoding for context to help.
- Context-dependent memory effects grow in magnitude with increasing delays between encoding and retrieval.
- Mentally reinstating the context (if it is impossible to actually recreate the physical environment) reduces context-dependent memory effects.
  - It is easier to recall when mentally recreating the physical environment.
State-Dependent Memory

- **State Dependency:**
  - Recall partially depends on the match between the learner’s internal environment (i.e. physiological state, including heart rate) at encoding and retrieval.
  - Recall is best if encoding and retrieval *both* occur when:
    - Drunk (Goodwin et al., 1969)
    - Under the influence of marijuana (Eich, 1980)
    - Under the influence of caffeine
    - Sober
    - Exercising
    - At rest
  - State dependency disappears under recognition tests
Context-Dependent Memory

Mood

- **Mood-Congruent Memory** – about the person/item match
  - It is easier to recall events that have an emotional tone that matches the current mood of the person
  - Thus, depressed individuals are likely to recall mostly unpleasant memories, furthering their depression
  - Not really a demonstration of context-dependent memory because the mood at **encoding** is not the defining feature

- **Mood-Dependent Memory** – about the person/person match
  - Recall is dependent on the match in mood states between encoding and retrieval.
  - This should include neutral events encoded in that particular mood state.
Mood-Dependent Memory

- **Task:**
  - Induced either a pleasant/unpleasant mood at encoding by:
    - Playing merry/melancholy music
    - Asking participants to think about happy/depressing thoughts
  - Two days later, induced either the same or the opposite mood prior to recall.

- **Results:**
  - Free recall was vastly improved when mood states matched
    - Irrespective of the valence of the event recalled
Context-Dependent Memory

Cognitive Context-Dependent Memory

- **Cognitive context:**
  - The particular ideas, thoughts, and concepts occupying attention
    - Memory is facilitated when the cognitive context matches at encoding and retrieval

- Marian and Neisser’s (2000) bilingual study
  - **Task:**
    - Memory cues were provided in either Russian or English
  - **Results:**
    - Memories generated tended to be from the same *linguistic context* (i.e. events that occurred where that language was spoken)
  - **Conclusion:**
    - Bilinguals have two *language modes*, in which memories take place and are stored.
    - Memories are easier to access when retrieval takes place in the same language mode as they were encoded.
Reconstructive Memory:

- The active and inferential process of retrieval whereby gaps in memory are filled in based on prior experience, logic, and goals.
- Makes use of schemas
- Sometimes inferences lead to false memories

Dooling and Christiaansen (1977):

Task:
- Asked participants to read and study a passage
- One week later, half were told that the passage was about Helen Keller

Results:
- The half that were told that the passage was about Keller were far more likely to mistakenly claim that schema-consistent sentences like “She was deaf, dumb, and blind” appeared in the passage.
Recognition Memory

- **Recognition Memory:**
  - The ability to correctly decide whether one has previously encountered a stimulus in a particular context
  - Presents the intact stimulus (i.e. target), unlike in recall.
  - Requires *discrimination* between *old* and *new* stimuli
    - *Old (studied)* stimuli are those previously presented.
    - *New (nonstudied)* stimuli:
      - Are called *distractors*, lures, or foils
      - Permit a measure of the participants’ level of guessing and decision-making bias for accepting items as old
Recognition Memory

Signal Detection Theory

- **Signal Detection Theory:**
  - A model for explaining recognition memory
  - Based on auditory perception experiments:
    - Typical Task:
      - Ask participants to detect a faint tone (signal) presented against a background of noise
      - The tone’s loudness against the background noise is manipulated
Recognition Memory

Signal Detection Theory

- Recognition accuracy depends on:
  - Whether a signal (noise/target memory) was actually presented
  - The participant’s response

- Thus, there are four possible outcomes:

<table>
<thead>
<tr>
<th>CORRECT</th>
<th>INCORRECT</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Hits</strong></td>
<td><strong>False Alarms</strong></td>
</tr>
<tr>
<td>Correctly reporting the presence of the signal</td>
<td>Incorrectly reporting presence of the signal when it did not occur</td>
</tr>
<tr>
<td><strong>Correct Rejections</strong></td>
<td><strong>Misses</strong></td>
</tr>
<tr>
<td>Correctly reporting the absence of the signal</td>
<td>Failing to report the presence of the signal when it occurred</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Actual Signal Status</th>
<th>Target</th>
<th>Lure</th>
</tr>
</thead>
<tbody>
<tr>
<td>“Old”</td>
<td>HIT</td>
<td>FALSE ALARM</td>
</tr>
<tr>
<td>“New”</td>
<td>MISS</td>
<td>CORRECT REJECTION</td>
</tr>
</tbody>
</table>
Recognition Memory

Signal Detection Theory in Memory

- Assumptions:
  - Memory traces have strength values (i.e. activation levels)
  - Activation levels dictate how familiar a stimulus feels
  - Traces vary in terms of their familiarity, based on:
    - Attention paid to the stimulus during encoding
    - The number of repetitions

- More Assumptions:
  - Familiarity values for “old” and “new” items are each normally distributed
  - On average, “new” items are less familiar than “old” items
    - However, some distractors are quite familiar because they appear often in other contexts or are similar to “old” items
    - Thus, there can be overlap between the distributions
  - Items that surpass a threshold (i.e. response criterion) of familiarity are judged “old”
Recognition Memory
Signal Detection Theory in Memory

- Everything more familiar than (to the right of) the response criterion ($\beta$ or $\beta$) will be judged “old.”
  - A centrally placed $\beta$ is unbiased.

- Everything less familiar (i.e. to the left of $\beta$) will be judged “new.”
  - Hits (in green)
  - Misses (in red)

- Above, the same distribution with the focus on the lure distribution to highlight:
  - Correct rejections (in green)
  - False alarms (in red)

- $D$ prime ($d'$) represents:
  - The distance between the distributions
  - The participant’s ability to discriminate the two distributions
Recognition Memory
Signal Detection Theory in Memory

- A more *liberal* guesser will:
  - Have a response criterion shifted to the left
  - Accept more targets as “old” (i.e. hits)
  - Accept more lures as “old” (i.e. false alarms)

- A more *conservative* guesser will:
  - Shift β to the right
  - Have fewer hits
  - Have fewer false alarms

- Thus, the overlap in the distribution leads to:
  - Trade offs between hits and false alarms
    - *Depends on the placement of the response criterion*
## Recognition Memory

### Signal Detection Theory in Memory

<table>
<thead>
<tr>
<th>Pros</th>
<th>Cons</th>
</tr>
</thead>
<tbody>
<tr>
<td>- Signal detection theory:</td>
<td>- Signal detection theory fails to account for</td>
</tr>
<tr>
<td>- Provides mathematical tools</td>
<td>- The <strong>word frequency effect</strong> of recognition memory:</td>
</tr>
<tr>
<td>to estimate a person’s:</td>
<td>- Low frequency words are better <strong>recognized</strong>*</td>
</tr>
<tr>
<td>- Ability to discriminate “old”</td>
<td>- The theory incorrectly predicts low-frequency items should be</td>
</tr>
<tr>
<td>from “new” items (d’)</td>
<td><strong>harder</strong> to recognize because they are less familiar</td>
</tr>
<tr>
<td>- Bias to guess (β)</td>
<td></td>
</tr>
<tr>
<td>- Corresponds with our intuition that we have a sense of an item’s “familiarity”</td>
<td></td>
</tr>
</tbody>
</table>

*Note: High-frequency words are easier to recall*
Recognition Memory

Dual-Process Accounts

- Since *familiarity* alone can’t easily account for such findings, theorists have posited two separate components of recognition memory:
  - **Familiarity:**
    - A sense of *knowing* something without being able to remember the context
    - Fast and automatic
    - Based on perception of a memory’s strength
      - Characterized by signal detection theory
  - **Recollection:**
    - *Remembering* contextual details about a memory
    - Slower and more attention demanding
    - More like cued recall
Recognition Memory

Evidence for Dual-Process Accounts (Yonelinas et al., 2002)

- Recollection, being an attention-demanding process, is selectively disrupted by:
  - Divided attention during encoding
  - Divided attention during recognition
  - Advanced age and damage to the prefrontal cortex

- Familiarity is usually faster than recollection
  - Supports the notion that familiarity is an automatic process, unlike recollection
Recognition Memory
Dissociating Recollection and Familiarity

- **Remember/Know Procedure** (Tulving, 1985)

  - **Task:**
    - For each test item, participants decide whether they recognize an item based on the subjective feeling that they:
      - **Remember** it being presented previously:
        - They can recollect contextual details of seeing the item
        - Taken as a measure of recollection
      - **Know** it was presented previously:
        - The item seems familiar, in the absence of specific recollections
        - Taken as a measure of familiarity
Recognition Memory
Dissociating Recollection and Familiarity

- **Process Dissociation Procedure** (Jacoby, 1991)
  - *Task:*
    - Participants study two sets of items in different contexts
    - Two different recognition tests follow:
      - **Inclusion Condition:**
        - Say “yes” if they recognize an item from either context
        - Correct recognition = **Recollection** + **Familiarity**
      - **Exclusion Condition:**
        - Say “yes” only if they recognize an item from one of the two contexts
        - **Familiarity** = False alarms in exclusion condition
        - **Recollection** = Inclusion’s correct recognition minus **Familiarity**
Source Monitoring

- **Source Monitoring**: Examining the *contextual origins* of a memory to determine whether or not it was encoded from a particular source (or was derived from a real or an imagined experience)

- The process is supported by:
  - Recollection
  - Exploiting regularities in the types of information from different sources, for example:
    - Auditory memories are distinguished by more auditory information (as opposed to visual)
    - Real memories are distinguished by more perceptual details
Source Misattribution Error

- **Source Misattribution Error:**
  - Falsely judging that a memory originated from a particular source
  - May be partially responsible for delusions
  - Henkel, Franklin, and Johnson (2000)
    - **Task:** Asked people to form a mental image of a visually presented word
    - **Results:** People who formed a mental image were more likely to mistakenly claim they saw a picture, rather than the printed word