Psychological Mechanism

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Human information-processing system

- two main constructs in contemporary memory theory:
  1. working memory
  2. long-term memory
     a. semantic memory
     b. episodic memory
Working memory

• The temporary storage of information that is being processed in any range of cognitive tasks (Baddeley, 1986).

• It is used to hold information for a short period of time as well as to perform various operations on the stored information.

➔ Working memory has two functions: storing and processing.
• As regards its storing function, WM is only able to hold about *seven* units of information.
• Since many sentences are longer than seven words, we need some way to deal immediately with more than seven words.
• One way we do this is to *chunk* the words into grammatical constituents such as Noun phrase
  • [e.g., My sister, My sister’s boy, My sister’s little boy, etc.] or Verb phrase [e.g., Bought a book, Bought a book of deserts, Bought a book of chocolate deserts, etc.],
• Thereby reducing the storage burden to perhaps two or three constituents.
Measuring working memory: memory span test
Participants are given a series of items (words, letters, numbers, and so forth) and asked to recall the items in the order presented. Sometimes they are asked to recall them in backward order. A person’s memory span is the number of items that can be reliably recalled in the correct order.
The Baddeley-Hitch Model of WM

1. *Central executive* determines what activities visuospatial sketchpad and phonological loop should be doing at any given time determining info that will be stored in WM

2. *Visuospatial sketchpad* temporarily maintains and manipulates visuospatial information

   This component is responsible for holding visual and spatial information for short periods of time, so that it can be used during thinking, remembering and processing tasks (Logie, 1995).
3. **phonological loop**
   
   - **phonological store**
     
     is the area of the system in which speech material is held for short periods of time
     
     it simply holds the information; and ‘time-limited’, because the information fades rapidly
   
   - **articulatory rehearsal** mechanism is used to recite the information in the phonological store, thus prolonging their stay in the phonological store
     
     Baddeley describes the articulatory rehearsal mechanism as like a tape loop or a tape recorder with a two-second duration. The recitation processes can prevent the material decaying, by constantly refreshing it.
### Stroop task: NAME THE COLOR OF THE INK

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Stroop Demonstration

• Look at the following words and say each word as quickly as you can:
WHITE
RED
GREEN
BROWN
Stroop Demonstration, cont.

• Now look at the following words and say the *color* of the font, not what the word says, as quickly as you can.
WHITE

RED

GREEN

BROWN
Long term memory

– a memory structure that holds permanent knowledge

– **Declarative**
  • **Episodic** - memories about events
  • **Semantic** - knowledge of facts

– **Procedural** - memories about how to do things (e.g., the thing that makes you improve at riding a bike with practice).
Semantic memory

- Refers to our organized knowledge of words, concepts, symbols and objects; it includes our general knowledge (grammar, arithmetic), spatial knowledge (the typical layout of a house), social knowledge (how and when to be polite), etc.

- Semantic memory holds the information that is not tagged for a particular time or place (e.g., it holds the information that horses have four legs and a tail but not the memory of the last time you went horseback riding)

- To process language, we need to have knowledge of language that stored in our semantic memory. This would include knowledge of sounds, words, syntactic rules, as well as pragmatic aspects of language.
Episodic memory

- The division of permanent memory in which personally experienced information is stored.
- Holds traces of events that are specific to a particular time and space.
- This is the memory we use to keep a record of our personal experiences;
- It includes such items as what you had for breakfast this morning, what you were doing when you learned a man walked on the moon, or where you got your first job. (As these examples illustrate, episodic memory varies from person to person, and is constantly updated)
Roles of long-term memory

• Semantic memory contains information on the speech sounds and words that we retrieve during pattern recognition.

• While this process is going on, we are also building up an episodic memory representation of the ongoing discourse. That is, once we complete the processing of a given sentence, we might extract the gist of it and store that in episodic memory.
Central issues in language processing

• In this section, we examine several alternative ways in which linguistic information can be handled by the information processing system that we have just sketched above.

• Different types of process will first be presented and discussed individually, before being applied to an extended example of language processing.
Serial & parallel processing

• **Serial processing** refers to processes that take place one at a time.

• **Parallel processing** refers to processes two or more of which take place simultaneously.

• Suppose we wish to develop a model of language production.

  The starting point is the idea that the speaker wants to convey; the ending point is the actual articulation of the idea. But what happens in between?
• A serial model would divide the process into stages.
• There might be a stage devoted to building up the phrase structure of the sentence, another stage devoted to retrieving the lexical items that are inserted into that structure, and still another stage devoted to determining the correct pronunciation of these lexical items.
• The serial model would assume that these stages occur one at a time, with none overlapping.
• A *parallel model*, on the contrary, would assume that all of these processes could take place at the same time.

• That is, we could be phonetically specifying one word while we search for the next word, or both of these processes could take place as we flesh out the syntactic structure.
Example

• In example [1], we interpret the middle letter as an /h/ in one word, but as a /a/ in the other, despite the fact that the letter is physically identical in the two cases.
• The other examples [2] to [5] show degraded letters. It is not difficult, however, to identify what the word is in each case.
• The three degraded letters in example [2] can be identified respectively as /r/, /e/ and /d/; but the same three degraded letters appearing in the other examples are rather identified as /p/, /f/ and /b/. 
• At first glance, all this may appear to be paradoxical.
• It seems reasonable to say that we are using the context to help decide the identity of the degraded letters.
• However, that context is a word, and we normally think of first identifying the letters before identifying the word.
• How can we use the word to help identify the letter?
• The answer lies in *parallel processing*.
• Assume that we are identifying the individual letters, and at the same time, actively trying to fit the letters into various possible words.
• Some of the identified letters enable us to recognize the word as a familiar word, and then we identify the obscured letter from our knowledge of the spelling of the word.
• That is, we are processing at the letter and word levels simultaneously.
Top-Down and Bottom-Up processing

• Suppose you are listening to a lecturer, trying to comprehend what she/he says and remember the main points of the lecture.
• Your language processing can be analyzed as occurring at several levels.
• At the lowest level (the phonological level), you are identifying the phonemes and syllables that the teacher is using.
• At a higher level (the lexical level), you are using those phonemes and syllables to retrieve the lexical entries of the words from your semantic memory.
• At the next level (the syntactic level), you are organizing the words into constituents and you are forming a phrase structure for each incoming sentence.

• At the highest level (the discourse level), you are linking the meaning of a given sentence with preceding ones, and therefore you are organizing sentences into higher-order units.
• *Bottom-up processing* is a processing which proceeds from the lowest level to the highest level of processing in such a way that all of the lower levels of processing operate without influence from the higher levels.

• [This means that the identification of phonemes is not affected by the lexical, syntactic or discourse levels; it means that the retrieval of words is not affected by syntactic, and so on].
• A *Top-down processing* model, in contrast, states that some information at the higher levels may influence processing at the lower levels.

• For example, a sentence context may influence the identification of words within that sentence.
• We may say that a top-down model of processing is one in which one’s expectations play a significant role.

• If you know where a lecturer is going—based on previous experience with the instructor or maybe even by reading the text in advance of the lecture—then you can generate some expectations regarding what the next point might be. If you are correct, then you are using the higher levels of processing to facilitate lower levels of processing.
Automatic & controlled process

- Automatic process: doesn’t require any processing capacity
  - Require little attention
  - Obligatory
  - Fast

- Controlled process: requires processing capacity
  - Require resources
  - Under some volitional direction
  - Slow, effortful
Example

• One language processing task that is automatic, at least for adults, is recognizing common words, most probably due to our large amount of experience with words.

• In contrast, building up a phrase structure for a sentence is a controlled process.
Modularity

- Within linguistics, the concept of modularity refers to the independence of the different linguistic subsystems within the grammar.
- For example, a modular view of how we comprehend sentences is that we apply syntactic principles first and then utilize semantic knowledge. The interactive position is that both semantics and syntax are used simultaneously.
Example of language processing

[1] I was afraid of Ali’s powerful punch, especially since it had already laid out many tougher men who had bragged they could handle that much alcohol.

• Sentence [1] is another example of a “garden path sentence”

• The key word here is “punch”, which can mean either an alcoholic beverage or a boxing punch.

• The subjective impression for most people at the end of the sentence is: (a) I have assumed the wrong meaning (most probably because of “Ali” who is a famous boxer), and (b) I have to backtrack.
• A processing model that would account for such impressions might look like this:
  • when we encounter a word that has more than one meaning, we survey the immediate environment of that word, make a rapid decision as to the most appropriate meaning, and then stay with that meaning unless it becomes obvious that we are in error.
  • This model corresponds reasonably well with subjective impressions, but are these impressions accurate?
  • This model assumes *serial processing* (one meaning at a time), with *top-down processing* playing only a limited role (decision is based on immediate context, not the entire sentence).
• Because the emphasis is on decisions the comprehender must make during the course of comprehension, the model emphasizes controlled processes more than automatic processes.

• Nonmodular → common sense, relies on our general ability to figure things out, not specific to language