Short Term Memory vs. Working Memory

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Memory can be classified in different ways. In 1980, William James described two types of memory: primary and secondary. Primary memory refers to the "memory for events that have just happened" (Andrade & May, 2004, p. 59). Primary memory which is now referred to as short term memory (STM) is temporary and transient. On the other hand, secondary memory refers to the "memory that happened some time ago" (ibid.) secondary memory is permanent and long-lasting and it is now referred to as long-term memory (LTM) (Andrade & May, 2004). The distinction between STM and LTM is mentioned in Anderson (1995) as follows:

- Rehearsal of information in short-term memory builds up a representation of that information in long-term memory.
- The types of encodings are different in short-term and long-term memory.
- There is a dramatic difference in the durations of short-term and long-term memory. (p. 161)

Anderson asserts that each of these claims is based on empirical data.

A classical model of memory developed in 1968 by Atkinson and Shiffrin. Figure 1 illustrates their model. As seen in the figure 1, incoming information comes into STM. It was supposed that STM has several slots (around four). Every time information is rehearsed there is a chance for it to be transferred into LTM. Thus, the more rehearsal, the more retention would be. As there is a limited number of slots in STM, each time a new item comes to STM, an old item is decayed or transferred to LTM by rehearsal. The classic example is a telephone number which is kept in STM while repeating. (Anderson, 1995). "The Atkinson and Shiffrin theory is of only historical interest now" (ibid., p. 30).

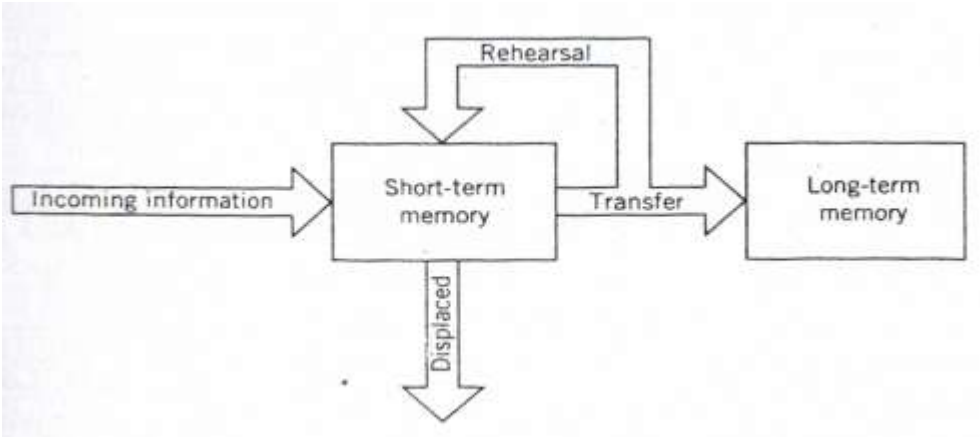

Fig.1: The Atkinson and Shiffrin's (1968) theory relating short-term and long-term memory (Anderson, 1995)

Today, many theorists use the concept of working memory (WM) to replace the concept of STM. WM is a theoretical construct proposed by Baddeley and Hitch (1974) as cited in Andrade and May (2004). This new model of STM "shifted the focus from memory structure to memory processes and functions" (p. 65). To put it another way, WM refers to both structures and processes used for storing and manipulating information. Kail and Hall (2001) cites Cowan (1988, 1995) who argues that "WM includes STM as well as the attentional processes used to keep some STM context in an activated state" (p.1). Similarly, Engle, Kane, and Tuholski (1999) as cited in Kail and Hall (2001) argues that WM is "a system consisting (a) a store in the form of long-term memory traces active above threshold, (b) processes for achieving and manipulating that activation, and (c) controlled attention" (ibid.). Thus, "STM is a subcomponent of WM" (ibid.) and to formulize it Kail and Hall (2001) proposes "WM = STM + attention" (ibid.). To

the researcher; however, a better formula would be WM = storage + manipulation.

In the model proposed by Baddeley and Hitch (1974, 2000) as cited in Andrade and May (2004), there are four components: central executive, visuo-spatial sketchpad, episodic buffer and phonological loop. Figure 2 demonstrates their model.

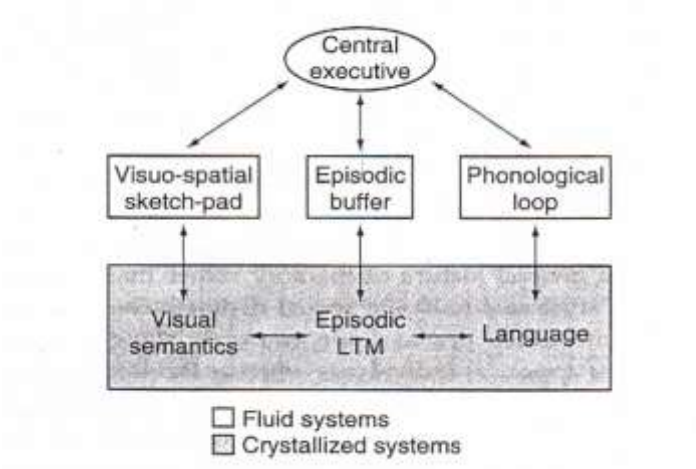

Fig.2: Baddeley's model of working memory (Andrade and May, 2004)

The phonological loop (PL) stores phonological information (sound-based information). It is also referred to as verbal short term memory. Here the phonological information is prevented from decay by continual repetition and rehearsal which is called articulatory loop. "Information is thought to decay from the store in about 2 seconds unless rehearsed" (p. 66) and there is a limited capacity of 7 plus or minus 2 items. Here, time plays an important role that is "words that take longer to say are harder to recall than shorter words" (p. 67). This is called the "word length effect" (ibid.). Cook (2001) puts that "the faster a person can repeat things, the more they can remember. Memory span is restricted by speed of articulation" (p. 84). He continues that "fast speakers have better spans than slow speakers" (ibid.).

As the name implies, visuo-spatial sketch pad (VSSP) stores visual and spatial information. Accoding to Andrade and May, research findings support the claim of a separate visuo-spatial STM.

Episodic buffer (EB) is a newer component added to this model in 2000 and according to Andrade and May (2004), it is in its infancy. However, this component accounts for the integrated information from VSSP and PL and possibly information from LTM. It combines information into a unitary episodic representation (Andrade and May, 2004).

The central executive acts as a central system enabling information in the subsystems (PL, VSSP, and EB) to be used in complex cognitive tasks. It is thought that the central executive is responsible for directing attention, co-coordinating concurrent tasks, retrieving from LTM, suppressing irrelevant information, selecting appropriate strategy and task switching (Andrade and May, 2004). "There is currently debate about whether these processes are functions of a unitary central executive, or whether there are several executives _ an 'executive committee'" (Andrade and May, 2004, p. 68).

In Baddeley and Hinch's model, WM serves as a gateway into LTM, receiving information from sensory processes and transferring it to LTM. However, there are other theorists (e.g., Cowan) who believe that WM is not a separate system but a part of LTM. They argue that STM is the activated subset of LTM (Andrade and May, 2004; Kail & Hall, 2001; Robinson 1995).

Measurement

To measure verbal STM, a *digit span* task is often used, requiring participants to listen to a list of digits and repeat the list immediately. *Matrix span* task is used to measure visual STM. Here the participants view a grid of black and white squares for a few seconds and then they are supposed to recall which squares were black by marking the appropriate squares on a blank grid. The *Crosi blocks test* measures special STM. The experimenter taps a square of blocks from among nine blocks and then the participant tries to replicate the square, that is tapping the same blocks in the same order (Andrade and May, 2004). According to Andrade and May (2004), there is disagreement about how best central executive can be measured. However, tests such as *random number generation* are used for research. On the other hand, *working memory span* task or complex span tasks are used to measure the overall efficiency of working memory. For example, in reading span task which is considered a complex span task, participants read sets of sentences and they are supposed to remember the last word from each sentence in the set (Andrade and May, 2004; Kail & Hall, 2001). Interestingly, factor analysis revealed that the simple span tasks (such as digit span) and complex span tasks (such as reading span) loaded on separate factors that were interpreted to reflect STM and WM, respectively. In addition, the factors were strongly correlated (Kail & Hall, 2001). Therefore, it seems that WM and STM are distinct but related and "WM plays a greater role than STM in higher order cognitive processes" (ibid., p. 2).

Contribution to Language Learning

As far as language learning is concerned the following claims are made:

- "Good Pl function is important for language learning" (Baddeley, Gathercole & Papagno, 1998 as cited in Andrade and May, 2004, p. 68).
- Strong correlation between working memory span and reading ability is shown (Daneman & Carpenter, 1980 as cited in Andrade and May, 2004).
- WM span correlates with measures of intelligence (Andrade and May, 2004).
- WM span correlates with ability to ignore irrelevant information (Andrade and May, 2004).
- WM may be the most important variable in predicting success for learners in many language learning situations (Ellis, N., 2006; as cited in Lightbown and spada).
- "In a second language, memory span is reduced" (Cook, 2001, p. 82).
- L2 learners' span increase as their English improves. However, they are usually slightly below the usual native speaker span even at advanced stage (Figure 3) (Cook, 2001).

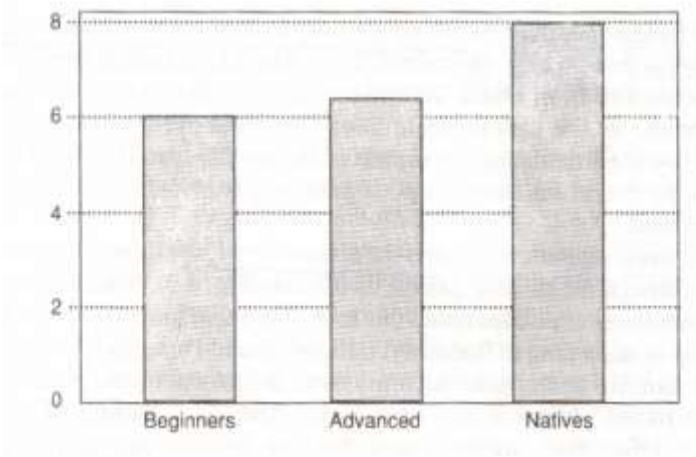

Fig.3: STM in L2 learners (Cook, 2001)

To sum up, STM refers to the ability to hold information in mind over a brief period of time. As concept of STM has expanded and it includes more than just the temporary storage of information, psychologists have created new terminology, working memory. The term WM is now commonly used to refer to a broader system that both stores information and manipulates it. However, STM and WM are sometimes used interchangeably (Hudson, 2008; Lightbown & Spada, 2006).

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