

Ch. 5 Working Memory

Baddeley's Working Memory

- Alan Baddeley (1970s)
 - WM redefined STM to focus on functionality rather than duration
 - Working SEPARATE from short term (in hippocampus)
 - Working memory does more than store—it is a multi-part system that holds and manipulates information
 - Performs mental operations like language comprehension, mental arithmetic, problem solving and decision making
- Working memory model
 - Separate capacities for verbal and visual information- phonological loop and visuospatial sketchpad
 - Central executive is the manager, tells other two what to do
 - Episodic buffer added in 2000



Independent Capacities

- **Baddeley & Hitch (1974)**
 - Subjects asked to make simple true/false decisions about spatially arrayed letters
 - For example, shown "BA"
 - Asked to decide whether the statement "B does not follow A" was t/f
 - Digit span task
 - Before each trial subjects were given 6 to 8 digits to memorize
 - Asked to recite the digits after spatial reasoning task
 - Proposed that if there is only one short term store, performance on spatial task should decline with addition of digit memorization
- Findings---

- With addition of digit memorization, subjects took slightly longer to answer but made no more errors
- Conclusions—
 - There are separate memory systems for verbal and visual working memory
 - Can do one verbal and one visual task at once, but not 2 verbal or 2 visual
 - Storage systems are coordinated by central control system that balances between processing and storage

Phonological Loop

- Phonological loop
 - Deals with spoken and written material
 - Processes language, sounds, subvocalization (the process of saying words in your head while reading- transforms written info to auditory)
- Two components
 - **Phonological store**
 - Passive, short term store of auditory information- holds info in speech based form
 - “Inner ear”- linked to speech perception
 - holds onto information but forgotten unless it is actively rehearsed/refreshed
 - **Articulatory loop**
 - Actively rehearses and refreshes info from the store
 - “Inner voice”- linked to speech production, also convert written material into articulatory code

Phonological Similarity

- **Phonological similarity effect**- when items sound the same they are phonologically similar- it is more difficult to store those items in working memory, causes confusion
- Demonstration
- Evidence of phonological store- phonological factors significantly affect the performance of the verbal working memory system

Word Length

- Articulatory processing of the phonological loop- the “speaking” of items by the inner voice for rehearsal- effected by word length
- **Word length effect**- performance on a recall task is worse when the items to be maintained are long words vs. short words
 - University, individual, operation, idiosyncrasy, allegation
 - Yield, brake, song, stage

- Key factor is not the number of syllables but rather the time it takes to pronounce them
 - Performance is worse for two-syllable words that have long vowel sounds
 - Long vowel= harpoon, voodoo
- Evidence of articulatory loop- pronunciation time affects the speed of silent rehearsal (not number of syllables)
- Elle & Hannelley (1980)
 - Subjects- Welsh and English bilingual children
 - The names of the digits in Welsh have the same number of vowels as English, but the vowel sounds are longer and take longer to say in Welsh
 - Findings—in Welsh, the children scored significantly lower on digit span than in English

Damage to the Phonological Loop

- Studies of patients with brain damage (Vallar & Papagno, 1995)
 - Phonological storage impairments- associated with left inferior parietal damage
 - Evidenced by lack of auditory verbal working memory (memory span of one or two items)
 - For visually presented info, no phonological similarity effect
 - Articulatory rehearsal impairment- associated with left inferior frontal cortex damage (near Broca's area)
 - Evidenced by inability to maintain verbal memory
 - For visually presented information, no word length effect
- Evidence of separate brain regions for separate functions

Neuroanatomy of Phonological Loop

- Paulesu et al (1993)
 - Subjects- English speakers with no knowledge of Korean
 - Asked to memorize a series of six visually presented items, either English letters or Korean characters
 - No access to verbal associations with letters
 - Used **articulatory suppression**- asked to perform overt and irrelevant speech (i.e. repeat the word "the" over and over out loud)—interferes with verbal memory and rehearsal
- Findings
 - **Articulatory suppression**- impaired memory performance for the English letters but not the Korean letters
 - PET images- revealed increased blood flow in both left inferior parietal cortex (storage) and left inferior frontal cortex (rehearsal) only for the English letters