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- Notice! Everyone will be tested on:
 - Chapter 4 (Sensation and Perception, pp. 120-129 and pp. 147-149)
 - Chapter 5 (Memory; pp.168-211)
 - Chapter 7(Language and thought; pp. 266-293)
 - Chapter 8 (Consciousness; pp. 294-318).
- For Psychology Majors (taking Foundations):
 - Under “Unit Assignment” in Blackboard can find essay questions.

Plan for rest of the course:

- Three lectures on Long-Term Memory (LTM):
 - Distinguish between different types of LTM today.
 - Tuesday and Wednesday focus on episodic LTM
- Two lectures on Language:
 - Consider whether language is instinct or not
 - Theory of reading
- One lecture on Linguistic Relativity:
 - How language impacts on perception
- Essay Unit Tutorial (Oct 26nd).
 - For psychology students to talk about about essays (other students welcome to come, but not required).
- Review Lecture (Date to be announced)

Key Points for today's lecture:

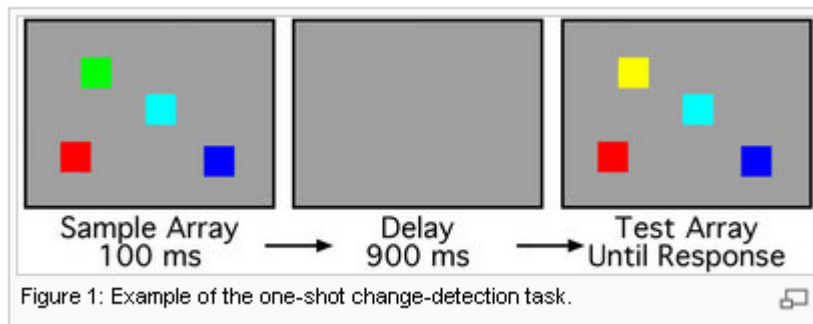
- Describe different types of Long-Term Memory (LTM) and highlight how LTM links to STM.
- Describe evidence that these different types of LTM are supported by different systems in the brain.
 - Evidence comes from dissociations.

Close links between STM and LTM:

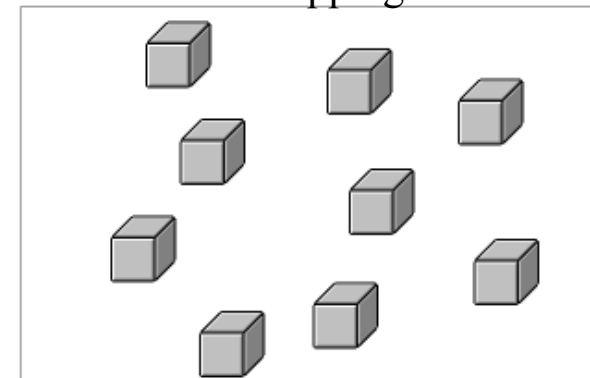
STM often divided into:

1. Phonological Loop (supports digit span)
2. Visuo-spatial Sketchpad

Standard visual memory task:
Change blindness task

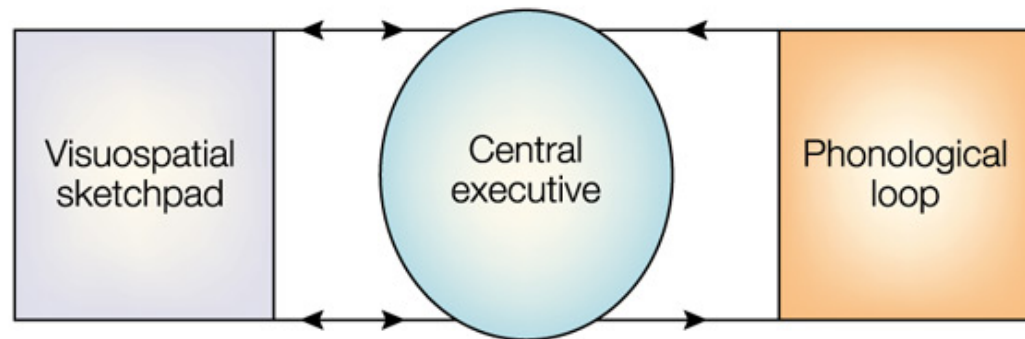


Standard spatial memory test:
Corsi block tapping test



3. Central Executive

- Classic “working memory model”

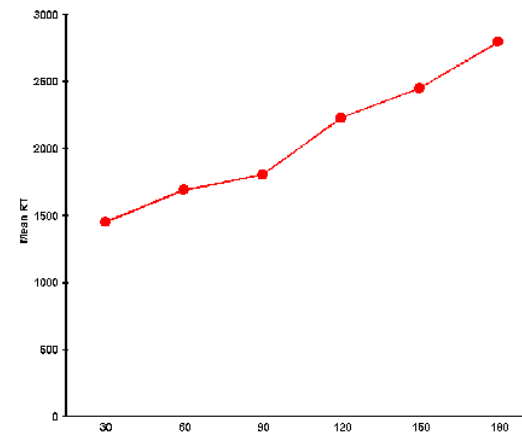
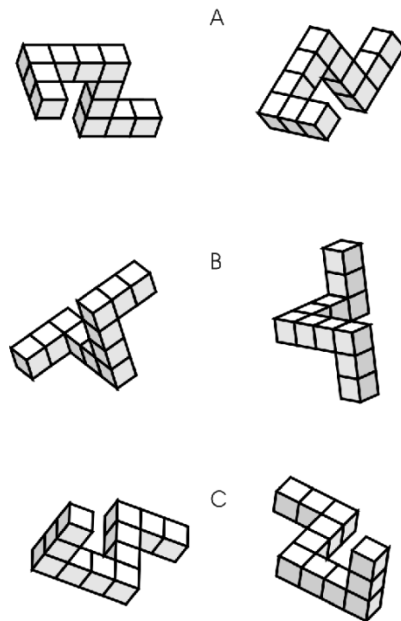


Baddeley, A. D., & Hitch, G. (1974). Working memory. *Psychology of learning and motivation*, 8, 47-89.

-Phonological loop and Visuospatial sketchpad support behaviour on tasks other than memory tasks

** Thus the term “working memory”

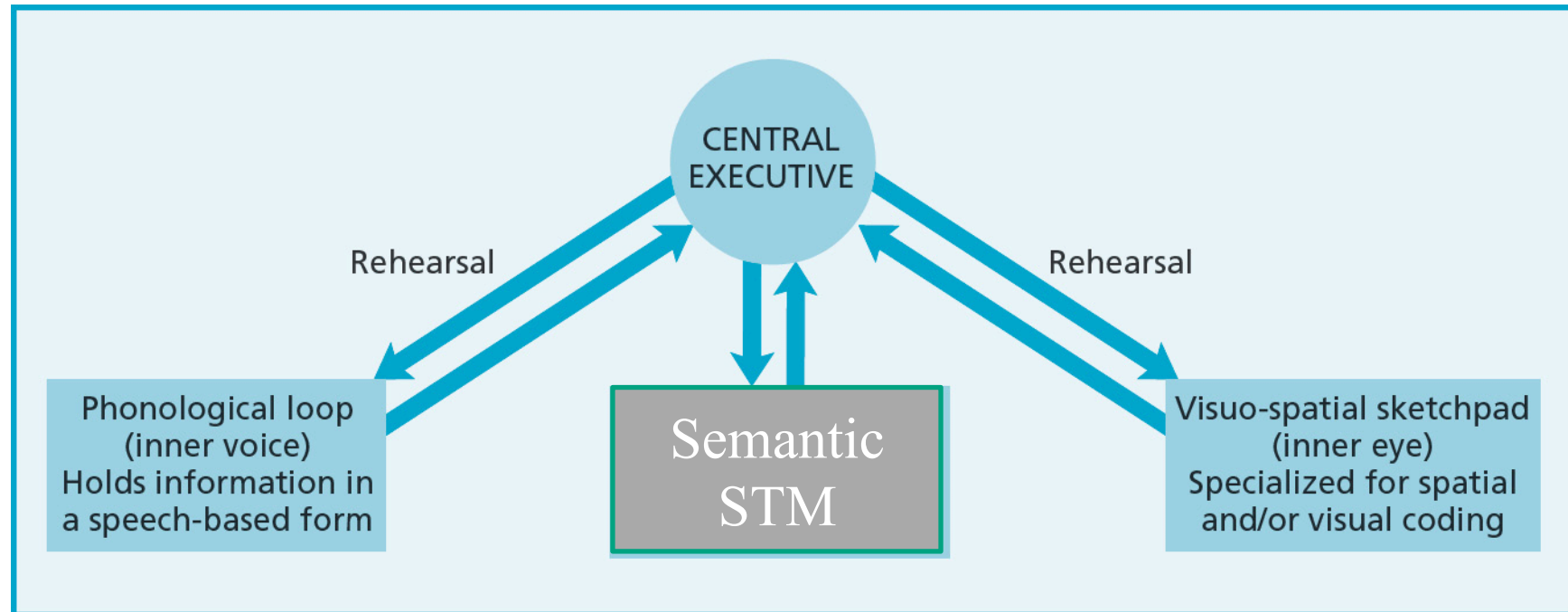
-Visual Working memory and reasoning about space:
e.g., Mental rotation relies on visual spatial sketch pad



Shepard, R. & Metzler, J. (1971). *Science*, 171, 701-703.

- STM may also contain a semantic component.
 - E.g., Martin, Shelton, Yaffee (1994). *Journal of Memory and Language*, 33, 83-111.
 - Patients have been identified who cannot repeat more than 1-2 words/numbers in a STM task but can speak normally in conversations.
 - When asked to repeat sentences verbatim they paraphrase.
- Suggests poor phonological STM, but good semantic STM that can store the gist of a sentence for a short time.
 - Also see: “release from proactive interference” for more evidence for semantic STM.

Might have to add another STM system to working memory model:



- One function of STM is to convert information into LTM.
 - Phonological STM → Phonological LTM
 - Visual-spatial STM → Visual LTM
 - Semantic STM → Semantic LTM

Phonological LTM

- Supports our ability to identify spoken words.
But no meaning associated with these memories.

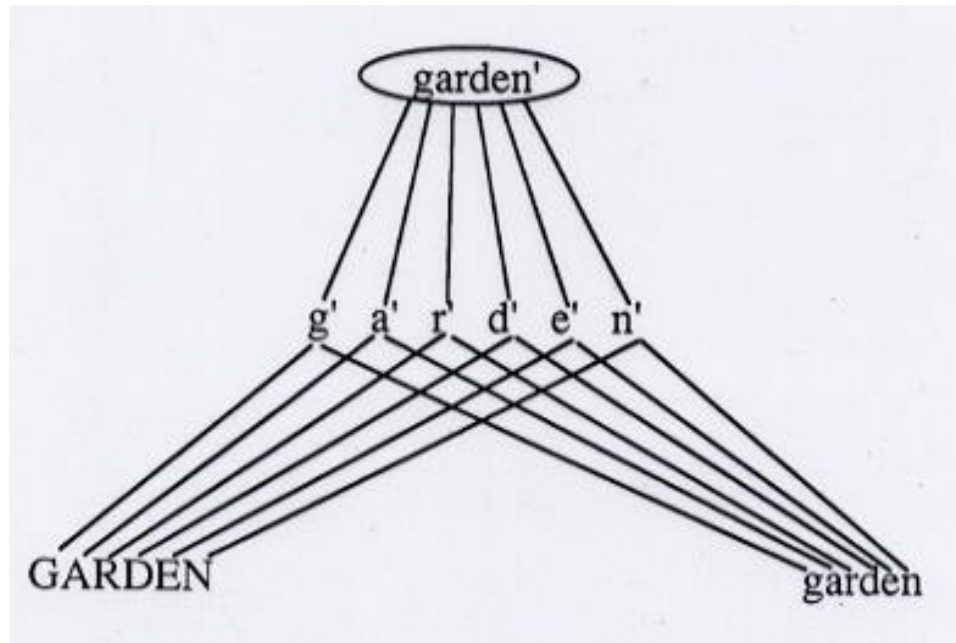


Phonological STM patients have difficulty learning new words in LTM.
Good predictor of literacy in children is nonword repetition.

Gathercole, S., & Baddeley, A. D. (1989). Evaluation of the role of phonological STM in the development of vocabulary in children: A longitudinal study. *Journal of memory and language*, 28, 200-213.

Visual LTM:

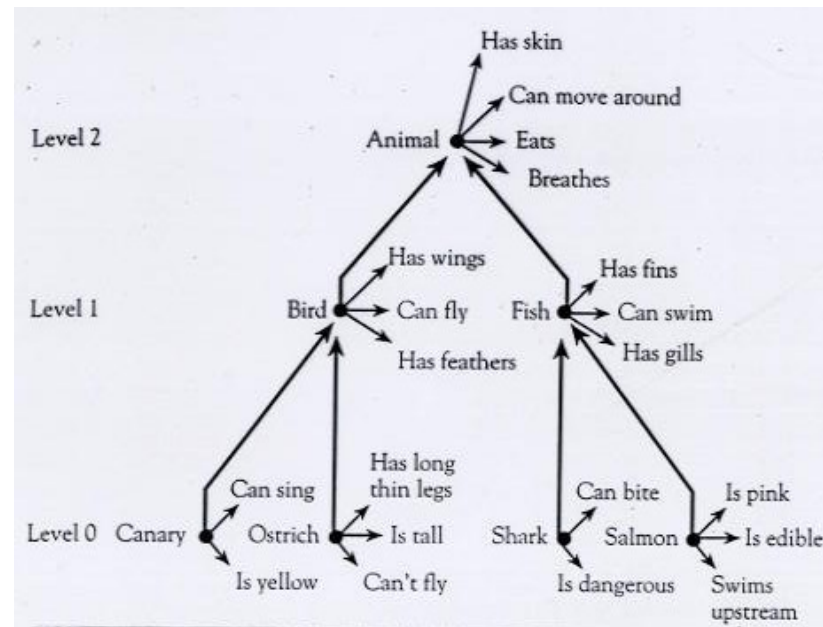
-Supports out ability to identify visual information, including written words, objects, faces, etc.



**Surprisingly little research exploring the link between visual STM and visual LTM. Jarrold & Baddeley (1997) *Cognitive Neuropsychiatry*, found that poor visual STM and poor route knowledge in persons with Downs Syndrome

Semantic LTM:

-Our knowledge of the meaning and function of words and objects.
Semantic memory supports inferences. i.e., an Ostrich breathes



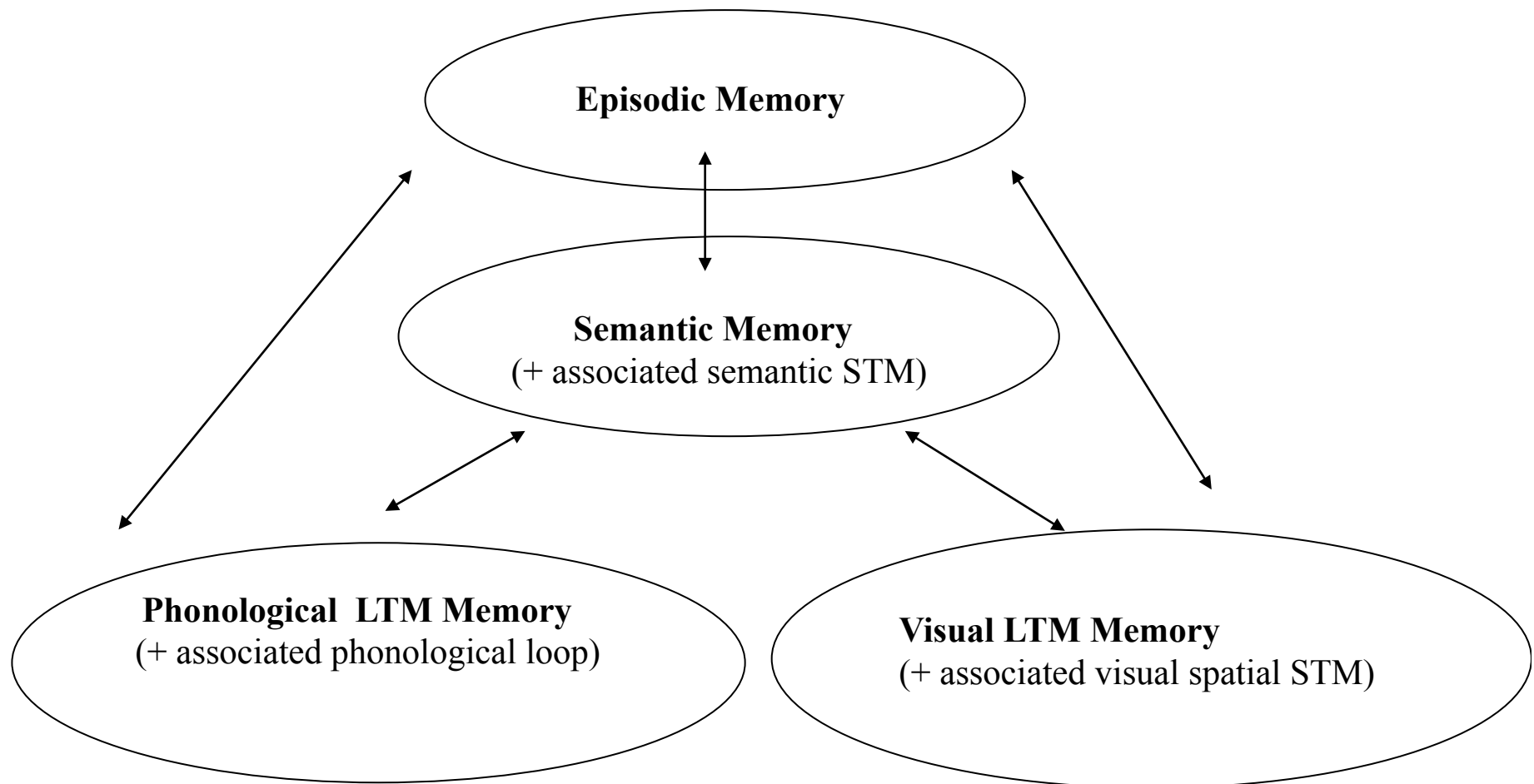
Semantic STM deficit leads to:

- Difficulty in learning new concepts
- Problems in understanding and producing complex meaningful sentences

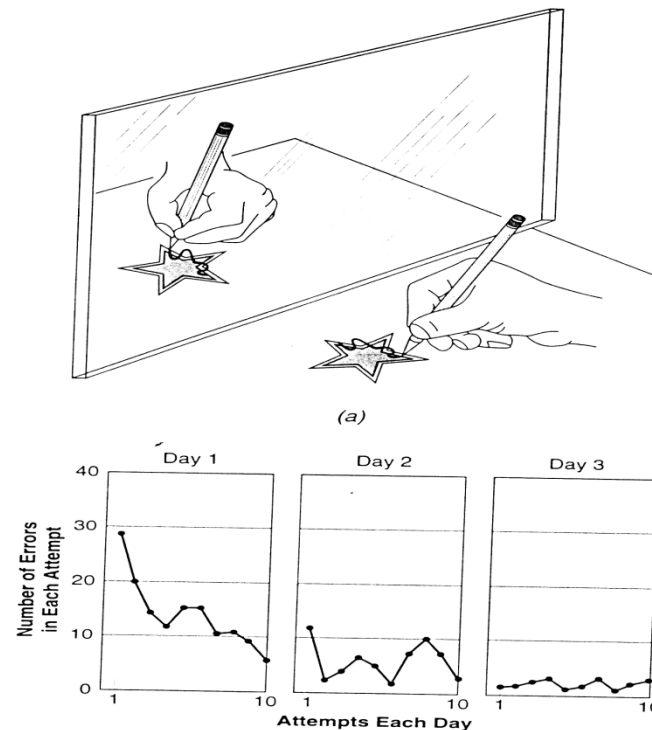
Freedman, M. L., & Martin, R. C. (2001). Dissociable components of short-term memory and their relation to long-term learning. *Cognitive Neuropsychology*, 18(3), 193-226.

Episodic Memory

- Links memories from various LTM systems to store an record of a personal event.

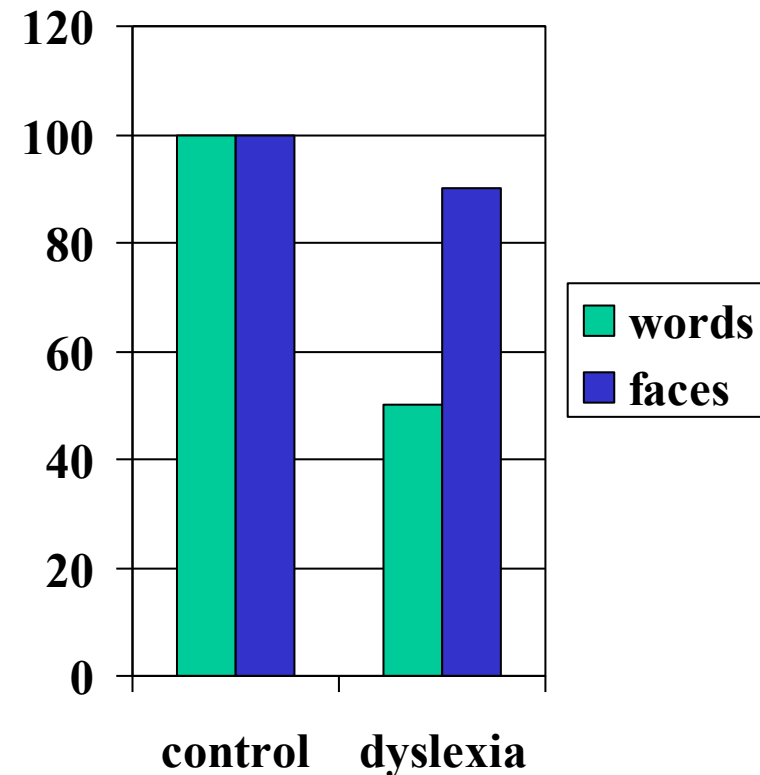


- In addition: Procedural memory
 - Learning skills over many trials (e.g., riding a bike)



Evidence for different LTM systems comes from dissociations

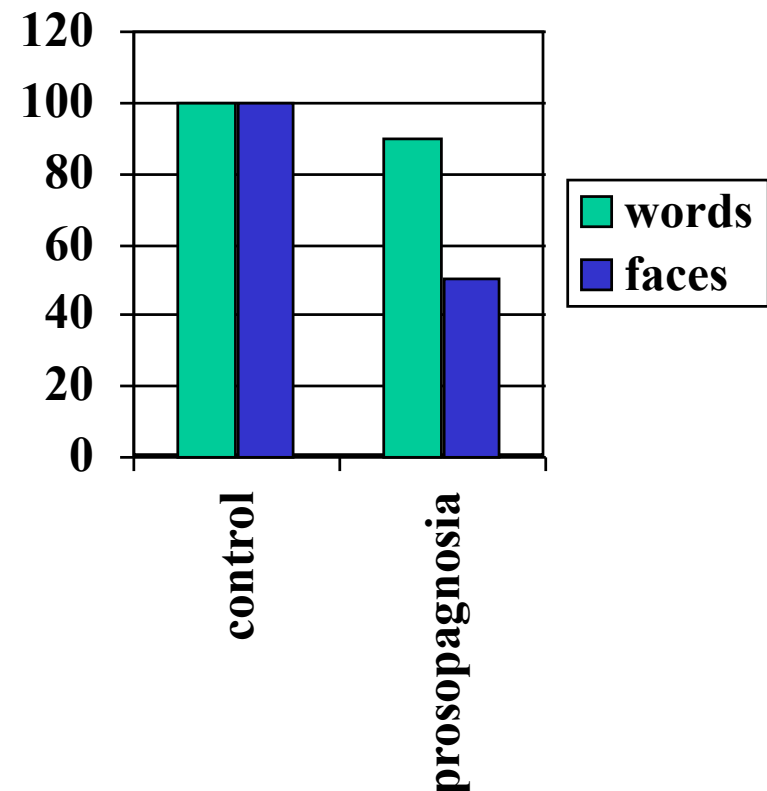
- Single Dissociation: An experimental manipulation or neurological impairment affects performance on Task 1, but not task 2.
 - For example: Dyslexic readers have a difficulty identifying words compared to control participants, but are fine in recognizing faces
 - But words just more difficult?



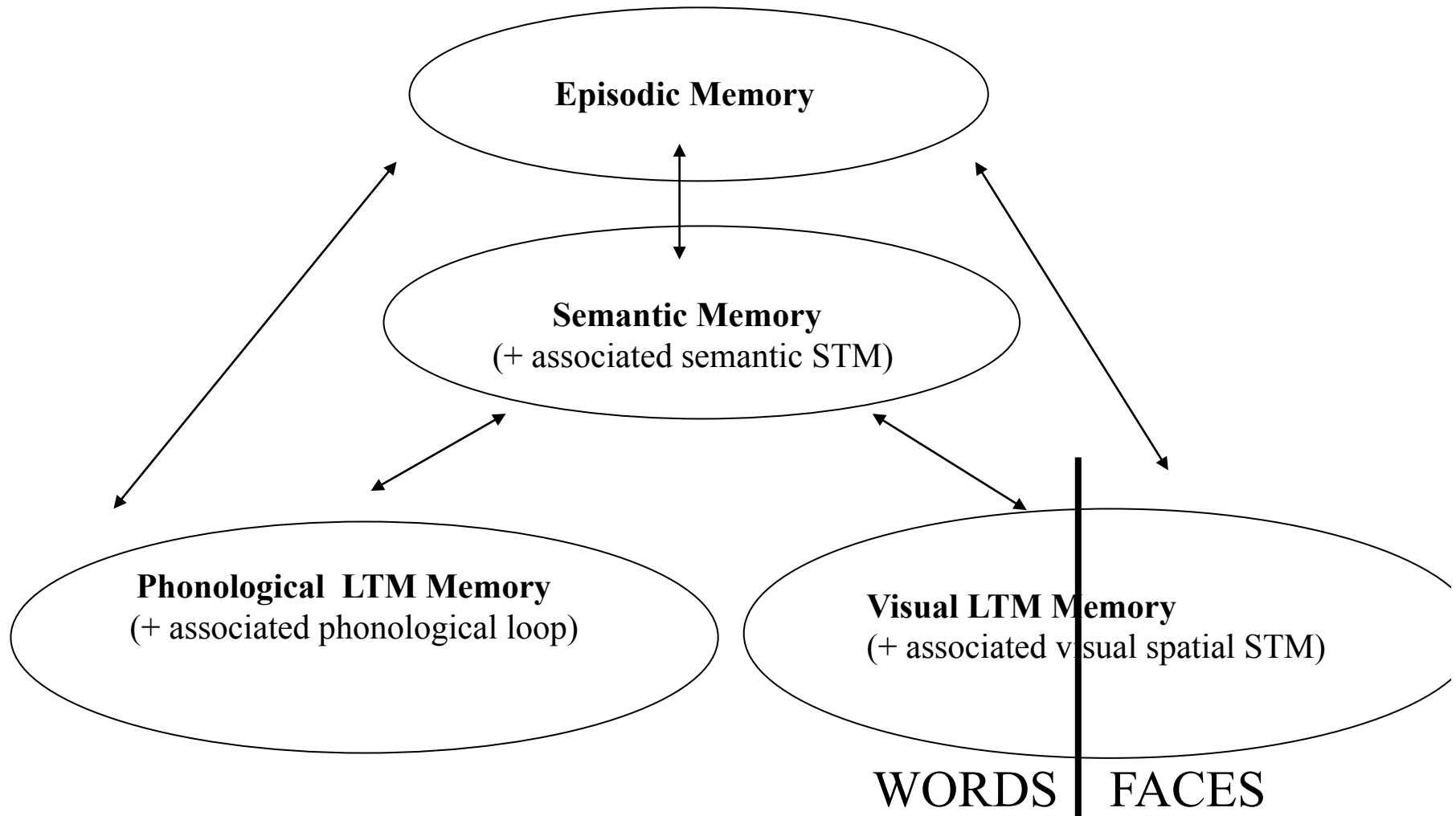
Task 1= Word ID, Task 2 = Face ID

Evidence for different LTM systems comes from dissociations

- Double Dissociation: **In addition**, another experimental manipulation or neurological impairment affects performance Task 2, but not Task 1.
 - For example, in prosopagnosia, the opposite pattern of results is obtained
 - This rules out difficulty argument!
- Suggests two types of visual LTM– visual LTM for words and faces.



Task 1= Word ID, Task 2 = Face ID

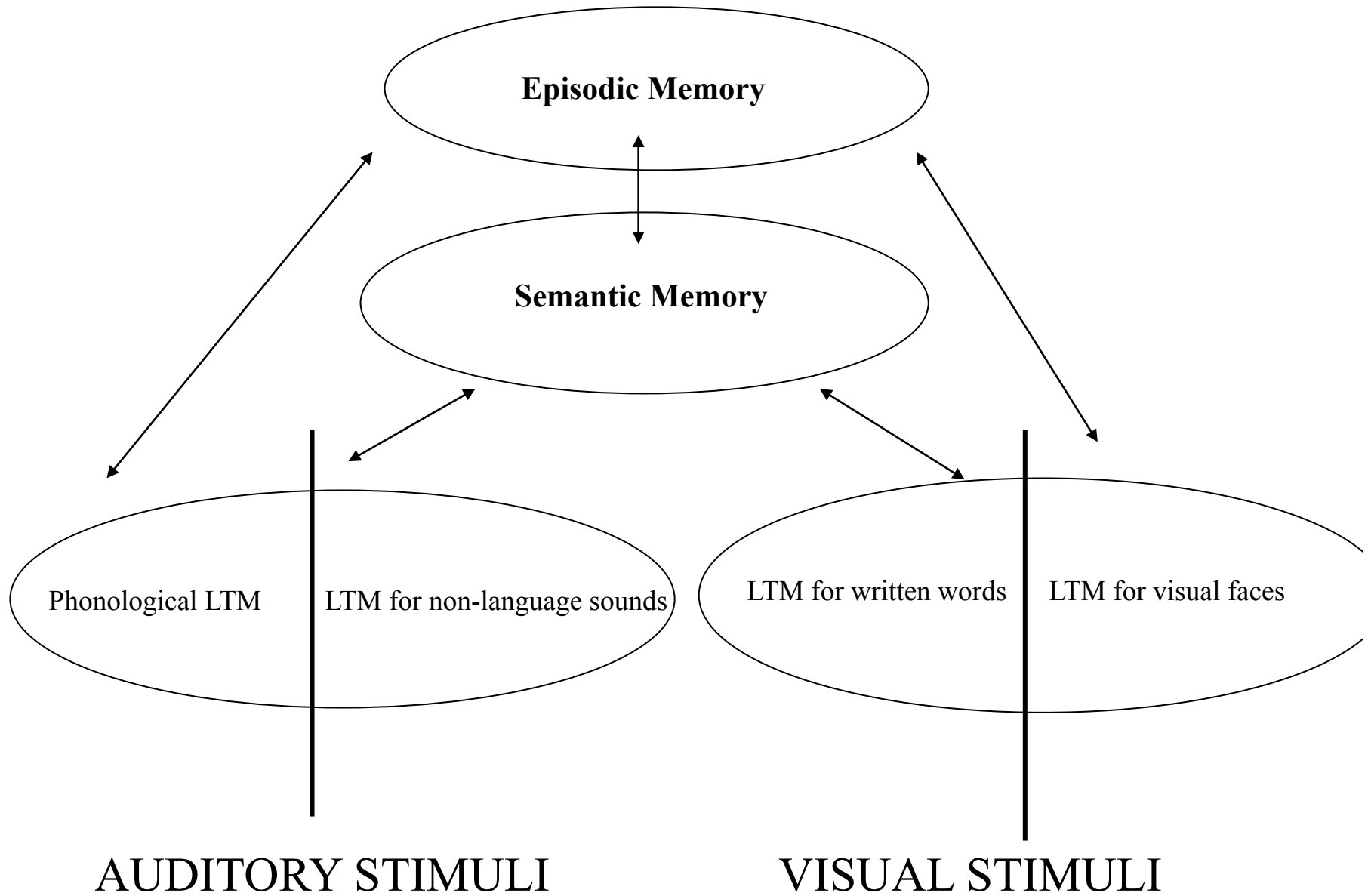


LTM system for sound stimuli can also be broken down:

- Pure word deafness: Patient cannot understand words, but can understand environmental sounds. E.g., can understand the sound “miaow” but not the spoken word “CAT”.
- Auditory agnosia: Can understand spoken words, but not environmental sounds.

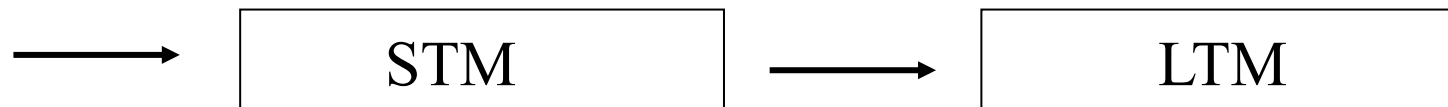
One patient says “Is it not strange that I can hear the clock ticking and cannot hear you speak?” and another says in response to the sound of a dog barking, “How come I can understand your voice but not these sounds?”

From: Coltheart, M. (2004). Are there lexicons? *The Quarterly Journal of Experimental Psychology Section A*, 57(7), 1153-1171



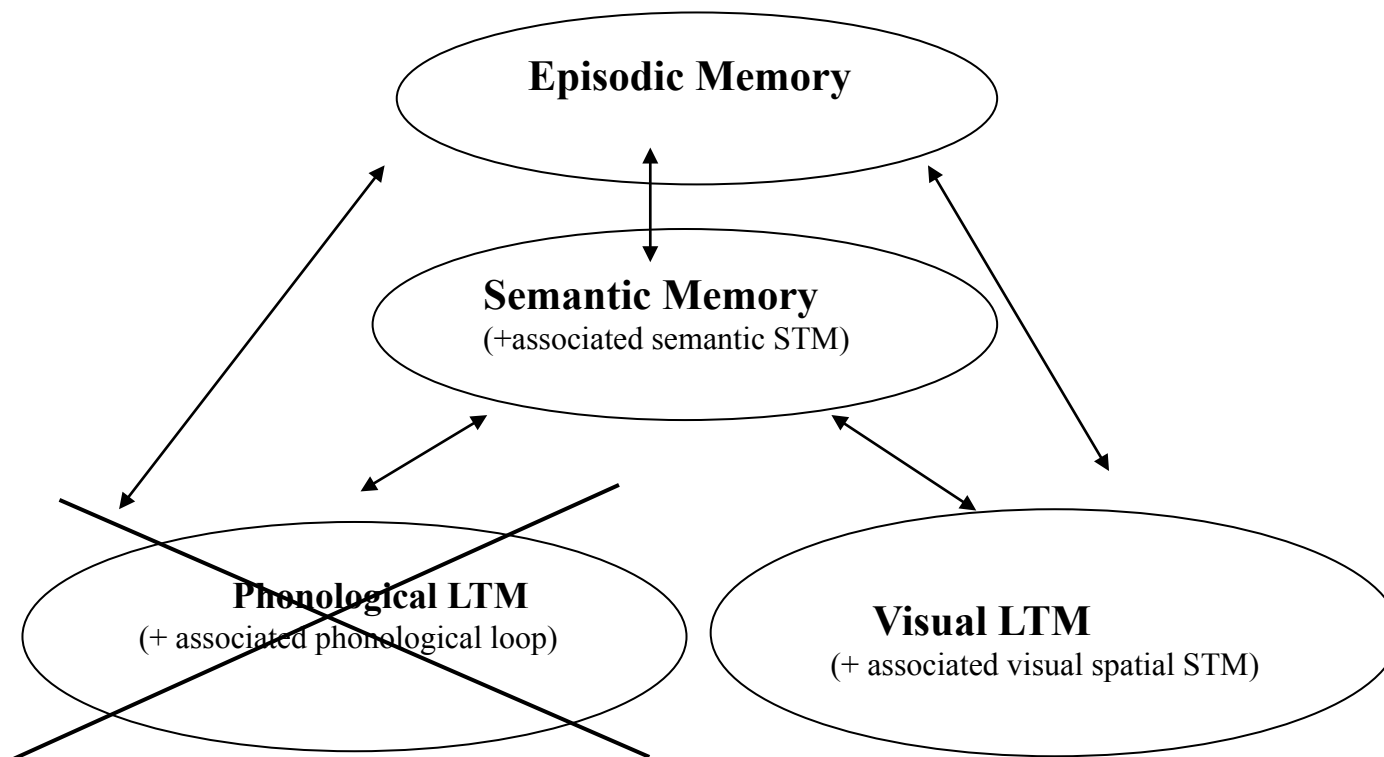
Dissociations between Episodic LTM and Phonological STM

- Anterograde amnesic patients (e.g., H.M.) have poor episodic memory and good phonological STM.
- Phonological STM patients have poor phonological STM but good episodic memory.
 - Double dissociation! Suggests that STM and episodic memory are different memory systems.
- Does this contradict the view that information first stored in STM before being transferred to LTM?



*** NO!!!

- Patients with phonological STM deficits do have difficulties learning new phonological LTMs. But episodic memory can be supported by other STM systems



Dissociations between Episodic LTM and Procedural Memory

- Amnesia selectively affects episodic memory. Procedural memory is fine.
- Parkinson's and Huntington's Disease selectively affects procedural learning.
 - Together, these two sets of results constitute a double dissociation.

Performance of undergraduate students when pressing buttons in response to lights presented in various locations. This is a form of procedural memory (learning with repeated trials)

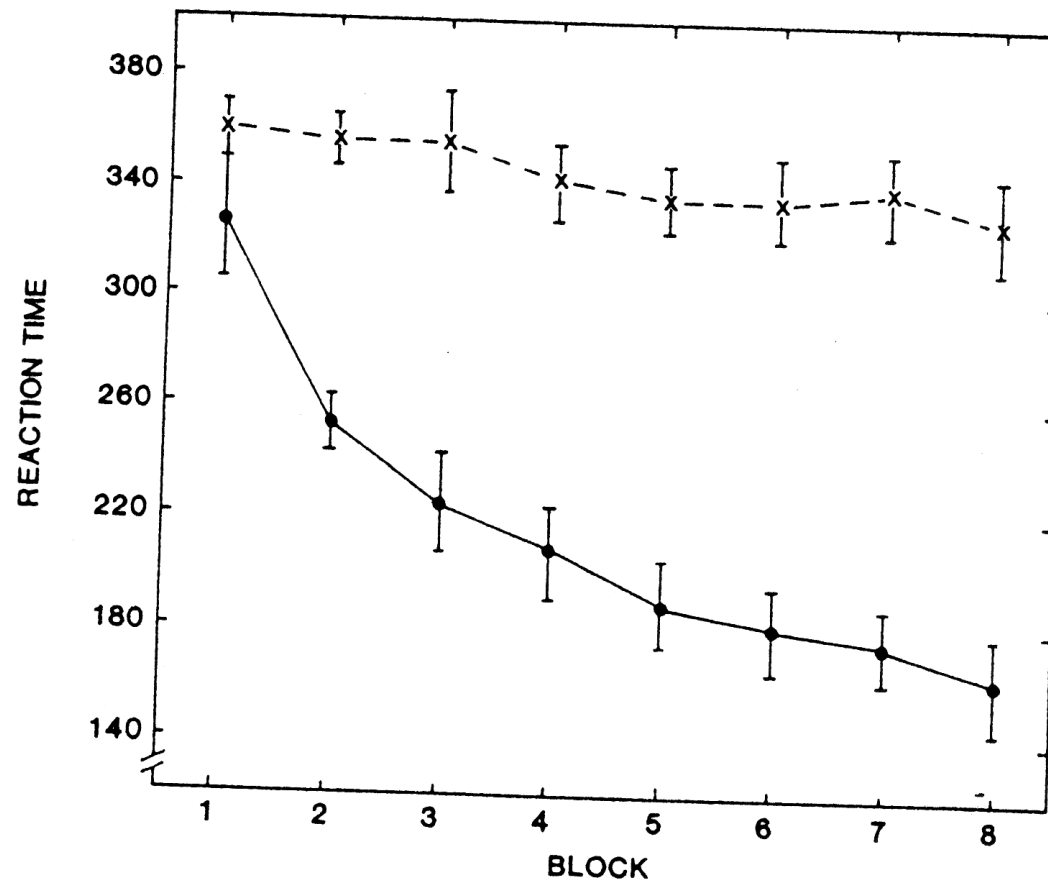


FIG. 1. Mean of median reaction time in milliseconds in each block of Experiment 1. Filled circles: repeating sequence; x's: random sequence. Bars represent standard errors.

Performance on this task is preserved in amnesia

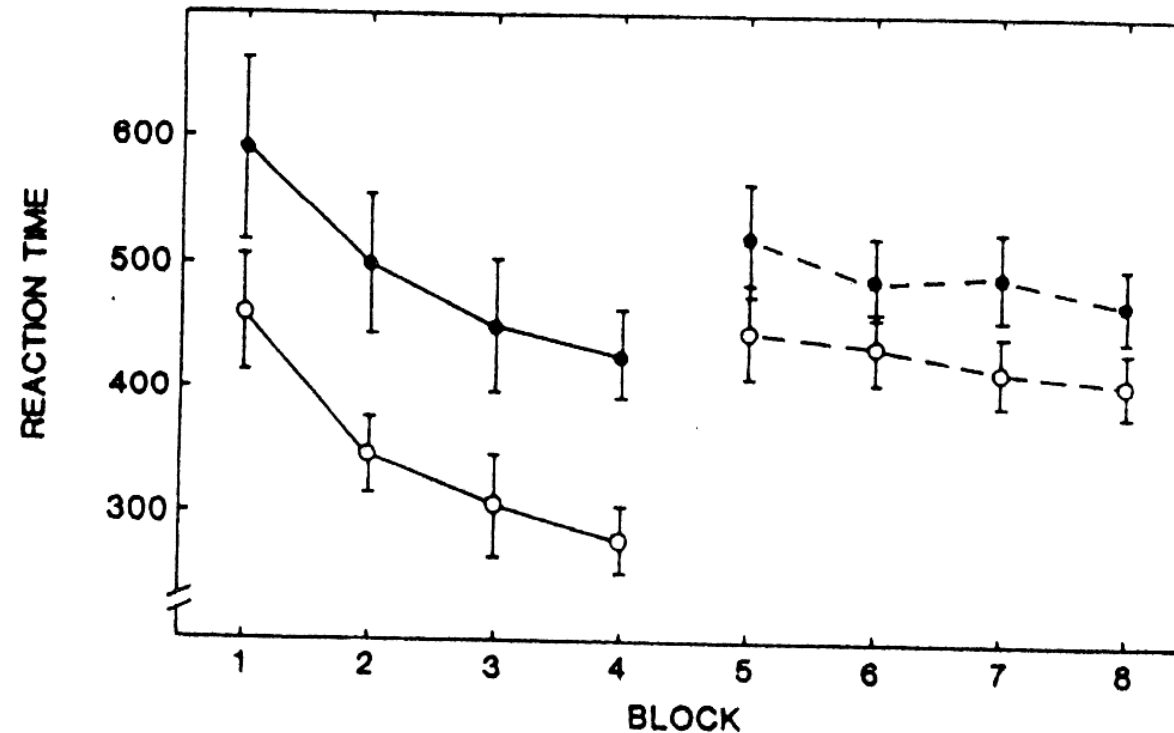


FIG. 8. Mean of median reaction time in milliseconds of six Korsakoff patients (filled circles) and eight healthy age-matched control subjects (open circles). During Blocks 1-4 all subjects received the repeating sequence (solid lines); in Blocks 5-8 they received the random sequence (dashed lines). Bar represent standard errors.

Nissen, M. J., & Bullemer, P. (1987). Attentional requirements of learning: Evidence from performance measures. *Cognitive psychology*, 19(1), 1-32.

Impaired performance following basal ganglia lesions

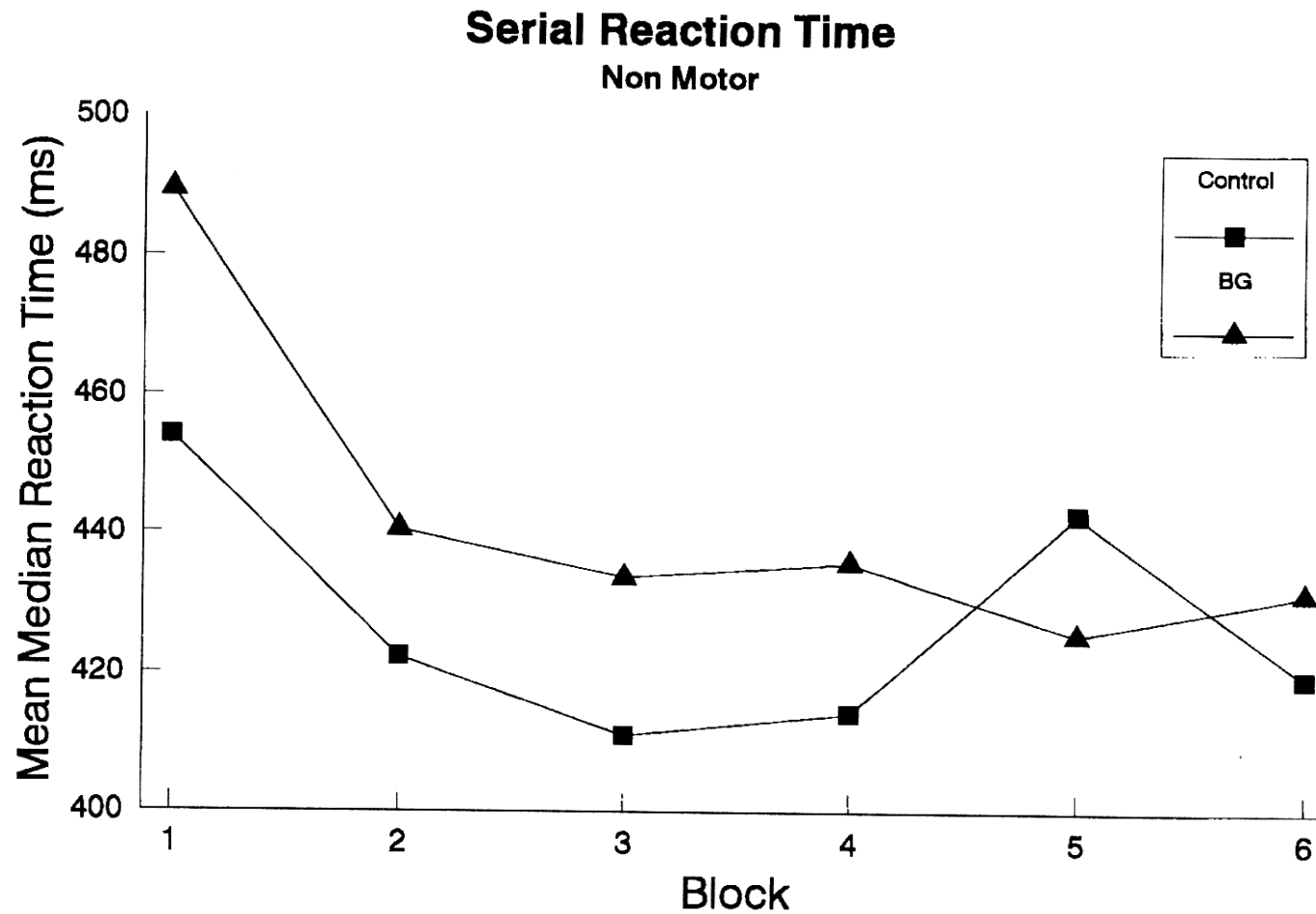
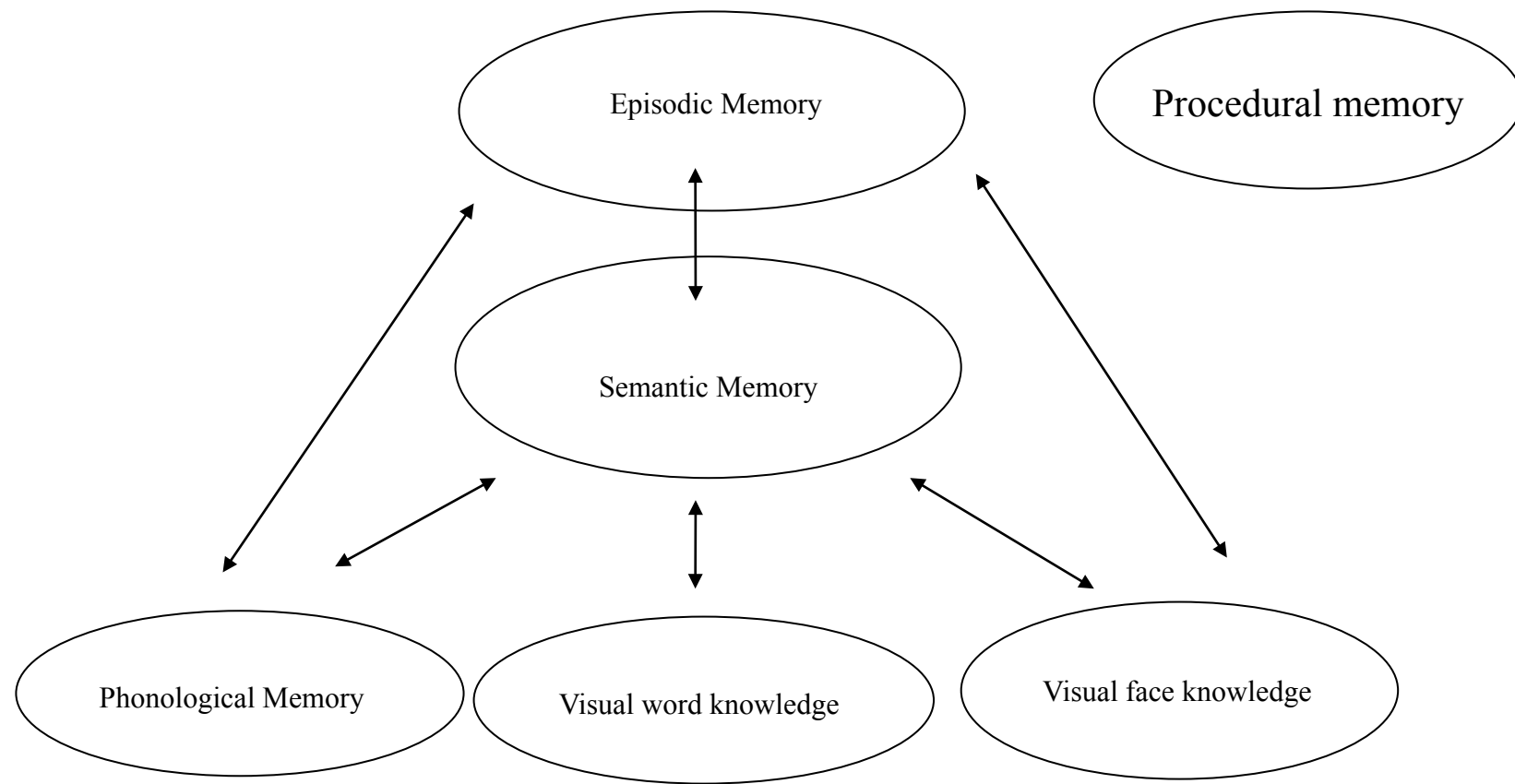


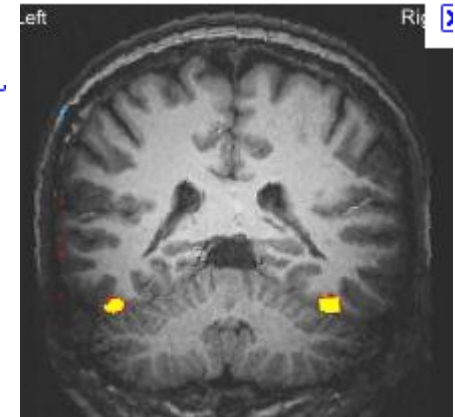
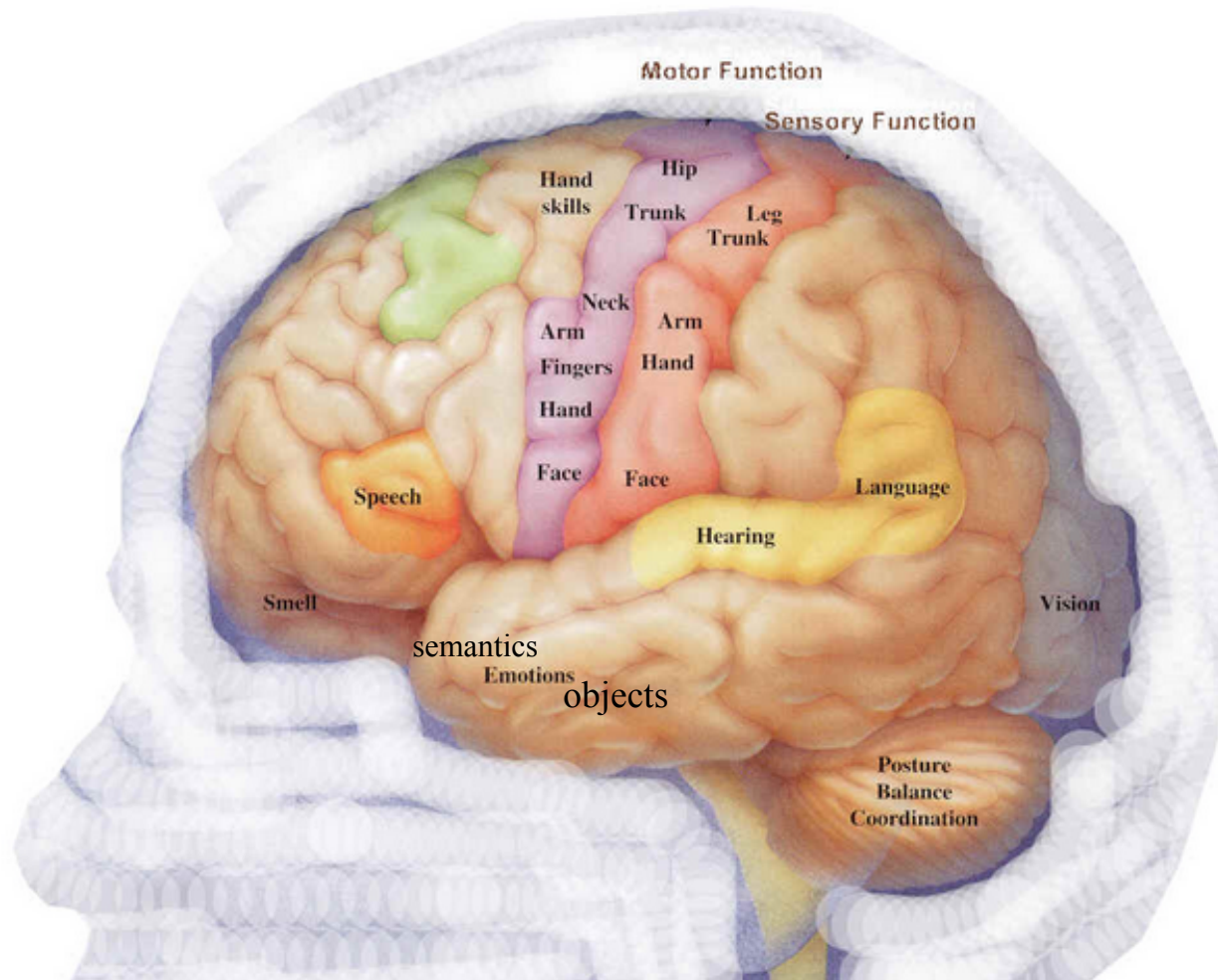
Fig. 5. The mean of the median reaction time of the BG and control groups in the six blocks of trials in the non-motor SRT task.

Vakil, E., Kahan, S., Huberman, M., & Osimani, A. (2000). Motor and non-motor sequence learning in patients with basal ganglia lesions: the case of serial reaction time (SRT). *Neuropsychologia*, 38(1), 1-10.

Overview of memory systems:

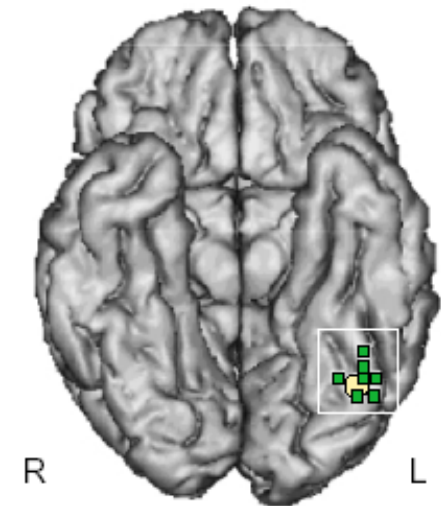


LTM Systems spread across cortex



faces: Left & right
fusiform gyrus (more right)

(a)



Words: Left fusiform gyrus