Memory: Yes I Remember or Wait I Know

Naveen Kashyap, PhD
Indian Institute of Technology Guwahati
Email: naveen.kashyap@iitg.ernet.in

attention -> perception -> memory


A MOUSE, YOU SAY?
DO YOU REMEMBER IT,
OR JUST KNOW IT?


SYNDROME
THERAPIST
RSJ

Forming & Using Memory Trace

Memory is one of the most basic processes that we use in our daily life. Right from the first hour of the morning to the last hour before sleep memory plays….”the most important” part in the smooth running of our lives.

Psychologists define memory as ***“memory is an organisms ability to store, retain and recall information”.*** *The loss of memory can be extremely devastating to people. Alan Baddeley (1990) describes the case of a musician broadcaster who suffered from intense amnesia.*

> *….his amnesia was so dense that he could remember nothing for more than a few minutes before. He was often found writing down time and events. The amnesia was so intense that if his wife returned after a few minutes he would greet her with great joy declaring that it was so long that they were meeting…..*

Metaphors of memory

Memory has been conceived as many different entities. Neath (1998) noted that ***Plato wrote*** about memory, comparing it variously to an *aviary* and to a *wax tablet* on which impressions are made. During the middle ages memory was compared to ***a cave, an empty cabinet etc***.

In 1950's memory was compared to *telephone systems* and later in the 1960's to ***computer system***. Cognitive psychologists found an important fact about memory in the 60's and 70's that there are different types of memory according to the length of time the information is stored.

The *modal model of memory – assumes information is received, processed and stored differently for each kind of memory. Unattended information presented very quickly is stored only briefly in "**sensory memory".** Attended information is held in **"short term memory"** for periods up to 20-30 seconds. Information needed for longer periods of time – exam related knowledge or the name of our fourth grade teacher – is transferred to "**long term memory**"*

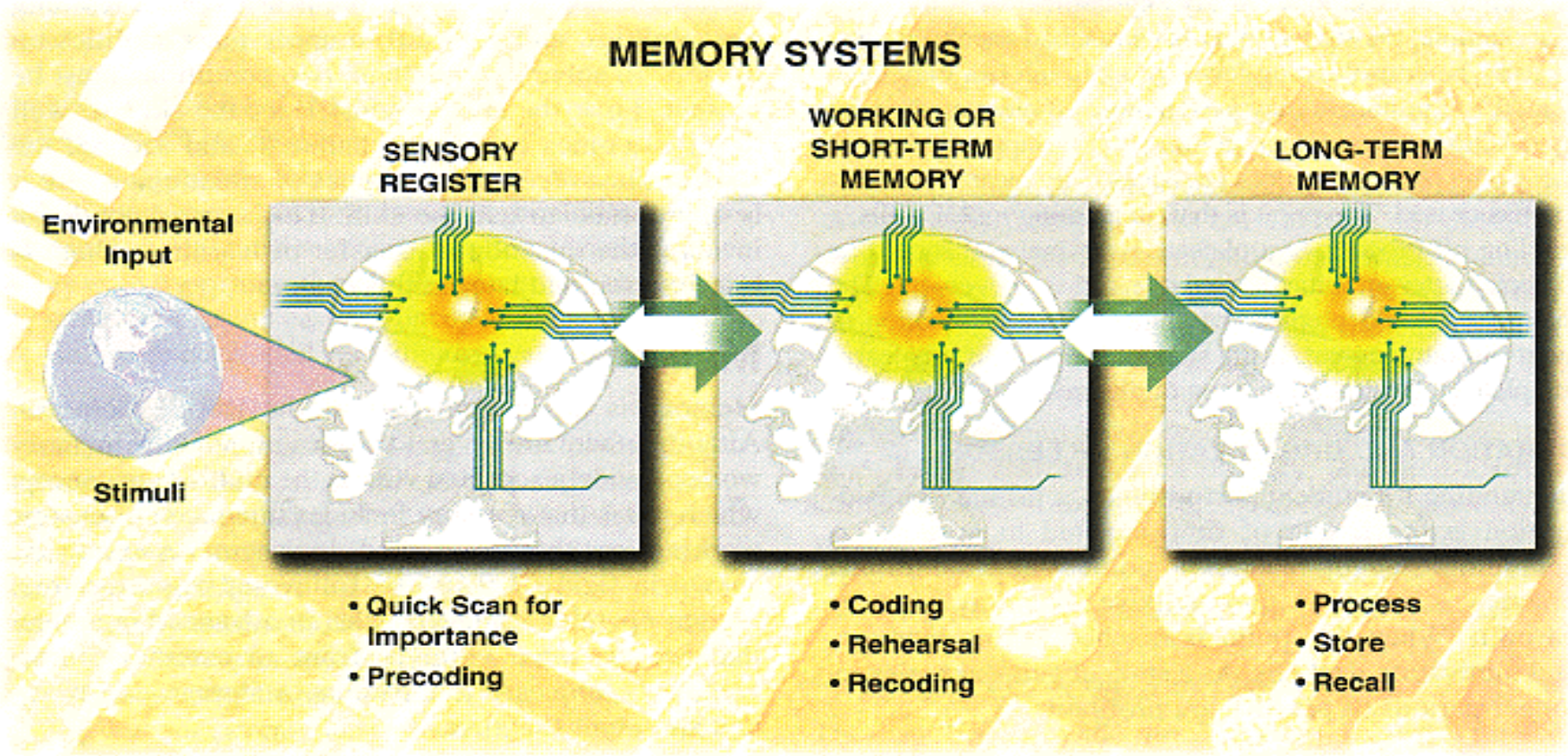


Figure 1-9. Information processing within the sensory register, working or short-term memory, and long-term memory includes complex coding, sorting, storing, and recall functions.

Sensory memory

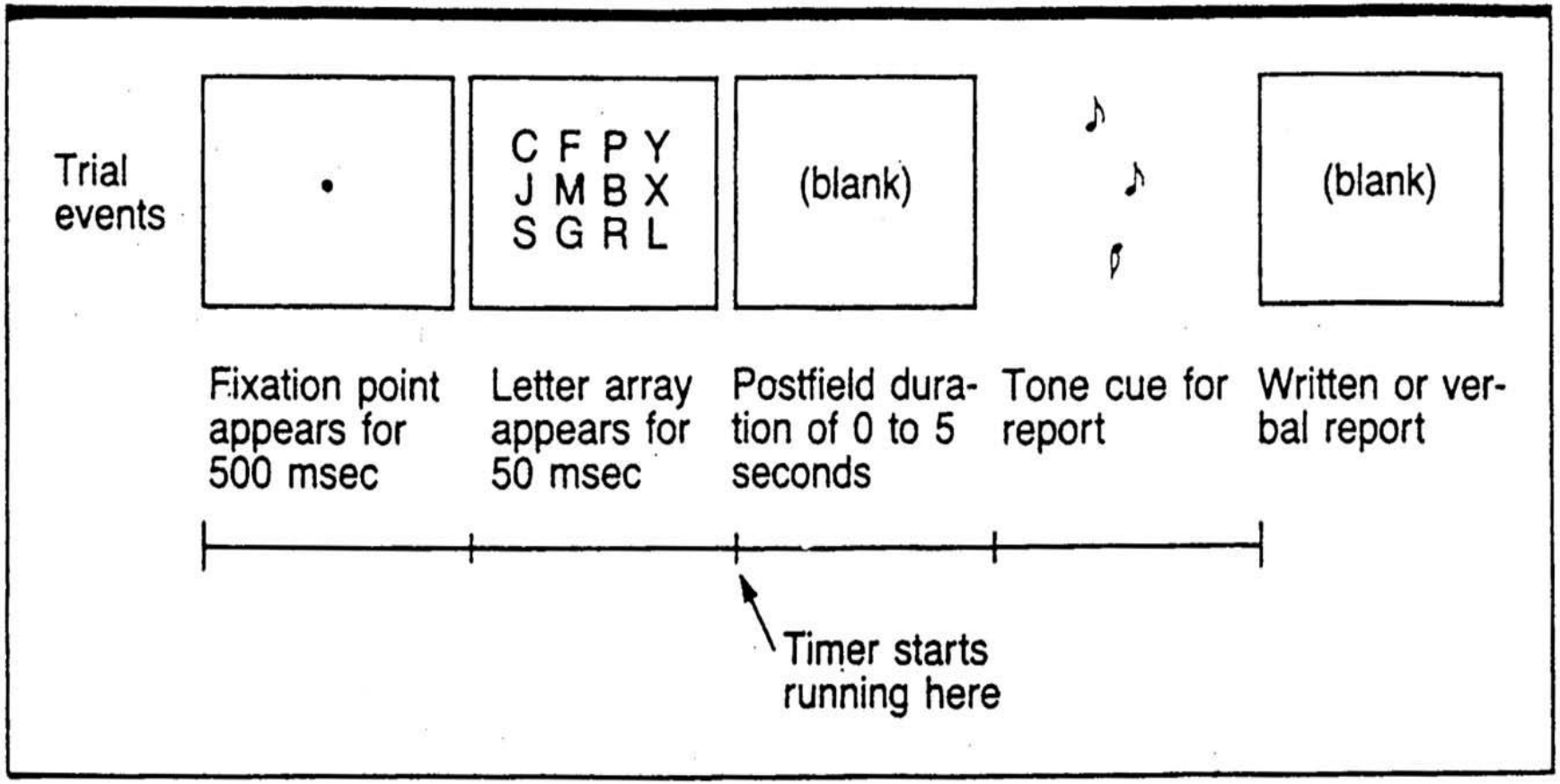
Sensory memory is closely connected to what we call “perception”. This kind of memory has been described as a record of our percepts, because it refers to the initial brief storage of sensory information – what you might retain after a quick glance to an object field.

Separate sensory memories exists for different modalities. For visual there is the *icon*, for auditory it is the *echo*, for touch it is *haptic* and so on…

The Icon

Neisser (1967) called the ***icon*** *a very brief visual memory. The icon is a sensory memory storage system for visual material, holding information for up to about 1 second. The information it holds is in a relatively unprocessed form.*

The best demonstration of iconic memory can be done using Sperling’s partial report technique (1960)**.** Averbach & Coriell (1961) showed that the icon can be “erased” by other stimuli presented immediately after the icon, a phenomenon known as “masking”



A schematic diagram of a typical trial in Sperling's (1960) experiments. After a fixation point appears for 500 msec, the letter array is displayed. The visual field after the display is blank. The tone cue can occur at the same time as the postfield, or it can be delayed up to 5 seconds.

The Echo

There is also a sensory memory for auditory material, which Neisser (1967) called the ***echo.*** *Moray, Bates & Barnett (1965) offered a clever demonstration of the echo. Participants were given a "four-eared" listening task, similar to dichotic listening. Using Sperling's partial report technique with lights the participants were made to perform the task. They too found added performance increase in partial reports as compared to whole reports.*

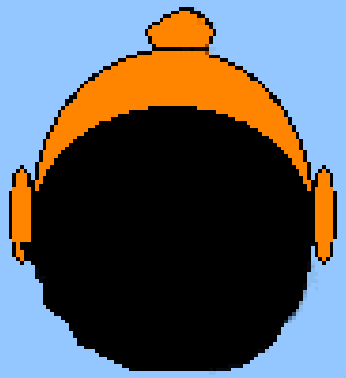
Darwin, Turvey & Crowder (1972) replicated Moray's experiment with better controls and found a much smaller partial report advantage. However their study revealed that

1) Echoic memory has larger capacity than Iconic Memory

2) Echo's can last about 20 seconds longer than Icons (Watkins & Watkins, 1980)

Darwin, Turvey, and Crowder (1972)

Left	Both	Right
B	8	F
2	6	R
L	U	10



Sensory memory can currently best be described by a number of properties

1) sensory memories are modality specific.

2) sensory memory capacities appear large but the length of time that information can be stored there is quite short much less than a second

3) the information that can be stored appears relatively unprocessed, meaning most of it has to do with physical aspects of the stimuli rather than with meaningful ones

EXAMPLES OF SENSORY MEMORY

Visual Sensory Memory. Hold your hand in front of your eyes and quickly wave it back and forth. If your hand motion is quick enough, you will be able to "see" your hand in one position for a fraction of a second after it has moved on to a different position.

Auditory Sensory Memory. With your hands, beat a quick rhythm on the desk. Can you still hear the echo after the beating is finished?

Tactile (Touch) Sensory Memory. Quickly rub the palms of your hands along a horizontal edge of your desk, moving your hands so that the heels touch first and the fingertips touch last. Can you still feel the sharp edge, even after your hand is off the desk?

Short term memory

Most of the time when people think about memory they think about holding onto information for longer than a second or two. This type of memory where information can be held for brief periods of time is called ***"short term memory"***.

short term/primary/active memory is the capacity for holding a small amount of information in mind in an active, readily available state for a short period of time.

Capacity of STM

A classic paper by George Miller (1956) holds the capacity for STM to be 7 ± 2 chunks of items. ***Chunking*** *is the process of combining smaller units of items into bigger meaningful units. For example consider the chunk*

F B I N S A K G B C B I C I A M I 5 B N D

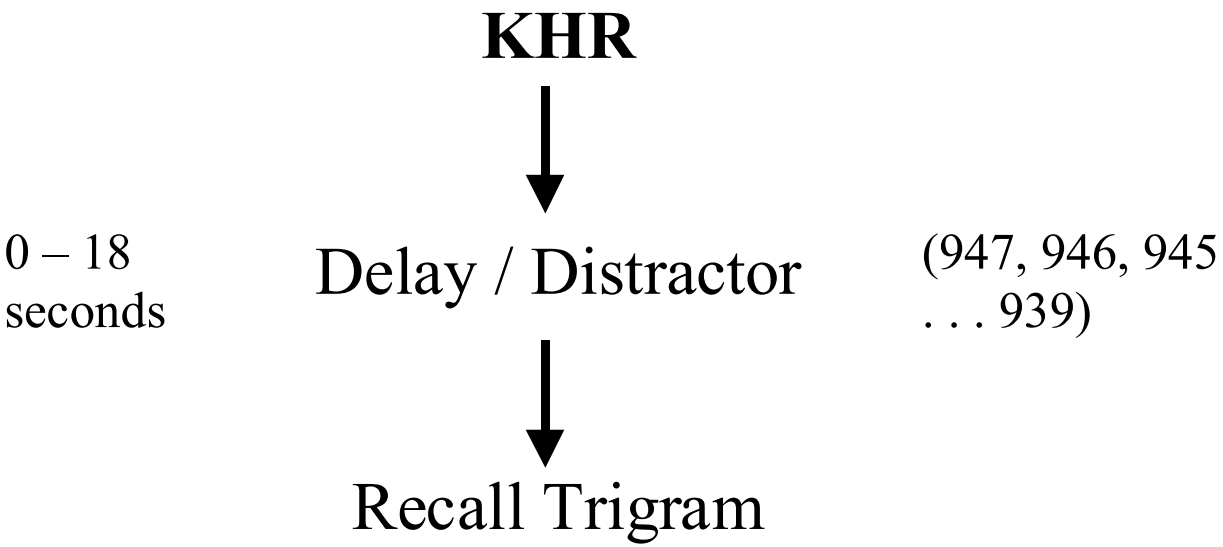
The total string can be learnt by breaking it into initials for security agencies around the world

Coding in STM

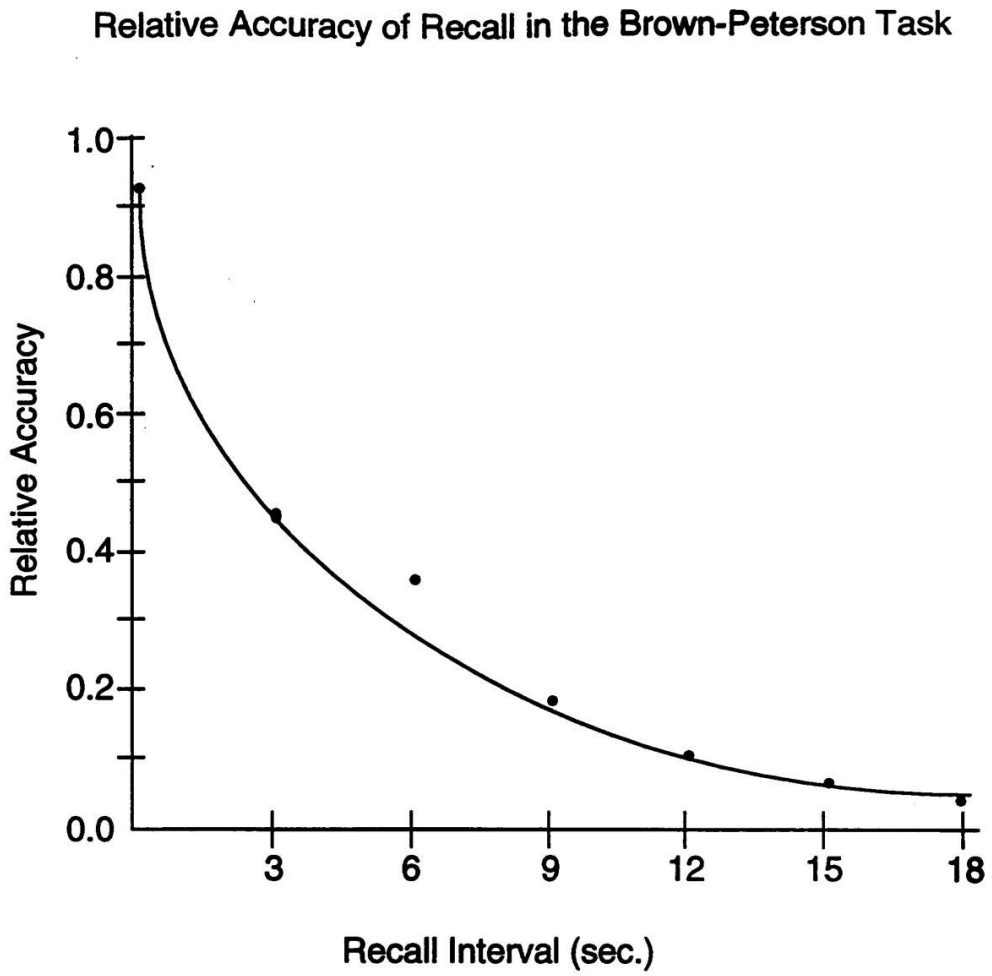
The term coding refers to the way in which information is mentally represented; that is, the form in which information is held. When given a phone number how does one remember it? Conrad (1964) tried to address this question by presenting people with visual letters to remember. He found that people often committed errors while retrieving by replacing the original letter with similar sounding letters (e.g., Target: B, Errors: C, G, E etc). Later Neath (1998) found that people use the acoustic code dominantly for STM storage and recall

Short Term Memory

- Brown/Peterson & Peterson (1959)
- Trigram task



Brown-Peterson Results



Trigrams

K X J

P L G

S Y T

H Z R

The results from both Brown's and Petersons study interpreted that failure to recall occurring due to "*decay of memory traces"* within about 20 seconds. The decays in STM happens as the items are not rehearsed.

A group of cognitive psychologists however challenged the decay theory of forgetting in memory and proposed a different mechanism called *"interference"* for forgetting from STM. The theory of interference proposes that

some information can "displace" other information making the former hard to retrieve.

Waugh & Norman (1965) – *Probe digit task for explaining interference*

In the task participants were given 16-digit numbers such as 1596234789024815. The last digit in the number is a cue for the participant to report the number that first came after the first occurrence of the cue in the number.

Waugh & Norman presented the numbers either quickly, at the rate of 4 digits per second or slowly at the rate of 1 digit per second. Their reasoning was that if decay caused forgetting in STM, then participants receiving a slow rate of presentation should not be as good at recalling digits from early in the number.

Keppel & Underwood (1962) found that forgetting in the Brown-Peterson task doesn't happen until after a few trials. They suggested that over time, proactive interference builds up.

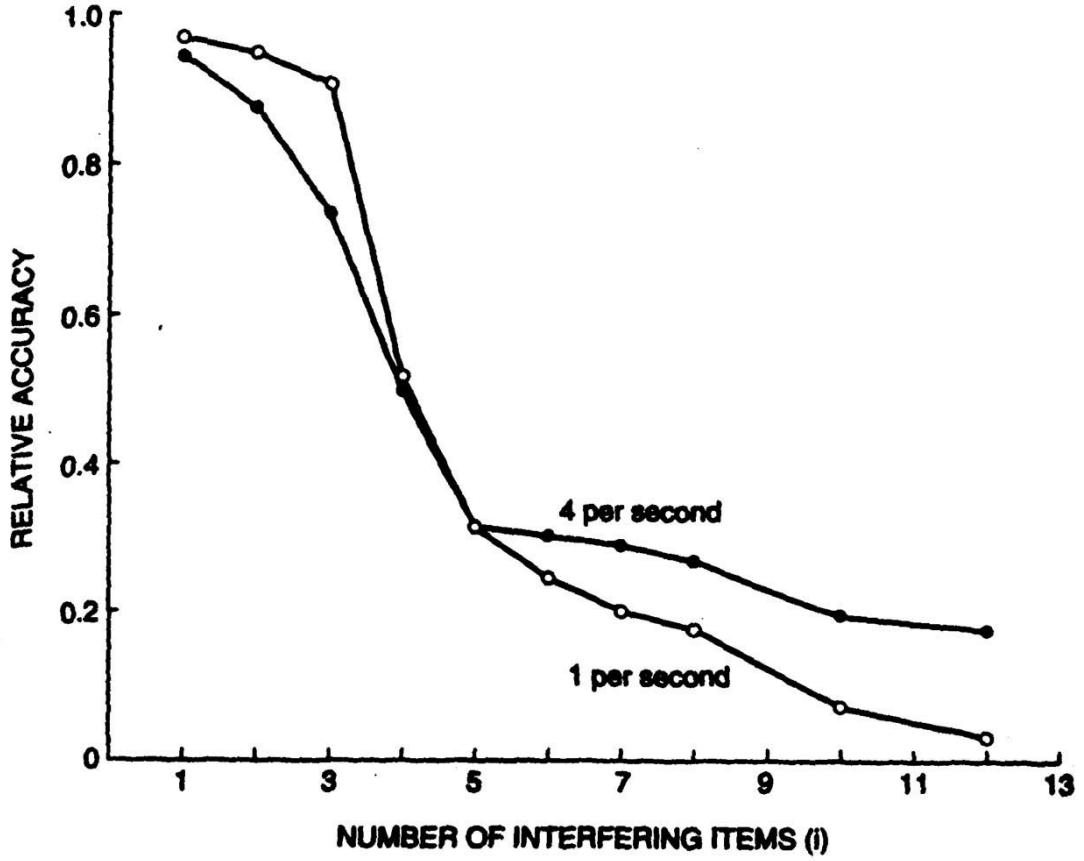
Digit Probe Task: Waugh & Norman (1965)

16 digits -----> probe digit

5 1 9 6 3 5 1 4 2 8 6 7 3 9 4

9 8 3 7 5 7 1 4 9 3 8 6 2 7 5 2

Effect of Presentation Rate vs. Number of Interfering Items on Recall (Waugh & Norman, 1965)



Is forgetting from STM a *decay or Interference* related phenomenon

This is a badly posed question as it rules out the possibility for loss by both the phenomenon. Baddeley (1990) argues that some trace decay does occur form STM. Altmann & Gray (2002) proposes that decay does occur and in fact is essential to avoid catastrophic proactive interference.

These authors believe that when information must be updated frequently in memory, its current value decays to prevent interference with previous values.

Retrieval from STM

How do we retrieve information from STM when we need it?

Saul Sternberg (1966, 1969) conducted a series of experiments and found some interesting facts relating to retrieval from STM. Retrieval from STM can be either using

a) ***Parallel Search*** *– where comparison of the probe is done with all items stored in the STM at the same time*

b) ***Serial Search*** *– where comparison of the probe is done with all items stored in the STM one at a time. Further serial search can either be*

a) ***self – terminating search*** *– which stops when a match to the probe is found*

b) ***exhaustive search*** *– where even if the match is found all item are checked with the probe*

Sternberg's result argue for serial exhaustive search as we retrieve information from STM

A review study done by Hunt (1978) found that people of all sorts showed results consistent with the idea that retrieval from STM uses serial exhaustive search, although search rate changes with the group.

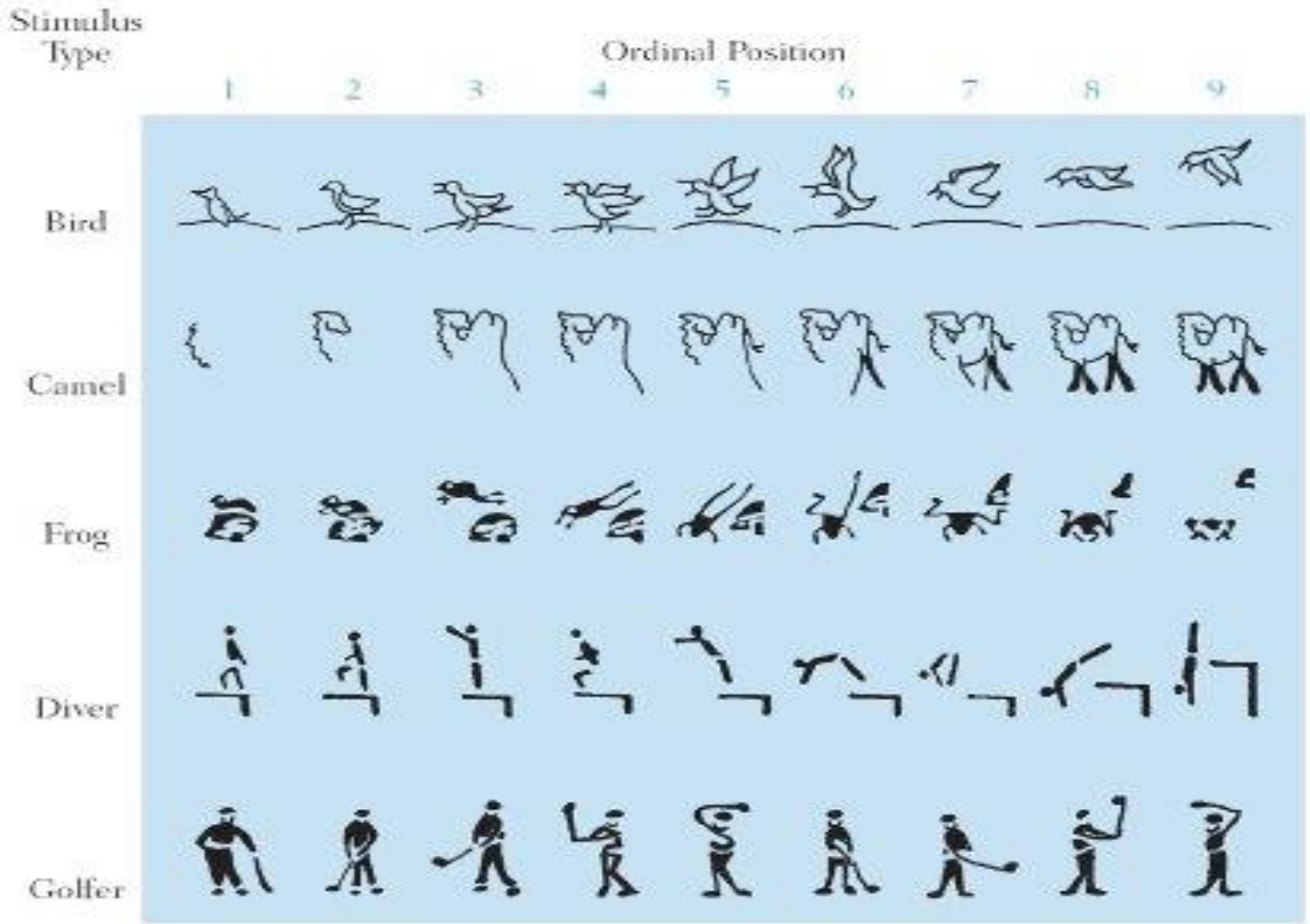
Similarly DeRosa and Tkacz (1976) demonstrated that with certain stimuli people apparently search STM in a parallel way.

De Rosa stimuli consisted of ***ordered sequences of pictures****. It became clear from further research on De Rosa's stimuli that*

a) if the memory set consisted of some ***randomly selected subset*** *of the nine picture – 1, 4, 6, 8 & 9 – from any of the sets the* ***results were similar to Sternberg's result***

b) If memory set consisted of an ***ordered subset of the original*** *sequence pictures – 2, 3, 4, 5 & 6 – then* ***it took participants no longer to search through five items than it did through two****.*

This result suggests that ***STM does treat organized material differently from unorganized material****. Also memory processes apparently work differently as function of the material (stimuli) to be remembered*


Stimulus Type
Ordinal Position
1
2
3
4
5
6
7
8
9
Bird
Camel
Frog
Diver
Golfer

Working Memory

The information processing model of Atkinson & Shiffrin (1968) describes information processing as being a two part process

a) the information representations being stored called either as “STM / LTM”

b) the structure storing it describes as “STS / LTS”

These authors conceived STS not only as a store for seven or fewer pieces of information for few seconds but found that information in STS somehow activates relevant information from LTS and gathers some of this information into STS.

They equates STS with consciousness and saw it as the location of various ***control processes*** *that govern the flow of information such as rehearsal, coding, integration and decision making.*

Baddeley & Hitch (1974) performed a series of experiments to test the model described above. The design was to have participants temporarily store a number of digits while simultaneously performing another task such as reasoning or language comprehension. The hypothesis was that if the STS capacity is taken up by stored digits fewer resources are available for other tasks so performance on other tasks suffer

Reasoning Task with Letter Recall

AB

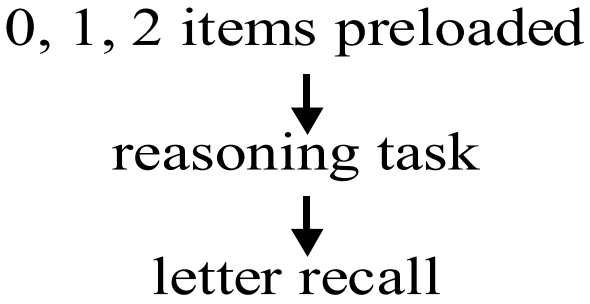
‘A’ precedes ‘B’? **T** or **F**

‘B’ is preceded by ‘A’ . **T** or **F**

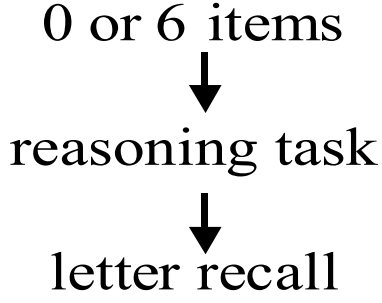
‘B’ does not precede ‘A’. **T** or **F**

Reasoning Speed and Letter Recall

Experiment 1:



Experiment 2:



Reasoning Times & Letter Recall Results

Table 4-3 REASONING TIMES AND LETTER RECALL UNDER VARIOUS MEMORY LOAD CONDITIONS

Experiment 1

	Memory load (number of letters held in memory)		
	0	1	2
Reasoning times	3.20 sec	3.31 sec	3.31 sec
Letter recall	Essentially perfect		

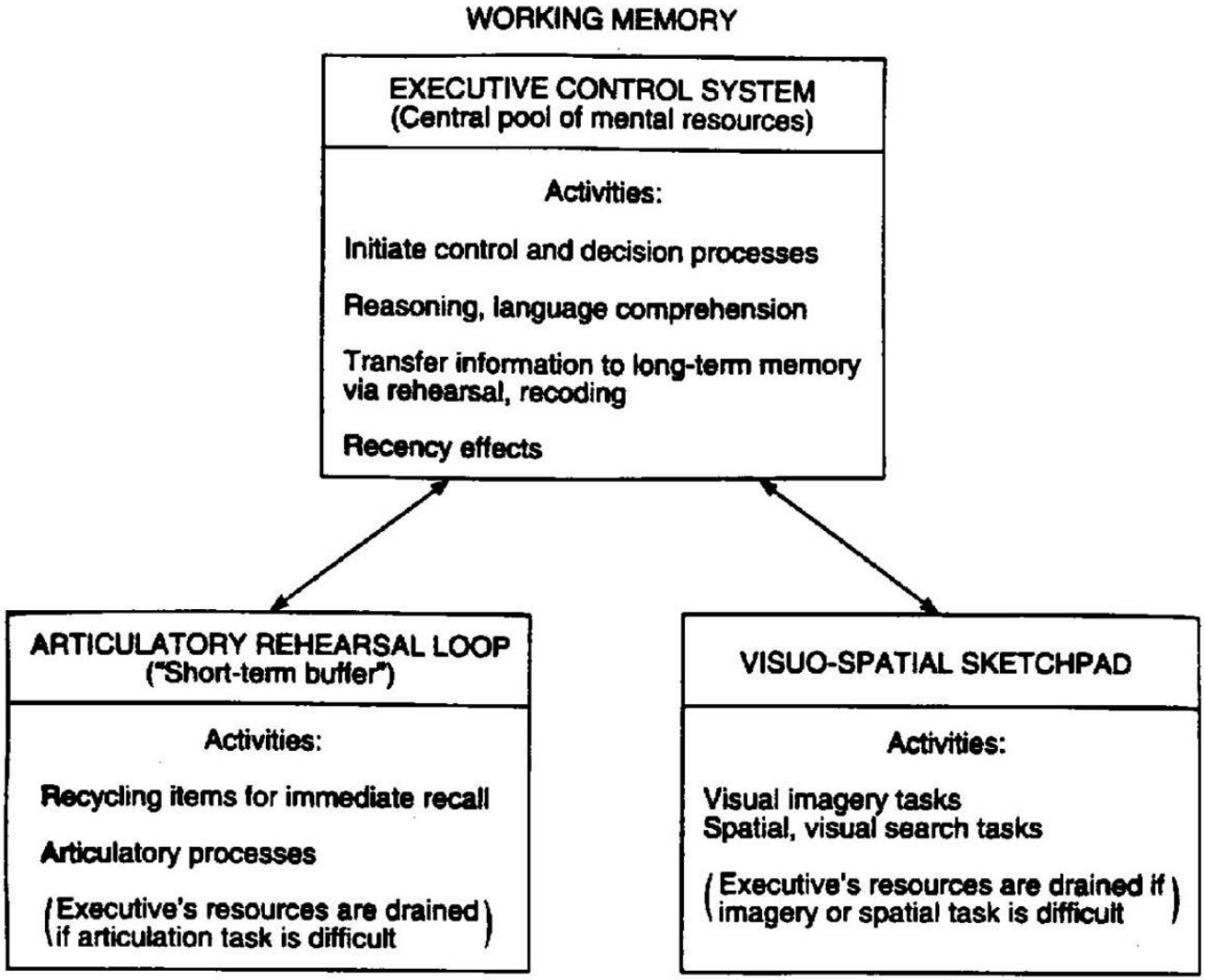
Experiment 2

	Memory load		
	0	6	
Reasoning times	3.27 sec	3.46 sec	"Equal stress"
Letter recall	5.5	3.7	
Reasoning times	2.73	4.73	"Memory stress"
Letter recall	5.8	5.0	

Note: In both experiments, a memory load of 0 was a control condition. In these conditions, subjects performed the reasoning task, and only then were they given the set of letters for the memory span task. Thus letter recall of 5.8 in the 0 Memory load condition means that 5.8 letters were recalled immediately after their presentation, where presentation followed the reasoning task.

Adapted from Baddeley & Hitch, 1974.

Baddeley Working Memory Model



Working memory *consists of a limited capacity "workspace" that can be divided between storage and control processing. Baddeley (1981, 1986, 1990) conceived of WM as consisting of three components.*

a) The first is ***central executive*** *– this component directs the flow of information, choosing which information will be operated on when and how*

*b) The p****honological loop –*** *which is used to carry out sub vocal rehearsal to maintain verbal material*

c) The ***Visuospatial sketchpad –*** *which is used to maintain visual material through visualization.*

What about daydreams?

- Daydreams are stimulus-independent thoughts (SITs).
- Neither the phonological loop nor the visuospatial sketchpad is solely responsible for SITs.
- Producing SITs appears to involve the central executive.