

Immediate Memory

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- I. Context
- II. History
 - (changing views of immediate memory)
- III. Proposed Properties of working memory
 - A. Capacity
 - B. Coding
 - C. Forgetting
 - D. Retrieval

Context

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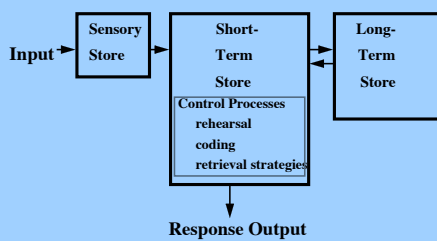
Immediate Memory refers to the general idea of a memory system dedicated to the storage of the recent past. It includes ideas such as:

- Short-term storage
- Short-term memory
- Working memory

I. Context

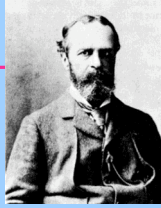
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Atkinson and Shiffrin Model



II. History

William James (1890, pp. 646-647)
primary memory (immediate)
vs.
secondary memory (long-term)



“An object which is recollected, in the proper sense of that term, is one which has been absent from consciousness altogether, and now revives anew. It is brought back, recalled, fished up, so to speak, from a reservoir in which, with countless other objects, it lay buried and lost from view. But an object of primary memory is not thus brought back; it never was lost; its date was never cut off in consciousness from that of the immediately present moment. In fact it comes to us as belonging to the rearward portion of the present space of time, and not to the genuine past.”

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II. History (cont.)

Freud (1856-1939)

Hierarchical architecture of human consciousness:

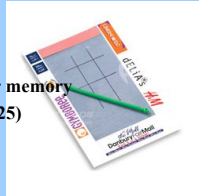
conscious mind

preconscious

unconscious mind

the “magic slate” as a metaphor for memory

(*Note on the Mystic Writing Pad*, 1925)



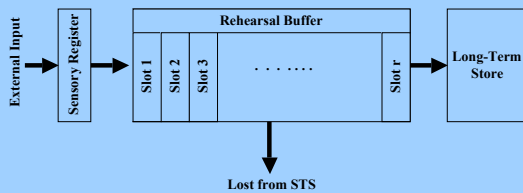
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II. History (cont)

Atkinson & Shiffrin (1968)

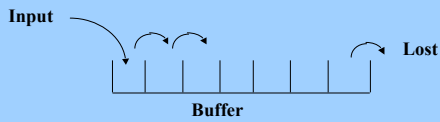
Short-term storage

buffer model



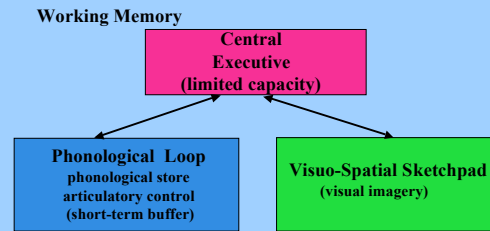
II. History (cont)

Buffer as a "push down stack"



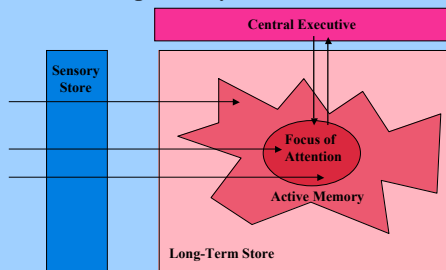
II. History (cont)

Baddeley (1986)



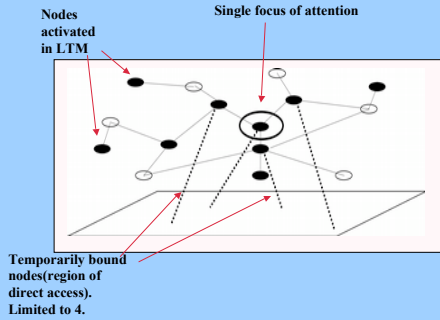
II. History (cont)

Cowan (1988) Embedded Process model of Working Memory



Three component framework (Oberauer, 2006)

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III. Proposes Properties of STS

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A. Limited Capacity

- 1) digit span task
- 2) Miller: magical number 7 ± 2
 - digit span tasks
 - categorization tasks (how many tones, etc)
 - judgments task

A. Limited Capacity (cont)

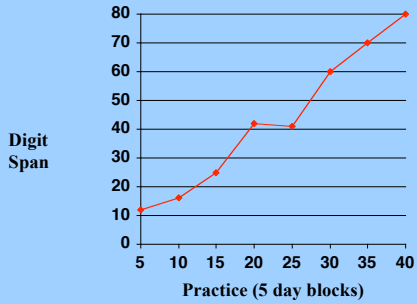
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3) Chunking and Memory Span (Ericsson, 1980)

male student practiced digit span task
1 hour practice a day, 3-5 days a week
total of 20 months practice (230 hours)
Digit span increased from 7 to 80

Exceptional memories: Made not born
(Ericsson, 2003)

Ericsson (1980) results



A. Limited Capacity (continued)

4) The Magical Number 4 (Cowan, 2000)
Compound STM limit (7 +/- 2)
 (measured by digit span)
 includes contributions from:
 sensory storage,
 LTM (chunking)
Pure STM capacity limit (4 +/- 1)
 measured under conditions that prevent contributions from other sources.
 e.g., Sperlings whole report, measures of chunk size, measures with unrehearsable material (long phrases)

A. Limited Capacity (continued)

5. No capacity limit, rather a time limit
 For Example, Baddeley's: Phonological loop

 The capacity limit is apparent because information in the loop decays (in a matter of seconds). It must be refreshed, and it is impossible to rehearse a lengthy series of items before decay creates a loss of information.

 Therefore, memory span is tied to word length, and the number of words an individual can rehearse.
 (Baddeley, Thomson, & Buchanan, 1975)

III. Proposes Properties of STS (cont)

B. Coding in STS

1) phonological coding

Conrad (1964)

Experiment 1

Presented letters aurally, immediately after each letter, participants were asked to write down the letter.

Experiment 2

Presented 6 letters visually, then participants were asked to write the list (memory span task).

Results: Correlation between errors made on the listening and memory tasks was $r = .64$.

Confusion matrix for auditory task

		Stimulus Letter									
		B	C	P	T	V	F	M	N	S	X
Response Letter	B	-	171	75	84	168	2	11	10	2	2
	C	32	-	35	42	20	4	4	5	2	5
	P	162	350	-	505	91	11	31	23	5	5
	T	143	232	281	-	50	14	12	11	8	5
	V	122	61	34	22	-	1	8	11	1	0
	F	6	4	2	4	3	-	13	8	386	238
	M	10	14	2	3	4	22	-	334	21	9
	N	13	21	6	9	20	32	512	-	38	14
	S	2	18	2	7	3	488	23	11	-	391
	X	1	6	2	2	1	245	2	1	184	-

Confusion matrix for Short-term memory task - visual presentation.¹⁸

		Stimulus Letter									
		B	C	P	T	V	F	M	N	S	X
Response Letter	B	-	18	62	5	83	12	9	3	2	0
	C	13	-	27	18	55	15	3	12	35	7
	P	102	18	-	24	40	15	8	8	7	7
	T	30	46	79	-	38	18	14	14	8	10
	V	56	32	30	14	-	21	15	11	11	5
	F	6	8	14	5	31	-	12	13	131	16
	M	12	6	8	5	20	16	-	146	15	5
	N	11	7	5	1	19	28	167	-	24	5
	S	7	21	11	2	9	37	4	12	-	16
	X	3	7	2	2	11	30	10	11	59	-

B. Coding in STS (cont)

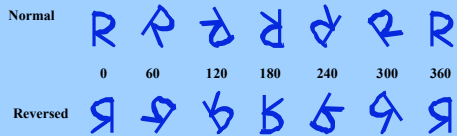
- 1) phonological coding (cont)
 - b) Schweickert, et al. (1990)
- GZDBPBV
MJYFHRK

Phonologically similar list are more difficult to remember.

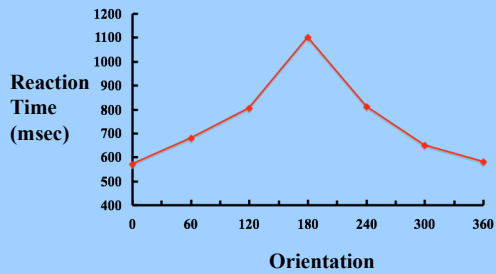
B. Coding in STS (cont)

- 2) Visual Coding
- Shepard's task (Cooper & Shepard, 1973)

Stimulus set:



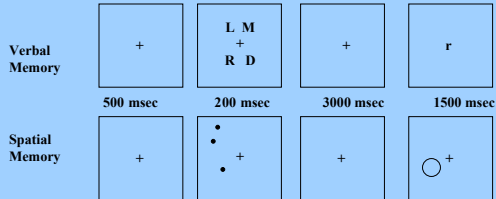
Shepard & Metzler (1971) results



3) Phonological and Spatial Coding in Working Memory (PET research)

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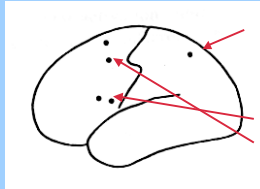
Smith & Jonides (1977) pet scans of subjects performing working memory tasks.



Smith & Jonides (1977) cont.

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Verbal -control



Phonological Store: posterior parietal (left lateralized)

Phonological Rehearsal: Borca's area, premotor and supplementary motor area (left lateralized)

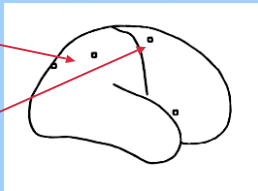
Smith & Jonides (1977) cont.

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Visual -control

Spatial Store: posterior parietal (right lateralized)

Spatial Rehearsal: premotor area (right lateralized)



III. Proposes Properties of STS (cont)

C. Forgetting from STS

Two hypotheses:

decay: information fades with time

interference: new information interferes with old

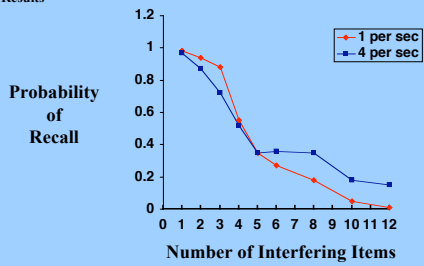
Waugh & Norman (1965)

probe-digit task: 27485667 beep 5?
43259412567 beep 9?

two rates of presentation:
1/sec vs. 4/sec

III. Proposes Properties of STS (cont)

Waugh & Norman's Results



Decay or Interference?

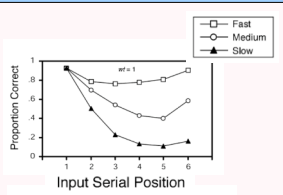
Lewandowsky, Duncan, & Brown (2004)

- Participants performed a serial recall task on short list of letters (H, J, M, Q, R, V)
- Recall was paced to create different retention intervals:
 - fast: 400 msec/item (6x400 = 2.4sec)
 - med: 800 msec/item (6x800 = 4.8 sec)
 - slow: 1600 msec/item (6x1600 = 9.6 sec)
- During recall, participants performed an articulatory suppression task to prevent rehearsal (repeated the word "super").

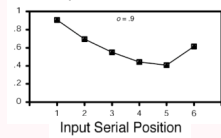
Decay or Interference?

Predictions from two models:

Decay:

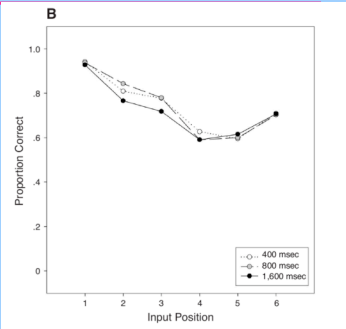


Interference:



Lewandowsky et al (2004) results:

Which model is supported?



III. Proposes Properties of STS (cont)

D. Retrieval from STS (Sternberg, 1966)

Task:

- list 1,9,4,3 (size = 4)
- test 4 (positive)
- or 2 (negative)
- list 2, 7, 1, 4, 9, 0 (size=6)
- test 9 (positive)
- or 3 (negative)

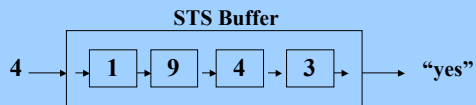
D. Retrieval from STS (Sternberg, 1966, cont)

Questions:

- 1) Is the search serial or parallel?
- 2) Is it terminating or exhaustive?
- 3) What is searched (coding)?

Serial or Parallel Search?

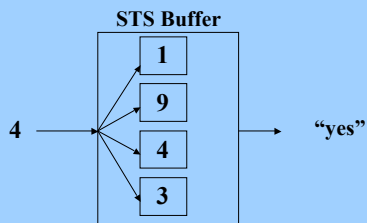
Serial Search



Prediction: reaction time should increase with list length.

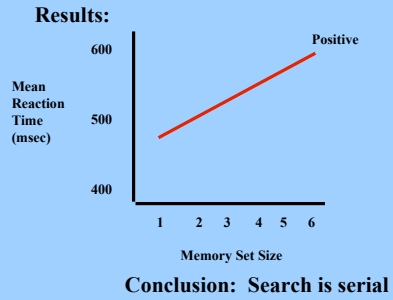
Serial or Parallel Search?

Parallel Search

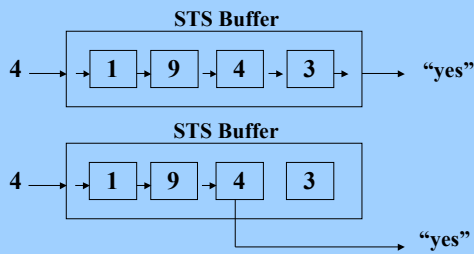


Prediction: Reaction time should stay the same across list length

Serial or Parallel Search?

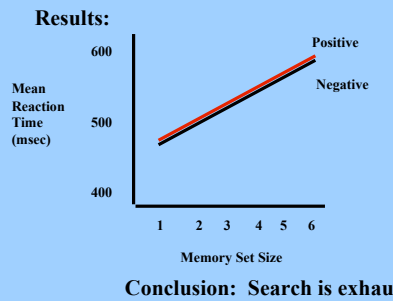


Is the search exhaustive or self terminating?

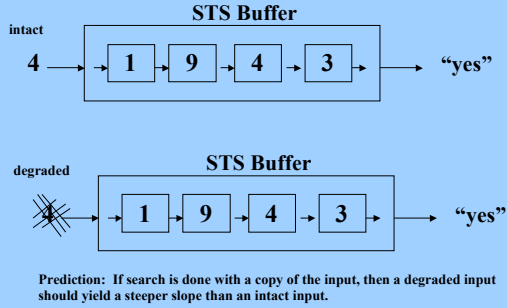


Prediction: If it is terminating, RT on **yes** trials should be faster than RT on **no** trials

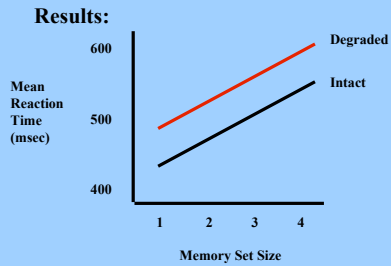
Is the search exhaustive or self terminating?



What is searched (coding)?



D. Retrieval from STS (Sternberg, 1966, cont)



Conclusion: Search is carried out with a "named" input.

D. Retrieval from STS (Sternberg, 1966, cont)

Summary:
 serial
 exhaustive
 named (phonological) code of list

Conclusions on STS

- A. STS plays a central role in information processing**
- B. Numerous theories have proposed a separate STS system.**
- C. Common properties of the system include**
 - 1) limited capacity**
 - 2) phonological and/or visual coding**
 - 3) loss of information resulting from displacement**
