

Short-Term Memory, Working Memory, and Attention

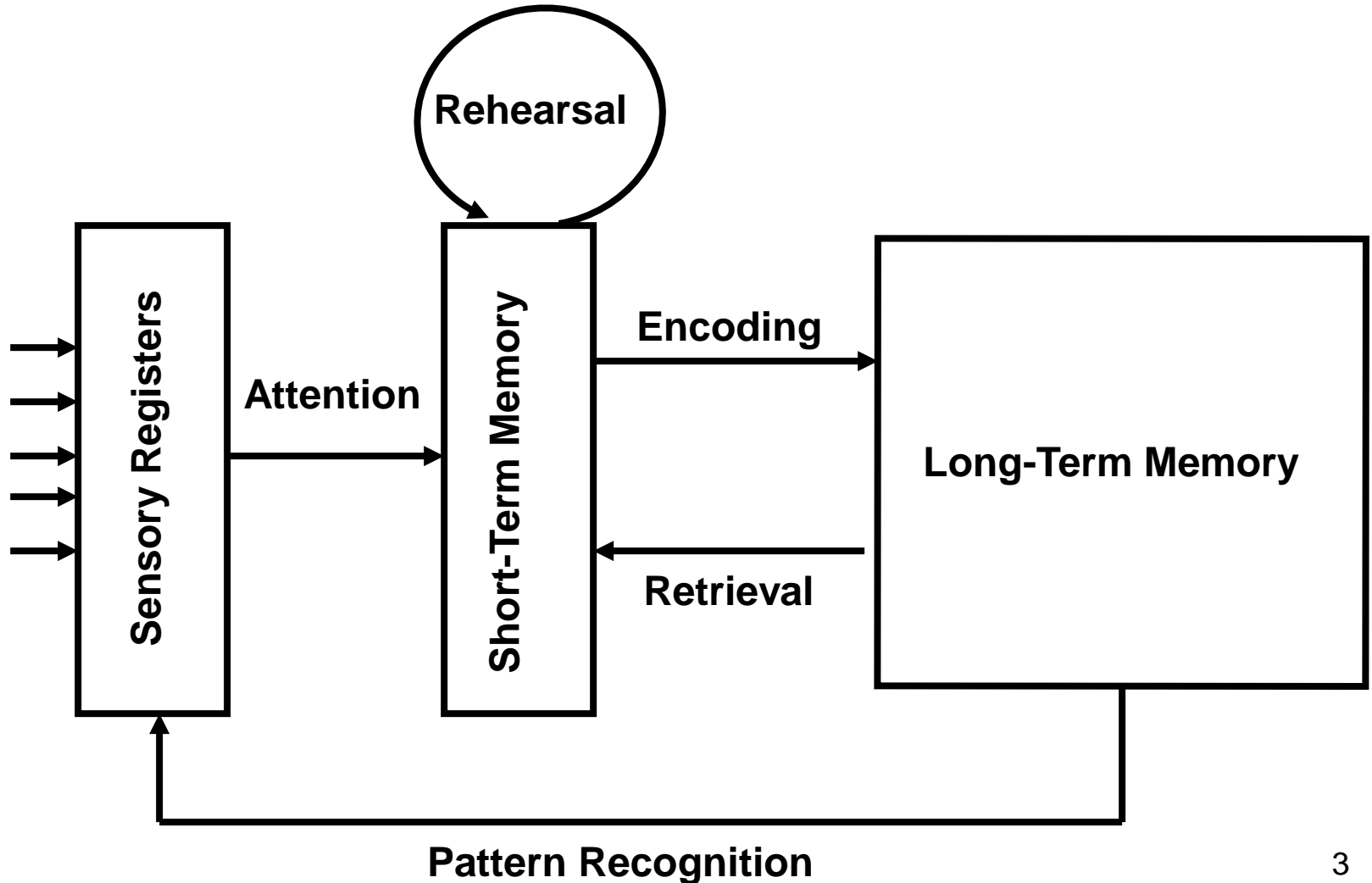
Lecture 17

Perception and Memory

- Perception Draws on Memory
 - Permanent Repository of World-Knowledge
 - Momentary Expectations
- Perception Changes Memory
 - Memory “Trace”
 - Mental Representation of Stimulus
 - Persists After Termination of Stimulus

The Multi-Store Model of Memory

After Waugh & Norman (1965); Atkinson & Shiffrin (1968)



Alternative Terminologies in the “Modal Model” of Memory

Atkinson & Shiffrin (1968); Waugh & Norman (1965), after James (1890)

- Sensory Registers
 - Sensory Memory, Sensory Store
- Short-Term Memory
 - Primary Memory
 - Working Memory
- Long-Term Memory
 - Secondary Memory

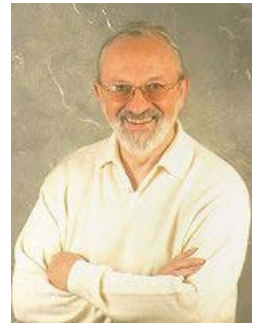


Sensory Registers

- One (or More) per Sensory Modality
 - Icon, Echo
- Unlimited Capacity
- Veridical Representation of Sensory Input
 - Precategorical
- Transfer to Short-Term Memory
- Forgetting via Decay or Displacement

The Sperling Experiment

Sperling (1960)

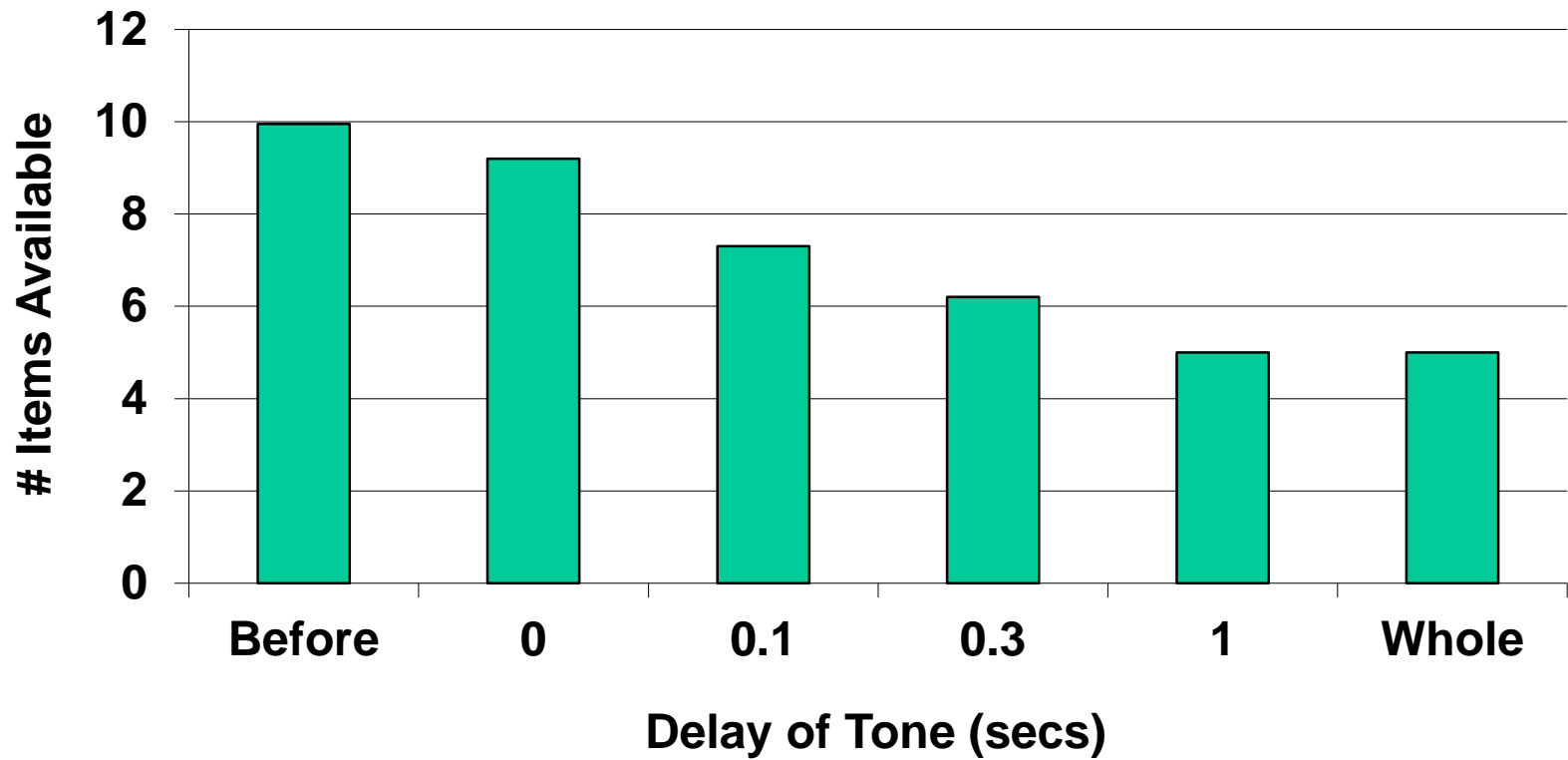


- Visual Presentation
- 3x4 Array of Letters
- Retention Interval
 - 0-1 sec
- Whole Report
- Partial Report

X	M	R	J
C	N	K	P
V	F	L	B

Retrieval from the Icon

Sperling (1960)



The Function of the Icon?

Haber (1983)

Iconic memory may only be useful
for reading a book in a lightning storm.

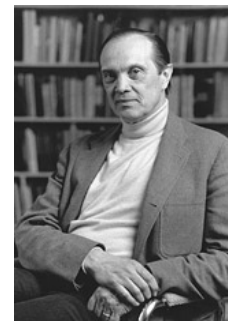


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Properties of Short-Term Memory

Miller (1956)



- Acoustic Recoding
 - Verbal Rehearsal
- Limited Capacity
 - “The Magical Number 7, Plus or Minus 2”
- Maintained by Rehearsal
- Transfer to Long-Term Memory
 - Passive Storage
- Forgetting via Decay or Displacement

Digit-Span Test

Read List of Digits

Write Them Down After I Stop

Digit-Span Test

1. 5 9 0

2. 4 8 6 1

3. 7 3 0 9 4

4. 2 4 9 6 5 8

5. 1 4 6 8 2 4 5

6. 3 9 2 1 5 7 6 0

7. 6 2 5 7 3 9 1 8 4

8. 0 6 3 8 9 4 1 7 2 5

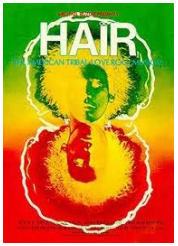
An Alphabetical “Digit-Span” Test

Read List of Letters

Write Them Down After I Stop

Chunking

After Rado & Ragni (*Hair*, 1967)



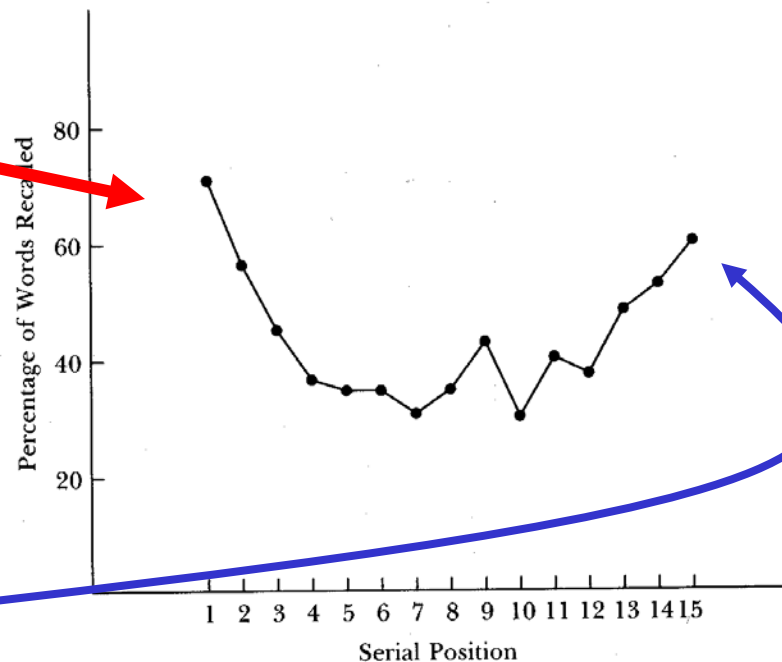
YSPBCUJBLDSL BGKAICIBF
FBICIAKGBLSDLBJUCBPSY

Properties of Long-Term Memory

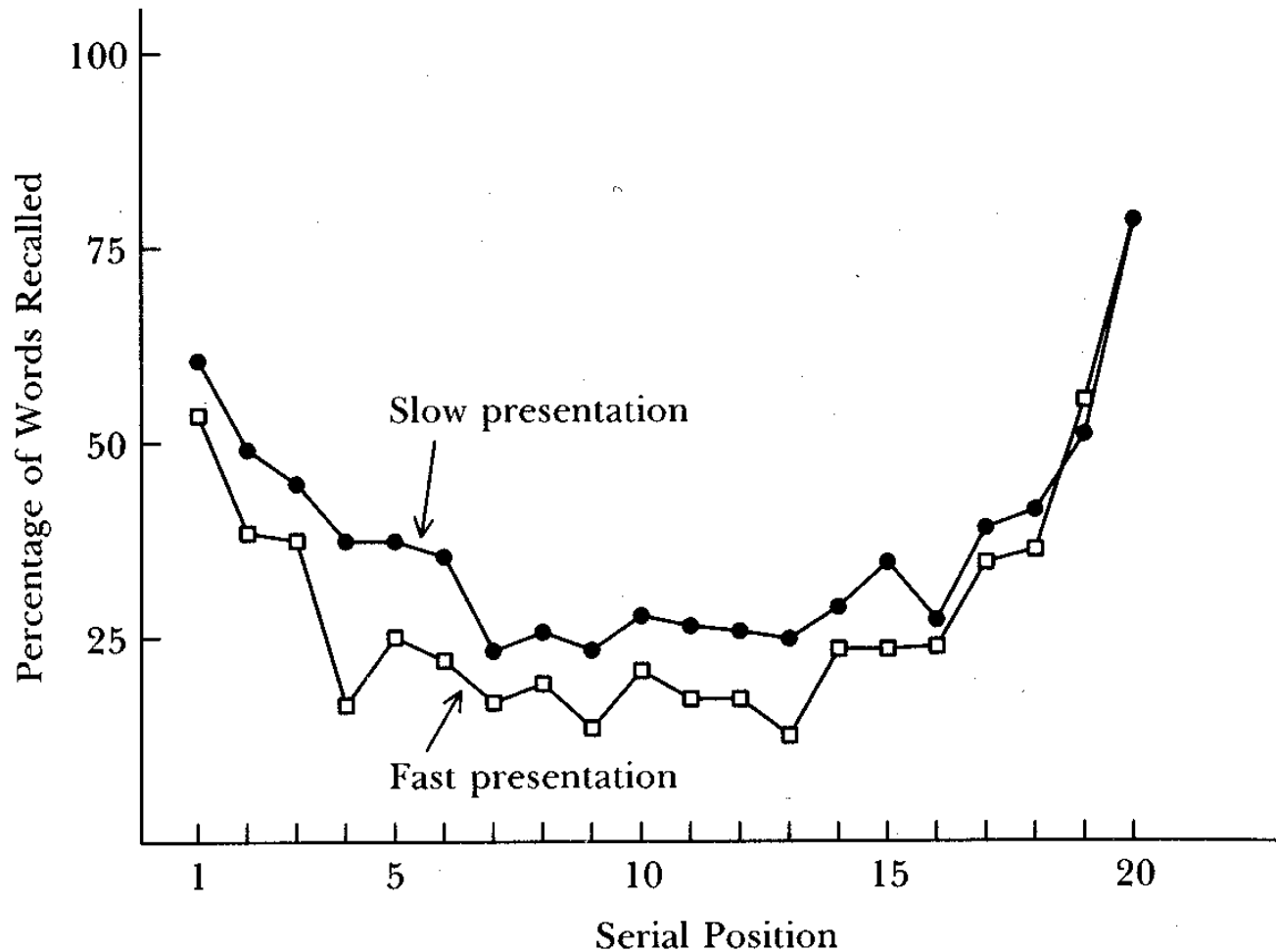
- Passive Repository of Knowledge
 - Enables Pattern Recognition
- Essentially Unlimited
- Retrieval
 - Copies information into short-term store

The Serial-Position Effect

- Single-Trial Free Recall
- Retention as a Function of Serial Position
 - Bowed Curve
- Primacy Effect
 - Retrieval from LTM
- Recency Effect
 - Retrieval from STM



Effect of Spacing on the Serial-Position Effect



Effect of Retention Interval on the Serial-Position Effect

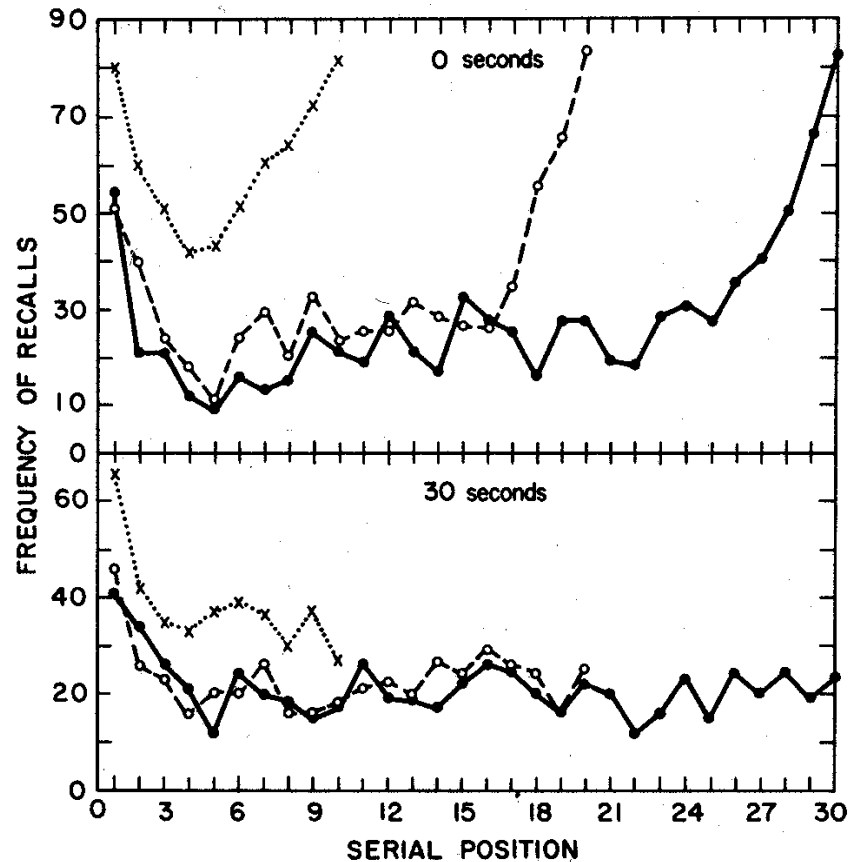


FIG. 28. Probability of correct recall as a function of serial position for free verbal recall with test following 0 seconds and 30 seconds of intervening arithmetic. After Postman & Phillips (1965).

Amnesia and Short-Term Memory

(Wickelgren, 1968)



Patient H.M.

Medial Temporal Lobes

Hippocampus, Mammillary Bodies

- Normal Digit Span
 - Normal Short-Term Memory
- Impaired Free Recall After Distraction
 - Impaired Long-Term Memory

Short-Term and Long-Term Memory Revisited

Shallice & Warrington (1970)

Patient K.F.

Left Parieto-Occipital Area

- Impaired Digit Span
 - Impaired Short-Term Memory
- Normal Free Recall of 10-Item Lists
 - Normal Long-Term Memory

Working Memory

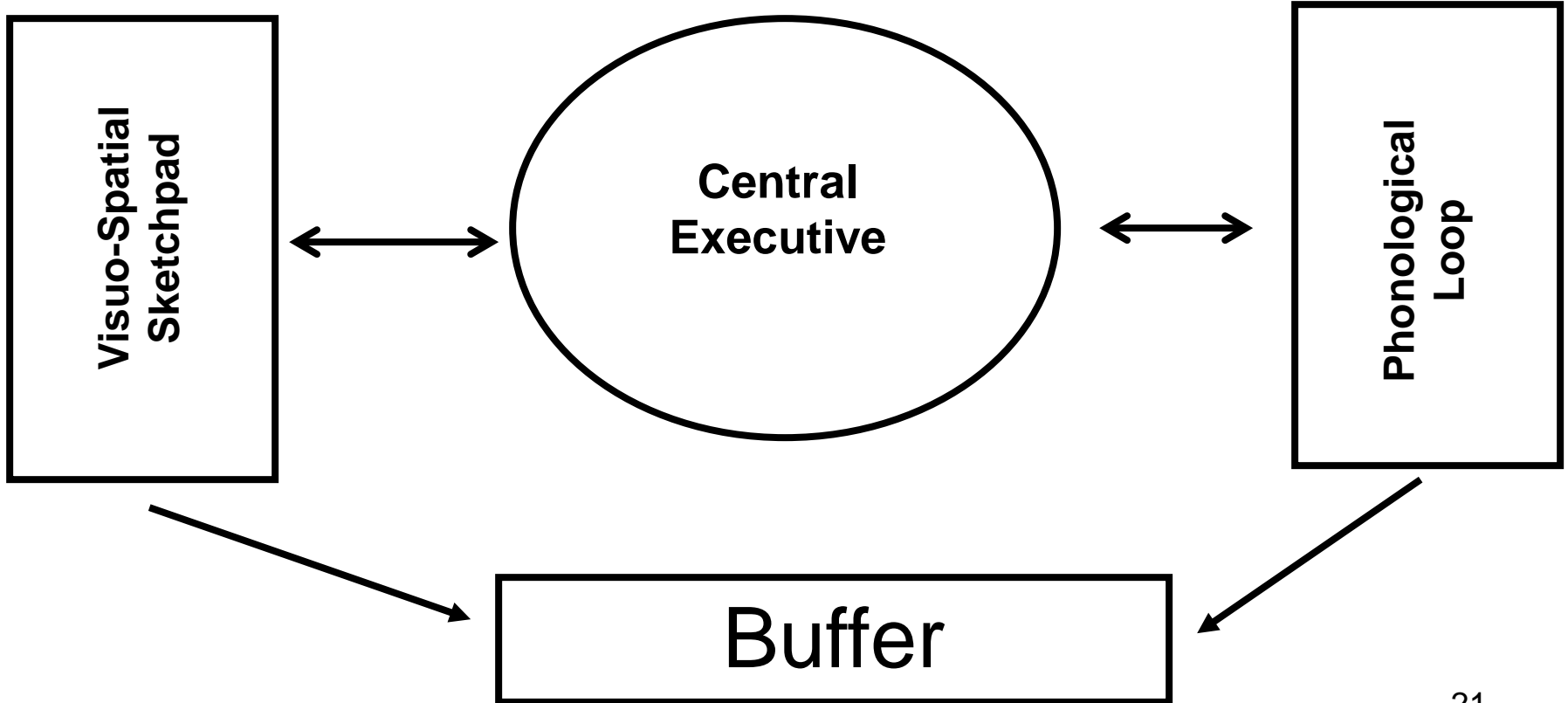
Baddeley & Hitch (1974)



- Not a Route to Long-Term Memory
- Maintains Item in Active State
 - While *Work* is Being Performed

Working Memory

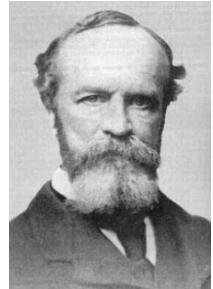
Baddeley, 1986



Attention

Links Perception and Memory

James (1890)



“Every one knows what attention is. It is the taking possession by the mind, in clear and vivid form, of one out of what seem several simultaneously possible objects or trains of thought. Focalization, concentration, of consciousness are of its essence. It implies withdrawal from some things in order to deal effectively with others....”



Dichotic Listening

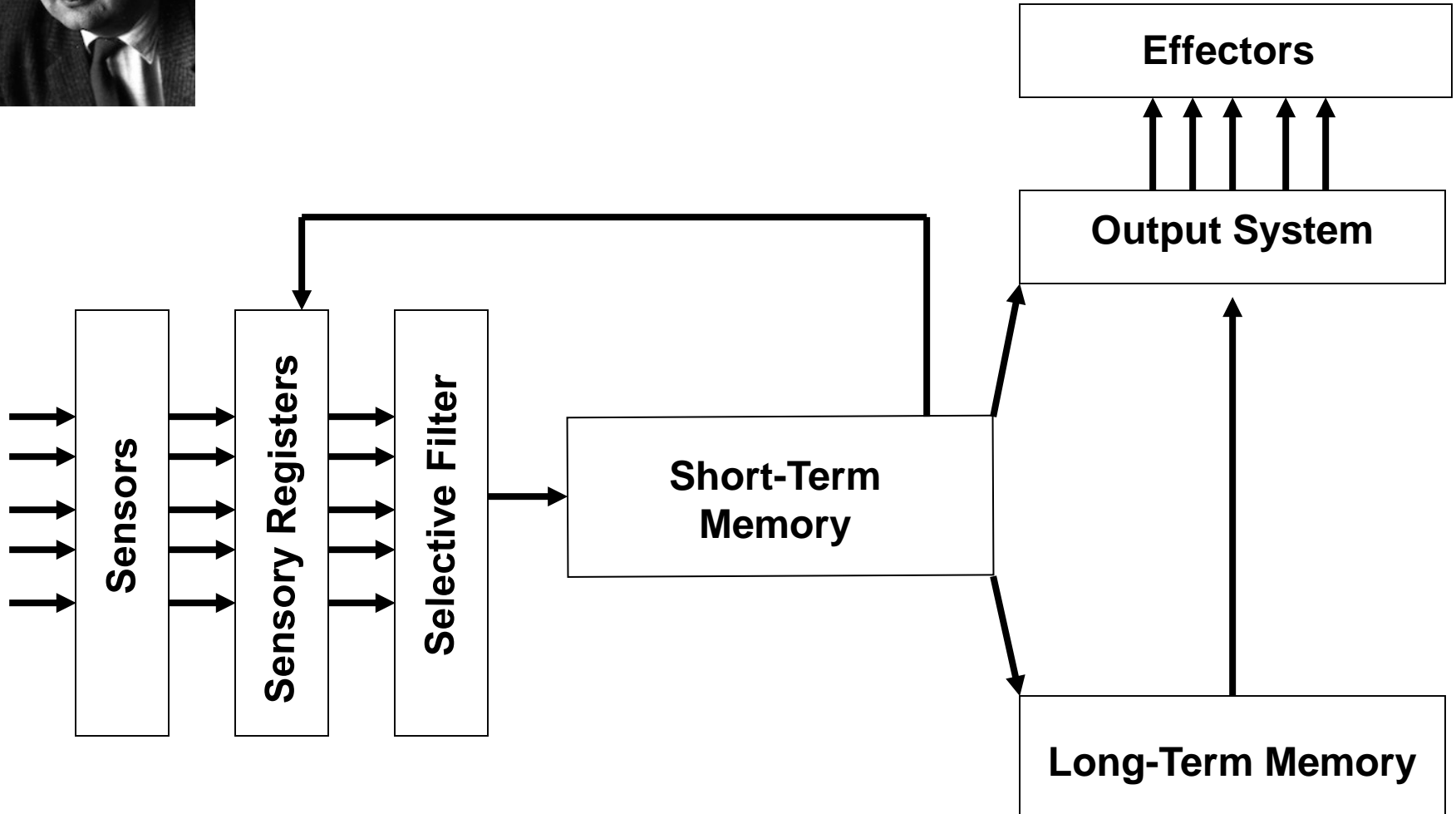
Cherry (1953)

- The “Cocktail-Party” Phenomenon
- Shadowing
- Memory for Unattended Channel
 - Switch in Language
 - Switch Between Forwards and Backwards
 - + Switch Between Male and Female Voice



Filter Model of Attention

After Broadbent (1958)

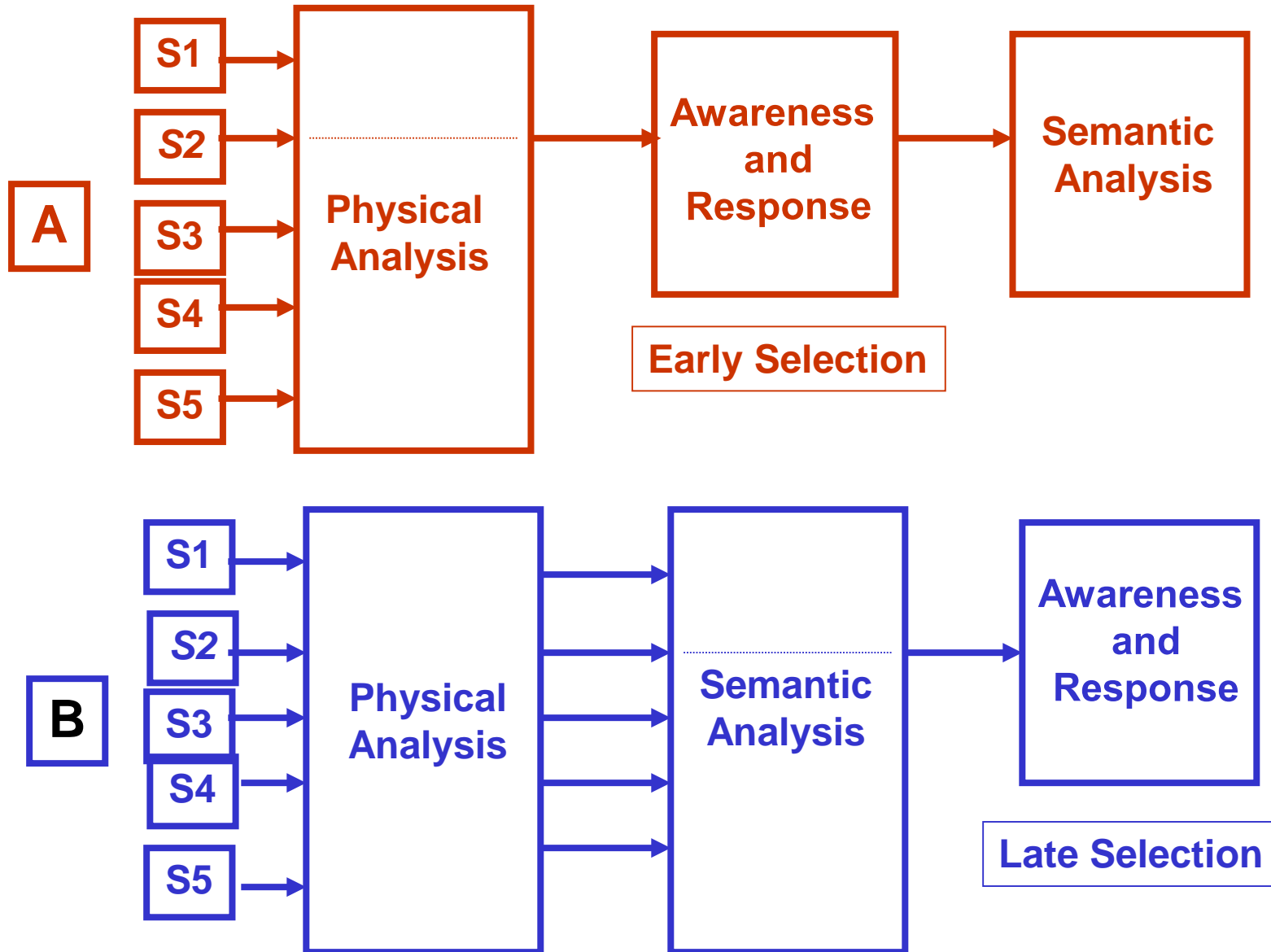


Problems with the Filter Model



- Moray (1952)
 - Attention to One's Own Name
- Treisman (1960)
 - Shift Shadowed Message Between Ears
- Preattentive Semantic Analysis
 - Can Go Beyond Physical Structure

Late- and Early Selection Compared

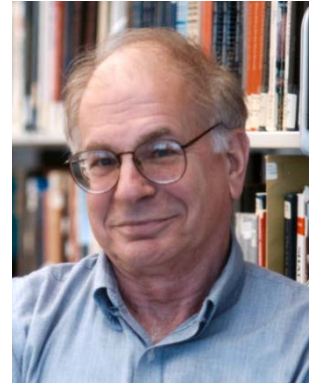


Persisting Problem: Extent of Preattentive Processing

- Analysis Without Conscious Attention
 - Limited to Physical Structure?
 - Extends to Semantic Meaning?
- Debate over Subliminal Perception
 - Is Subliminal Perception Limited to Analyses of Physical Structure?

Capacity Theory of Attention

Kahneman (1973)



- Attention = Mental Effort
 - Arousal
- Cognitive Resources are Limited
- Attention and Task Demands
 - Demanding: Controlled Processing
 - Require Allocation of Attentional Resources
 - Undemanding: Automatic Processing
 - Require No Attentive Effort
 - Result of Extensive Practice

Views of Attention and Automaticity

- Traditional “Filter” View
 - Elementary Processes are Preattentive
 - Physical/Spatial Analyses
 - Complex Processes Must be Post-Attentive
 - Meaning Analysis/Categorization
- Revisionist “Capacity” View
 - Elementary Processes Typically Preattentive
 - Performed Automatically
 - Complex Processes can be Preattentive *Too*
 - Once Automatized through Practice

RED	BLUE	RED	BLUE
GREEN	GREEN	GREEN	GREEN
GREEN	BLUE	GREEN	BLUE
BROWN	RED	BROWN	RED
BLUE	BROWN	BLUE	BROWN
GREEN	BROWN	GREEN	BROWN
RED	BLUE	RED	BLUE
BROWN	GREEN	BROWN	GREEN
RED	BLUE	RED	BLUE
GREEN	BROWN	GREEN	BROWN
RED	BROWN	RED	BROWN
BROWN	BLUE	BROWN	BLUE
BROWN	GREEN	BROWN	GREEN

The Stroop Interference Experiment

Stroop (1935)



Automatic vs. Controlled Processes

After LaBerge & Samuels (1974); Posner & Snyder (1975);
Schneider & Shiffrin (1977); Schiffrin & Schneider (1977)

- Inevitable Evocation
- Incurable Completion (Ballistic)
- Efficient Execution
- Parallel Processing
- *Unconscious* in the Strict Sense of the Term
 - Operate Outside Phenomenal Awareness
 - Operate Outside Voluntary Control

