Lecture 2 Seminal Ideas and Human Performance Modeling

Xiaojun Bi

Stony Brook University

xiaojun@cs.stonybrook.edu

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Review

Human Computer Interaction

- What is Human Computer Interaction (HCI)?

A discipline concerned with the design, evaluation and implementation of _____ for human use and with _____ surrounding them.

ACM SIGCHI Curricula for Human-Computer Interaction
by Hewett, Baecker, Card, Carey, Gasen, Mantei, Perlman, Strong and Verplank
http://old.sigchi.org/cdg/cdg2.html (access 2018)

Human Computer Interaction

- What is Human Computer Interaction (HCI)?

A discipline concerned with the design, evaluation and implementation of interactive computing systems for human use and with the study of major phenomena surrounding them.

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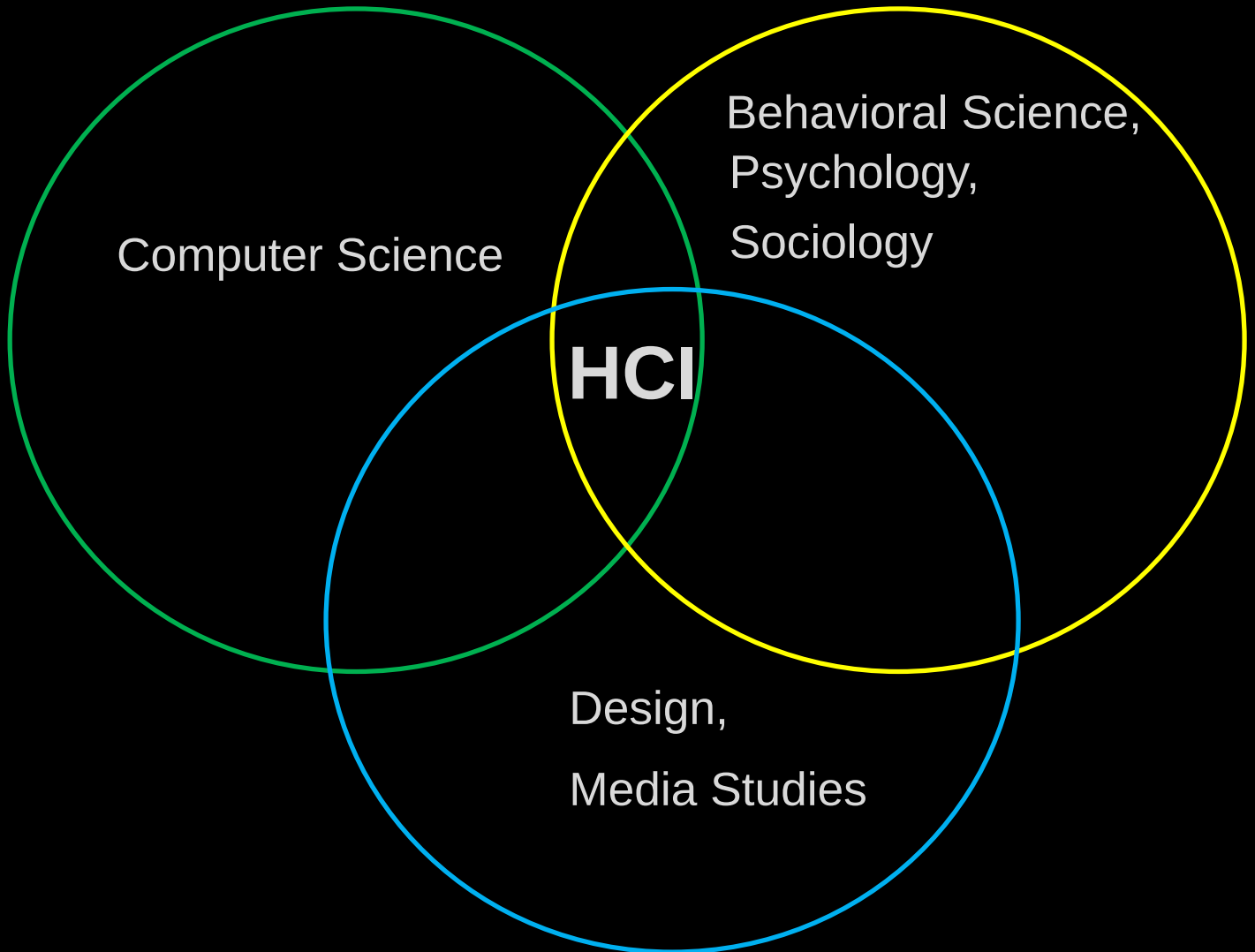
Human Computer Interaction

- What is Human Computer Interaction (HCI)?



Agenda

- Seminal Ideas
- Human Performance Modeling

Seminal Ideas

Demo Videos

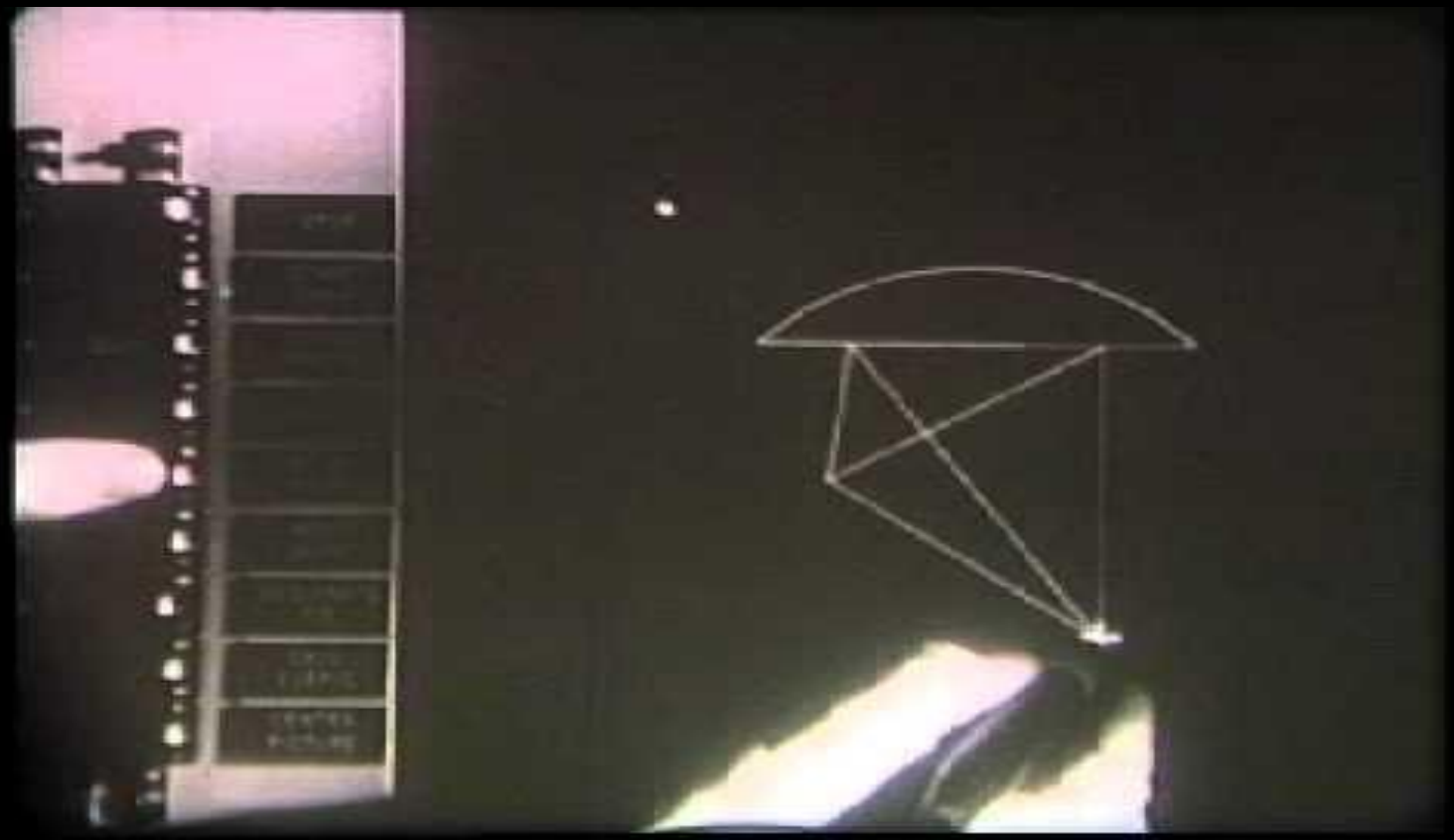
1968 Englebart's **NLS** Demo

Demo Videos

1968 Englebart's **NLS** Demo

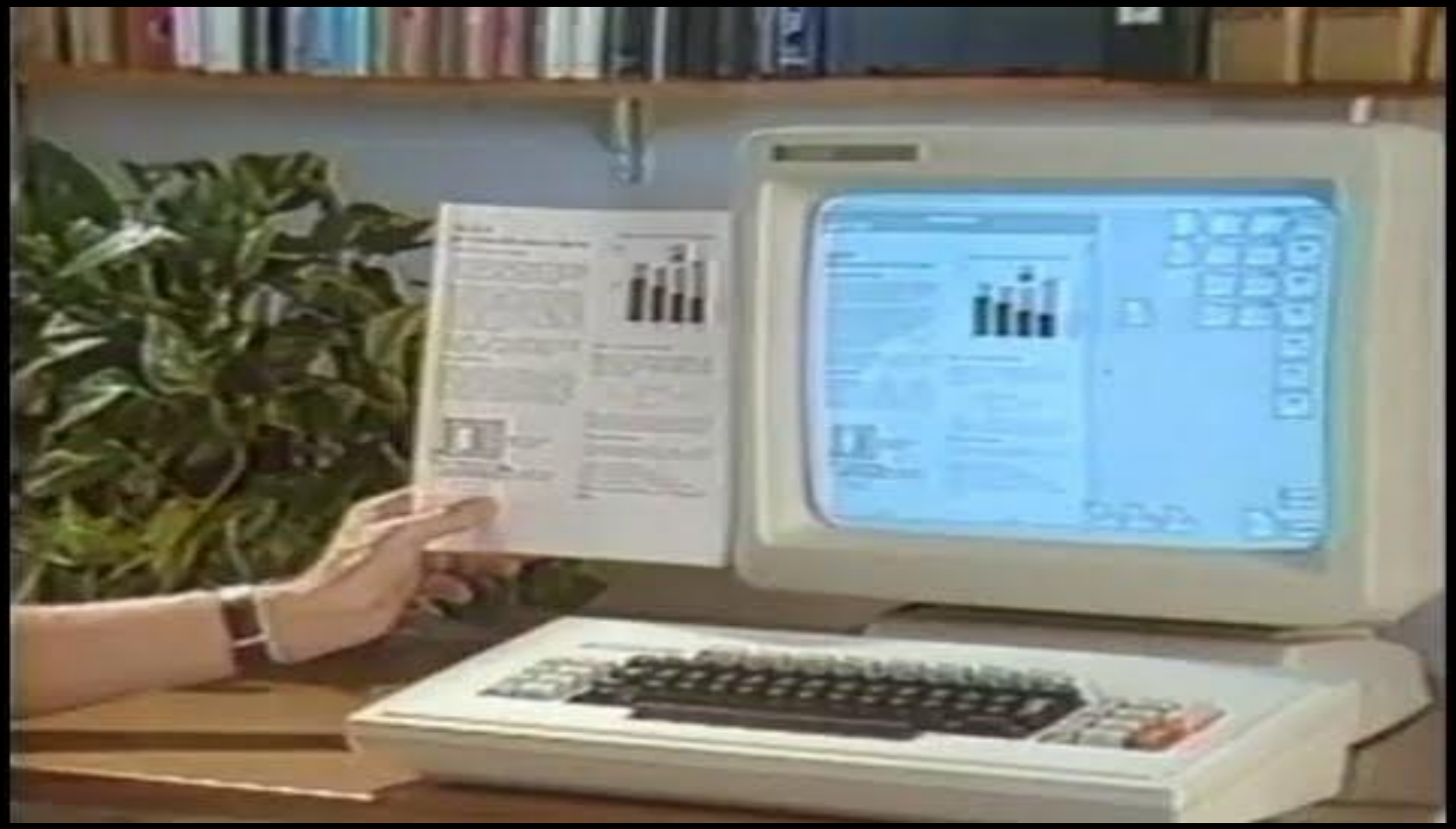
Demo Videos

1963 Sutherland's **SketchPad**



Demo Videos

1982 Xerox **Star**

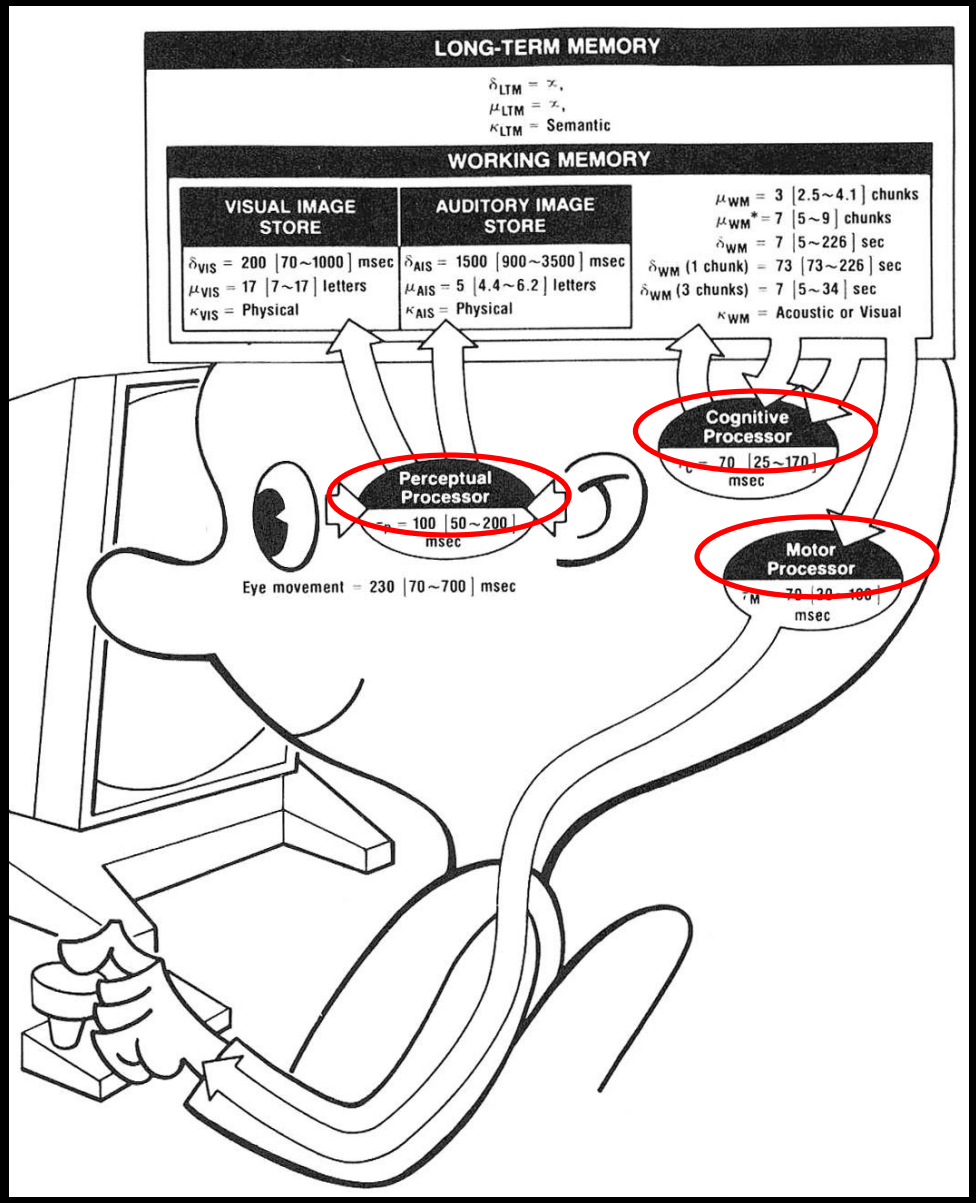


A Simple HCI Task

- Pressing the corresponding key

B

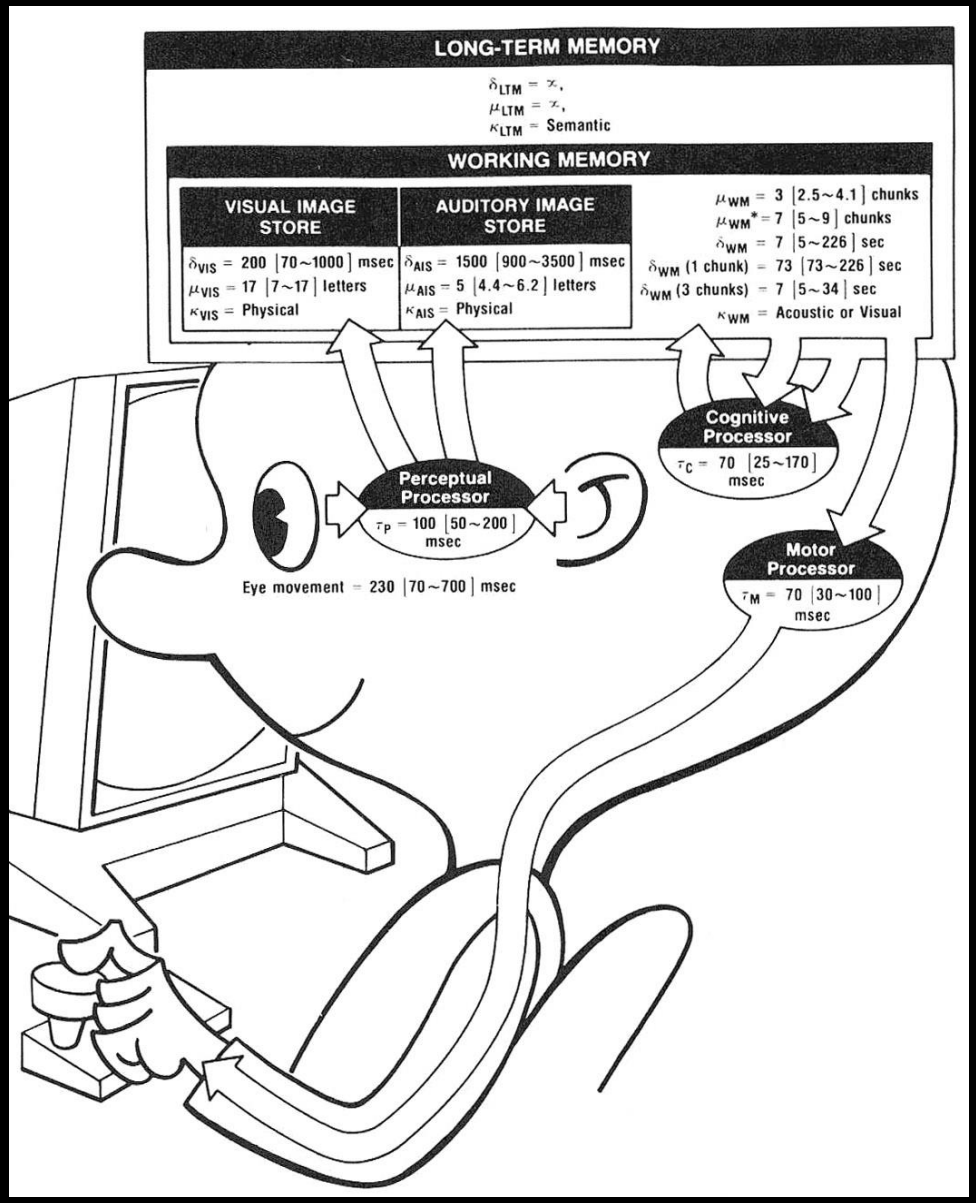
Human Information Processor



3 subsystems

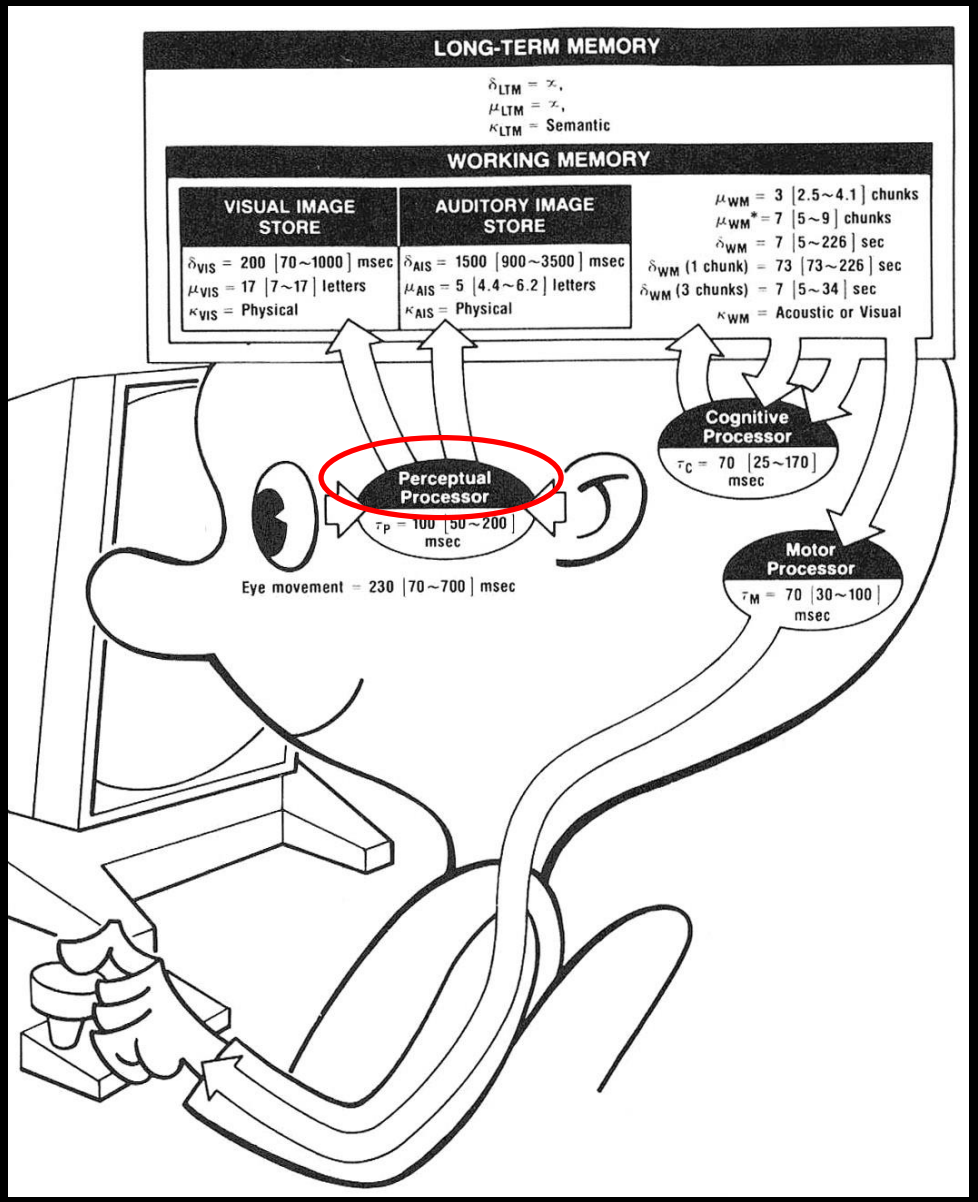
- Perceptual
- Cognitive
- Motor

Human Information Processor



- Each subsystem has its own memories and processors.
- Memory
  - μ, storage capacity in items
  - δ, decay time of an item
  - κ, main code type (physical, acoustic, visual, semantic)
- Processor
  - τ, cycle time
- Three subsystems can work in parallel.

The Perceptual System



- Function:

Carries the sensations of the physical world detected by the body's sensory systems into internal representations of the mind by means of integrated sensory systems.

- An Example: the visual system

  Eye-movement: 230 [70-700] ms

Human Performance

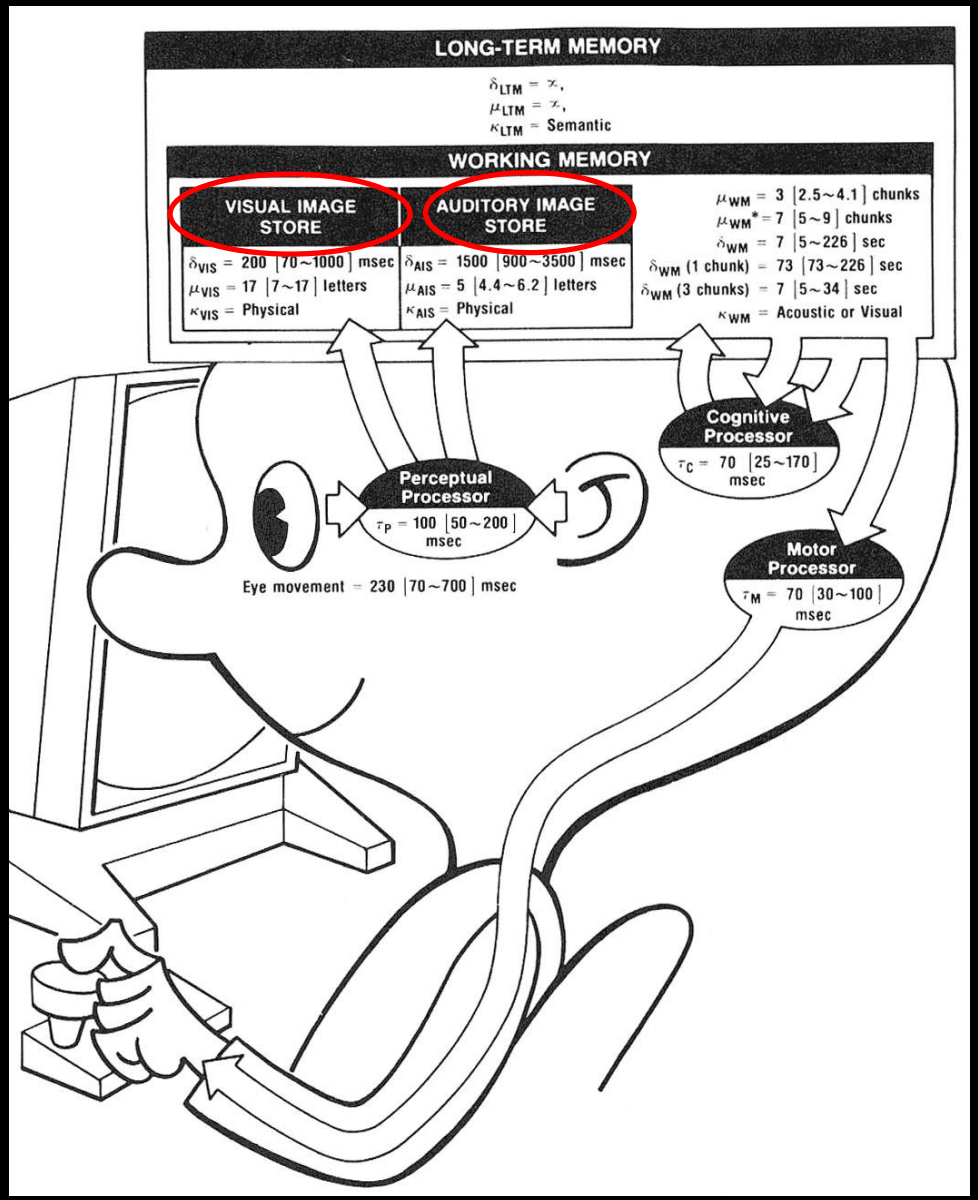
- Three Types of Models

  Best Performance (Fastman)

  Worst Performance (Slowman)

  Nominal Performance (Middleman)

Perceptual Memories

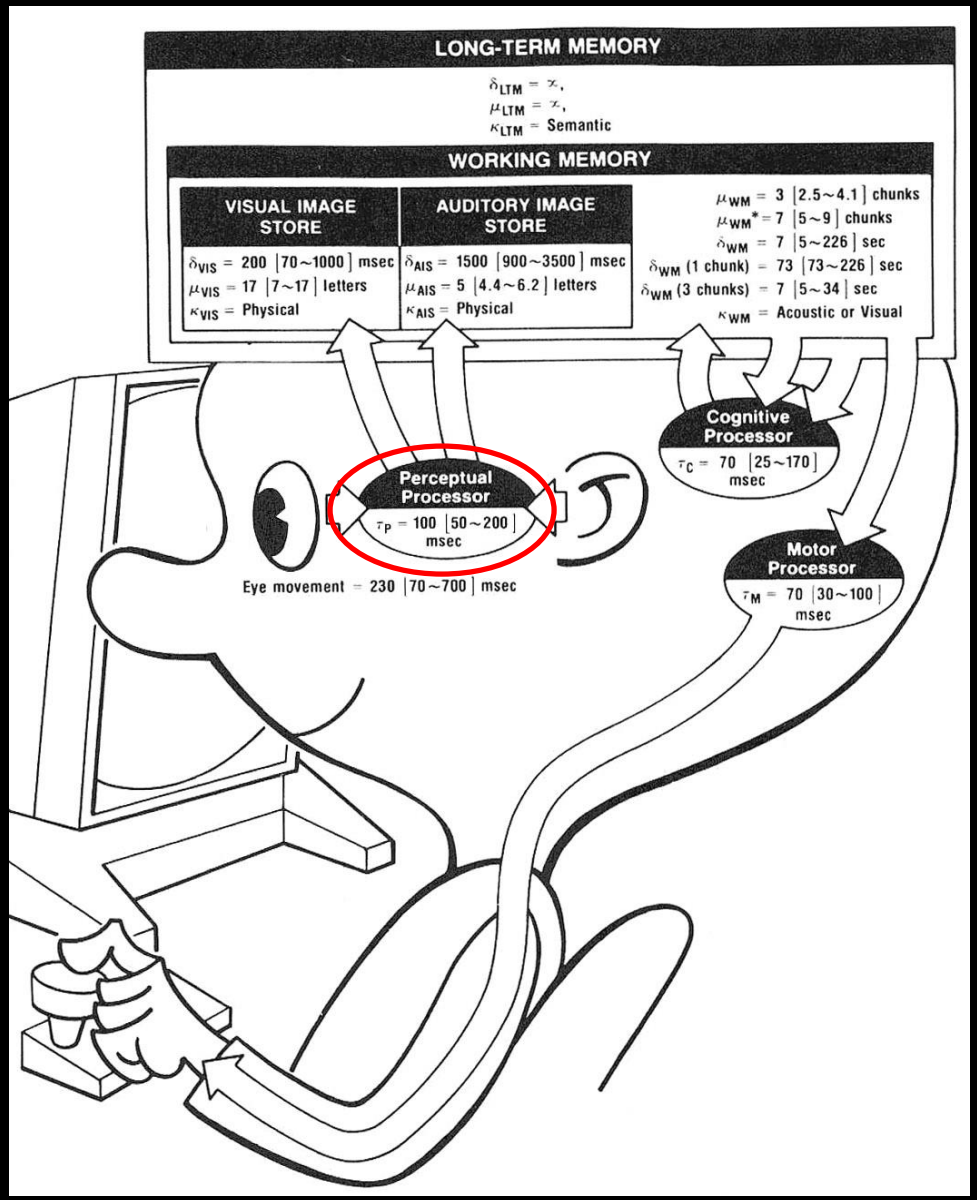


κ_{VIS}=physical
κ_{AIS}=physical

δ_{VIS}=200[90~1000]ms
δ_{AIS}=1500[900~3500]ms

μ_{VIS}=17 [7~17] letters
μ_{AIS}=5 [4.4~6.2] letters

Perceptual Processor



τ_p=100[50~200] ms

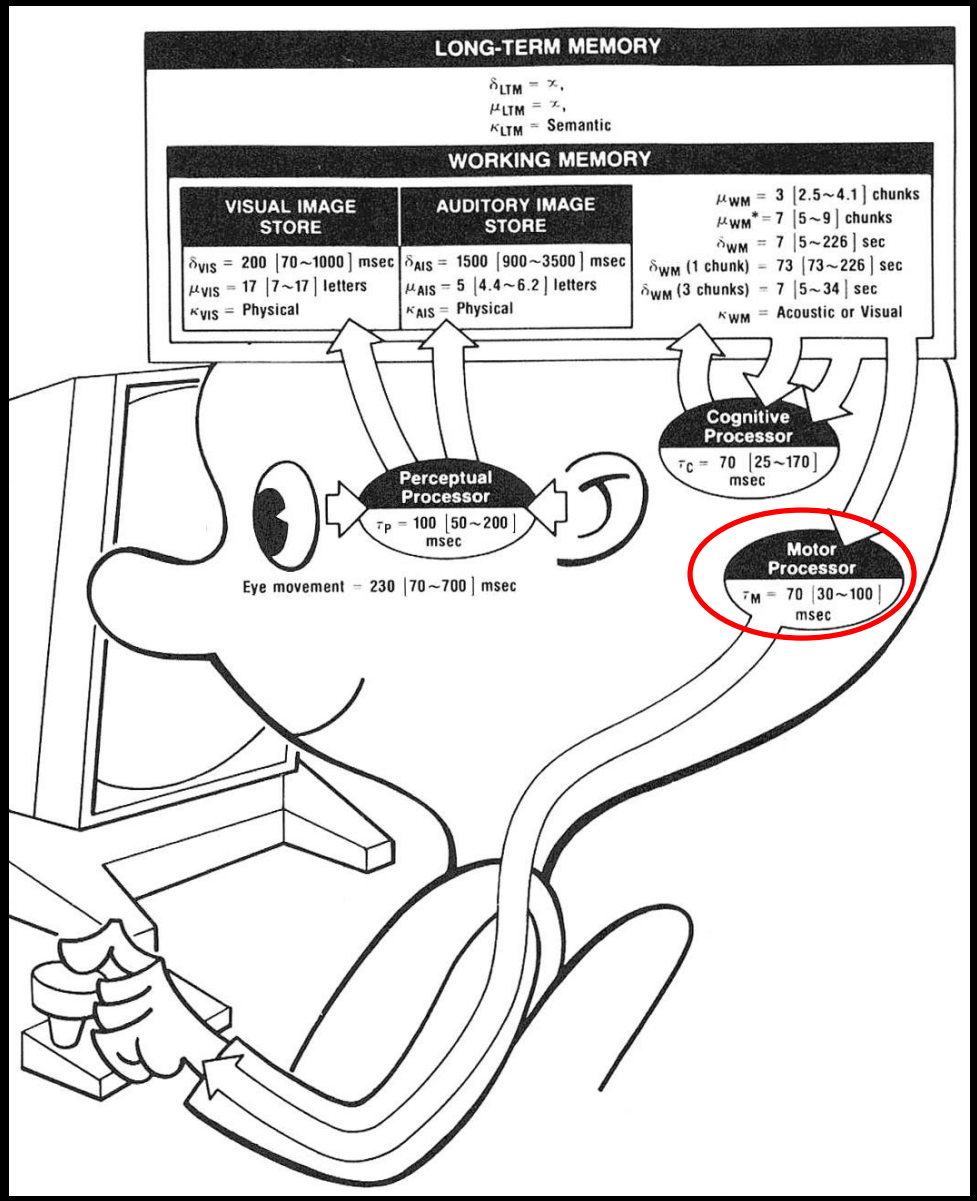
Perception

Moving Picture Rate

Example 1. Compute the frame rate at which an animated Image on a video display must be refreshed to give the illusion of movement.

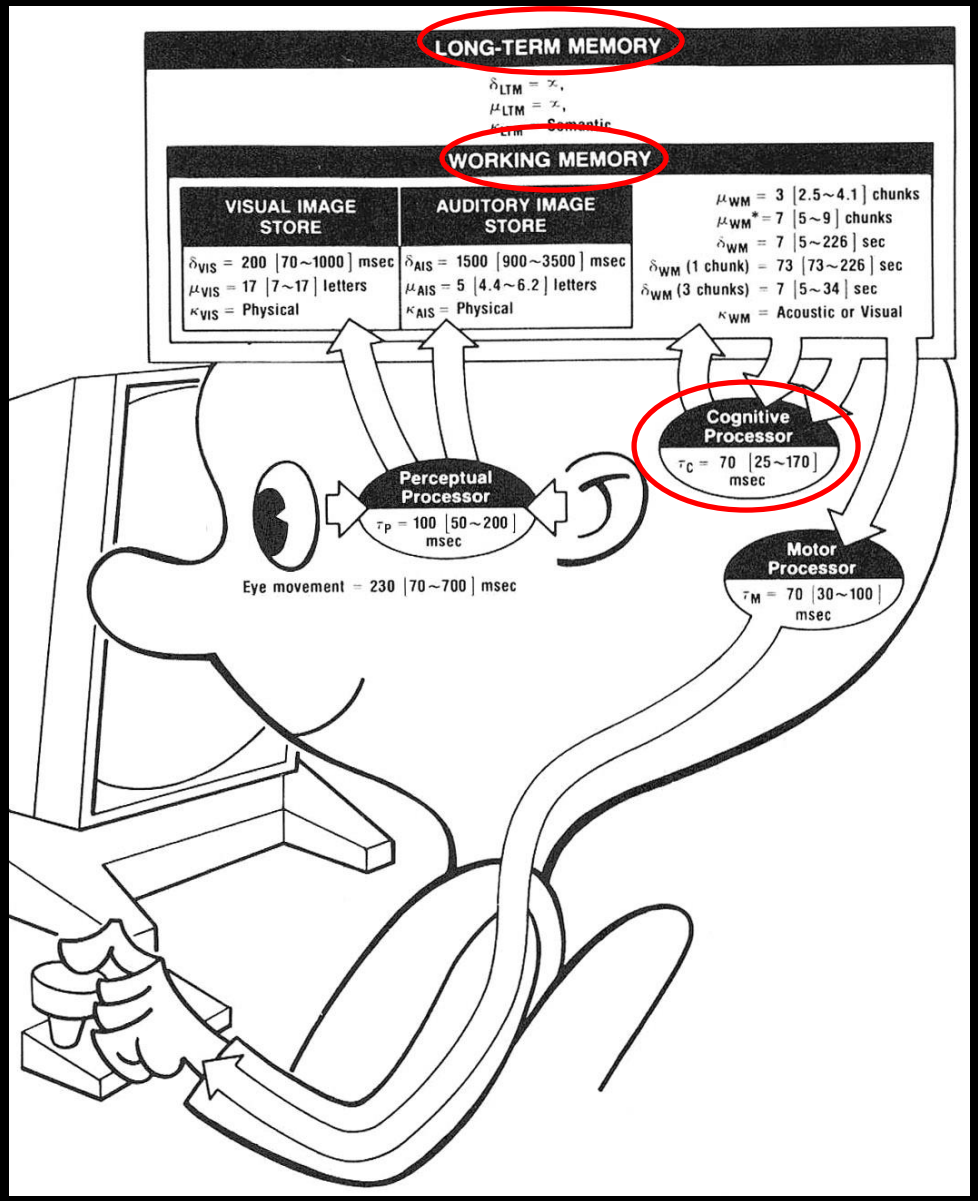
Frame rate > $1/\tau_p$ = 1 / (100 ms / frame)
= 10 frames / sec

Motor Processor



τ_M=70 [30~100] ms

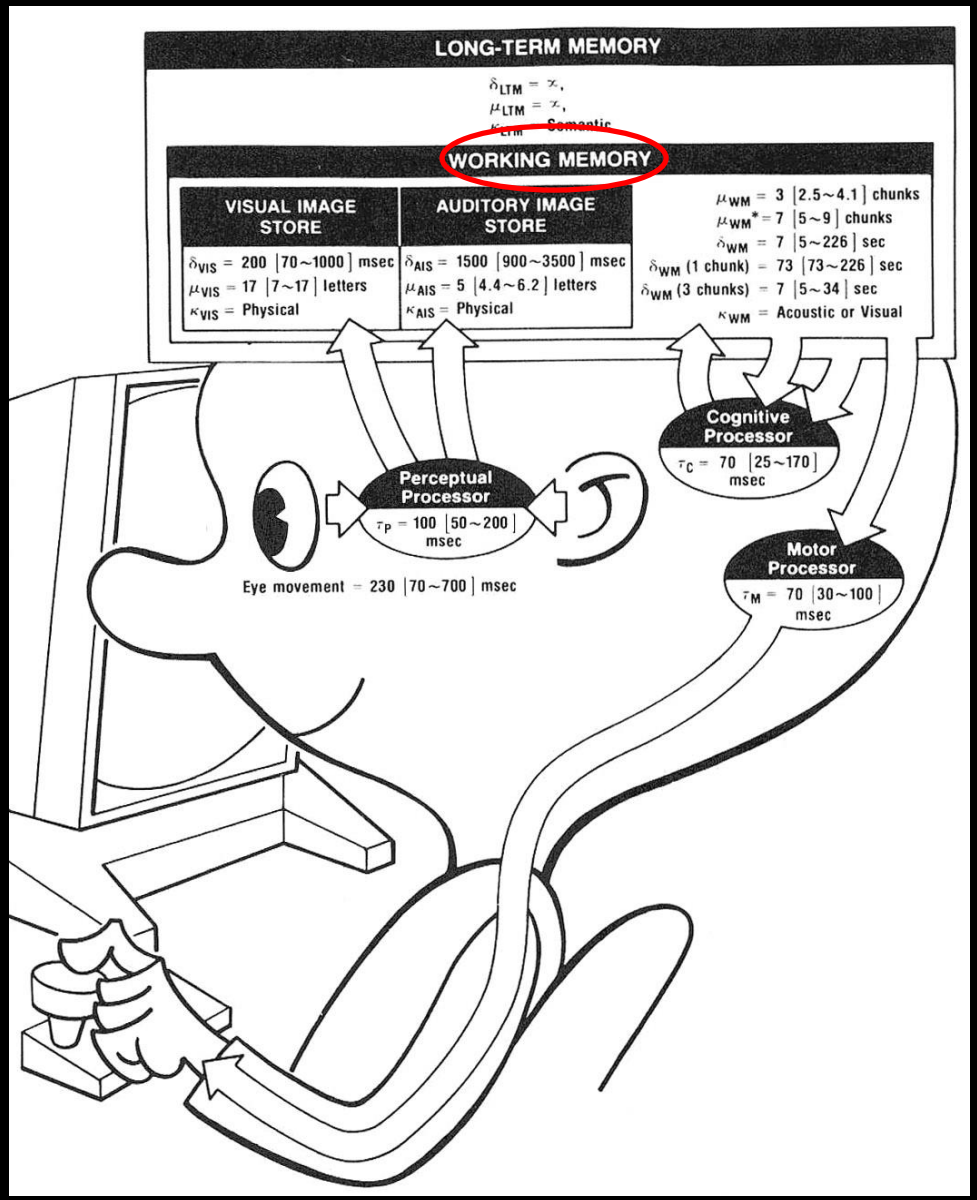
Cognitive System



- Working Memory:
To hold Information under current consideration

- Long-Term Memory:
To store knowledge for future use

Cognitive System

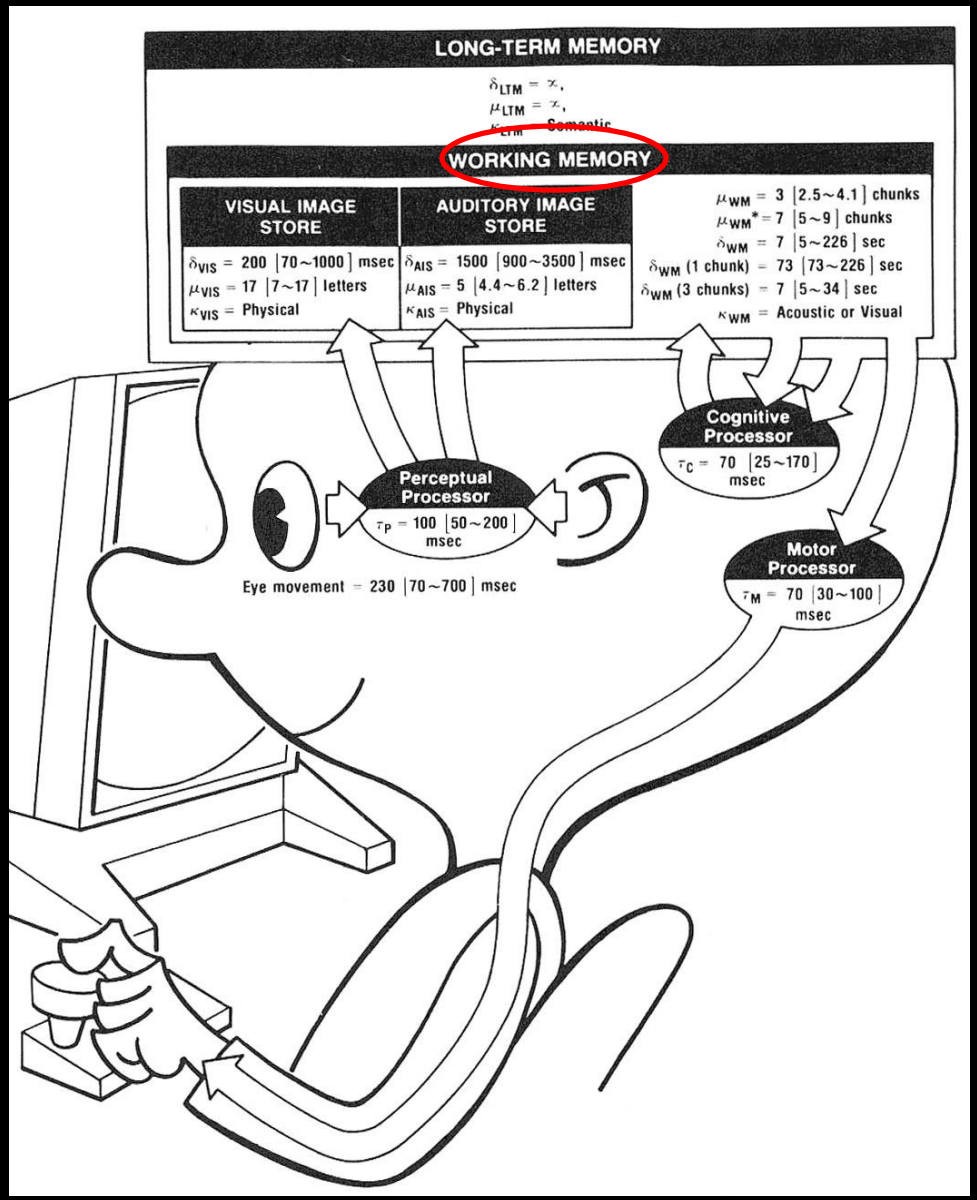


- Working Memory:

To hold Information under current consideration

κ_{WM}=acoustic or visual

Cognitive System



- Working Memory:

To hold Information under current consideration

Which sequence is easy to repeat?

B C S B M I U B S

Which sequence is easy to repeat?

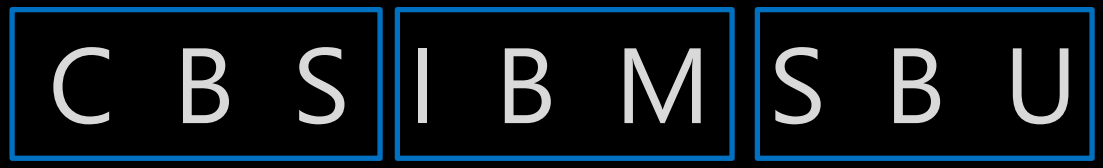
Which sequence is easy to repeat?

C B S I B M S B U

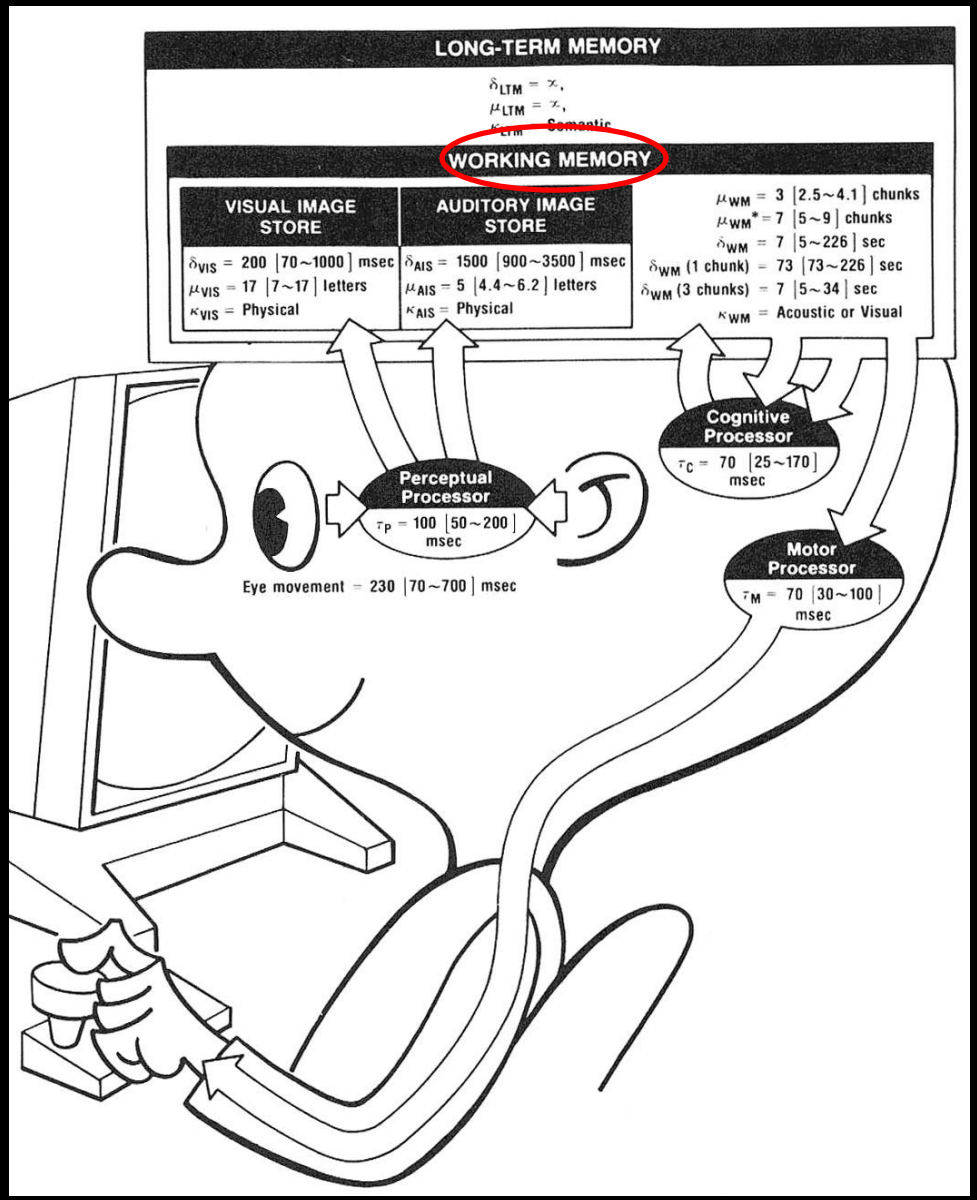
Which sequence is easy to repeat?

Which sequence is easy to repeat?

B C S B M I U B S



Cognitive System

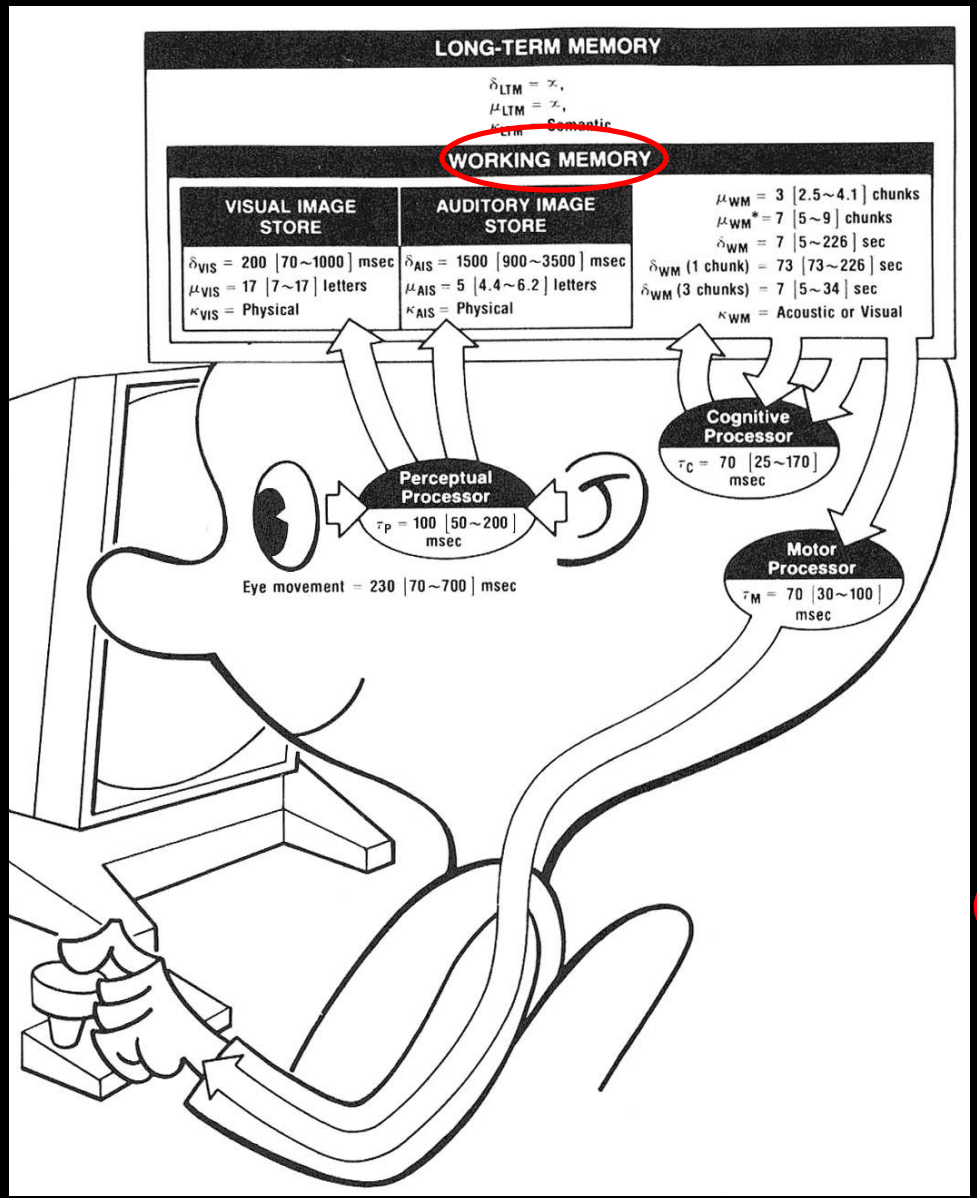


- Working Memory:

To hold Information under current consideration

Consists of *chunks*

Cognitive System



- Working Memory:

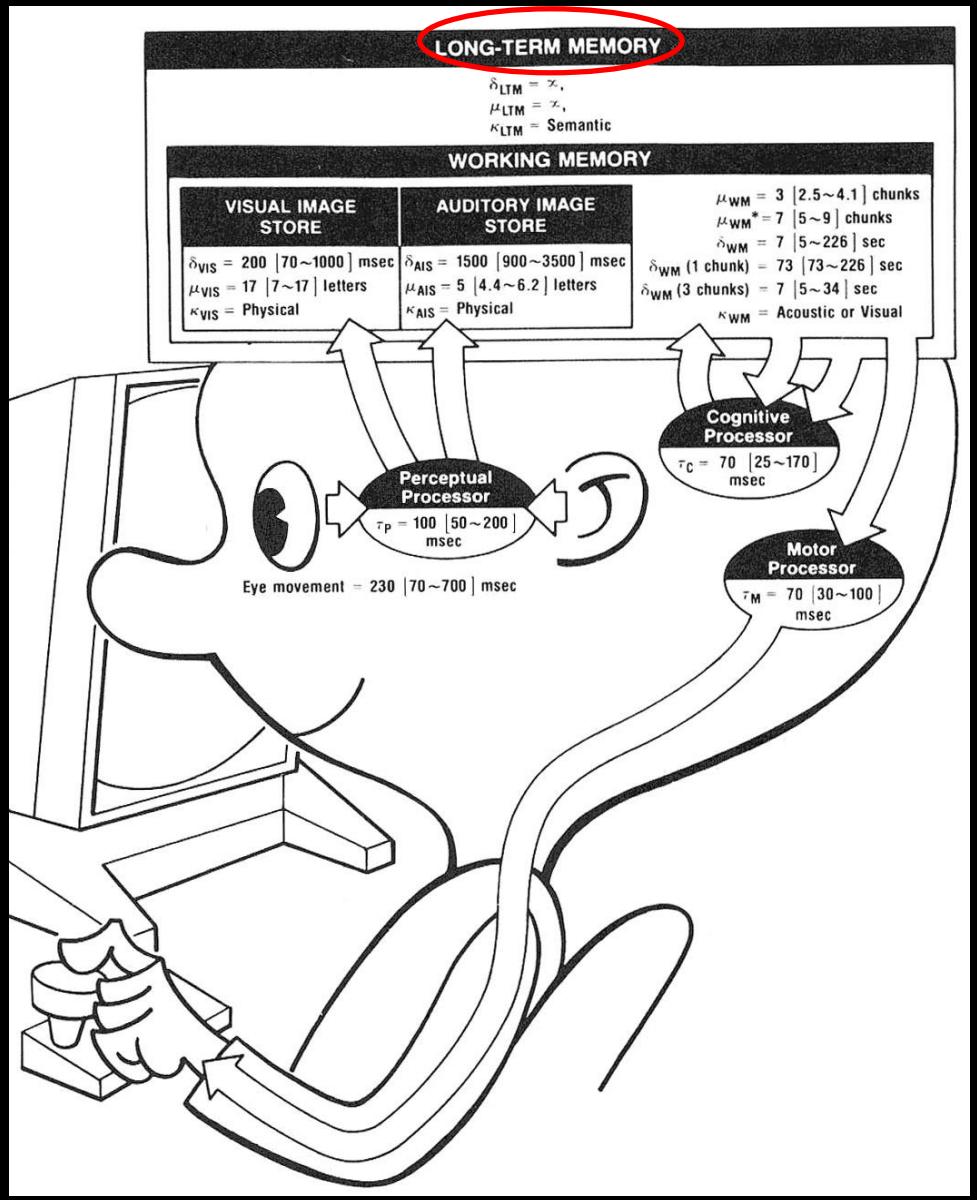
To hold Information under current consideration

δ_{WM}=7[5~226]sec

δ_{WM}(1 chunk) = 73[73~226] sec
δ_{WM}(3 chunk) = 7[5~34] sec

μ_{WM}=7 [5~9] letters

Cognitive System



- Long-Term Memory:
  To store knowledge for future use

  $\delta_{LTM}=\infty$

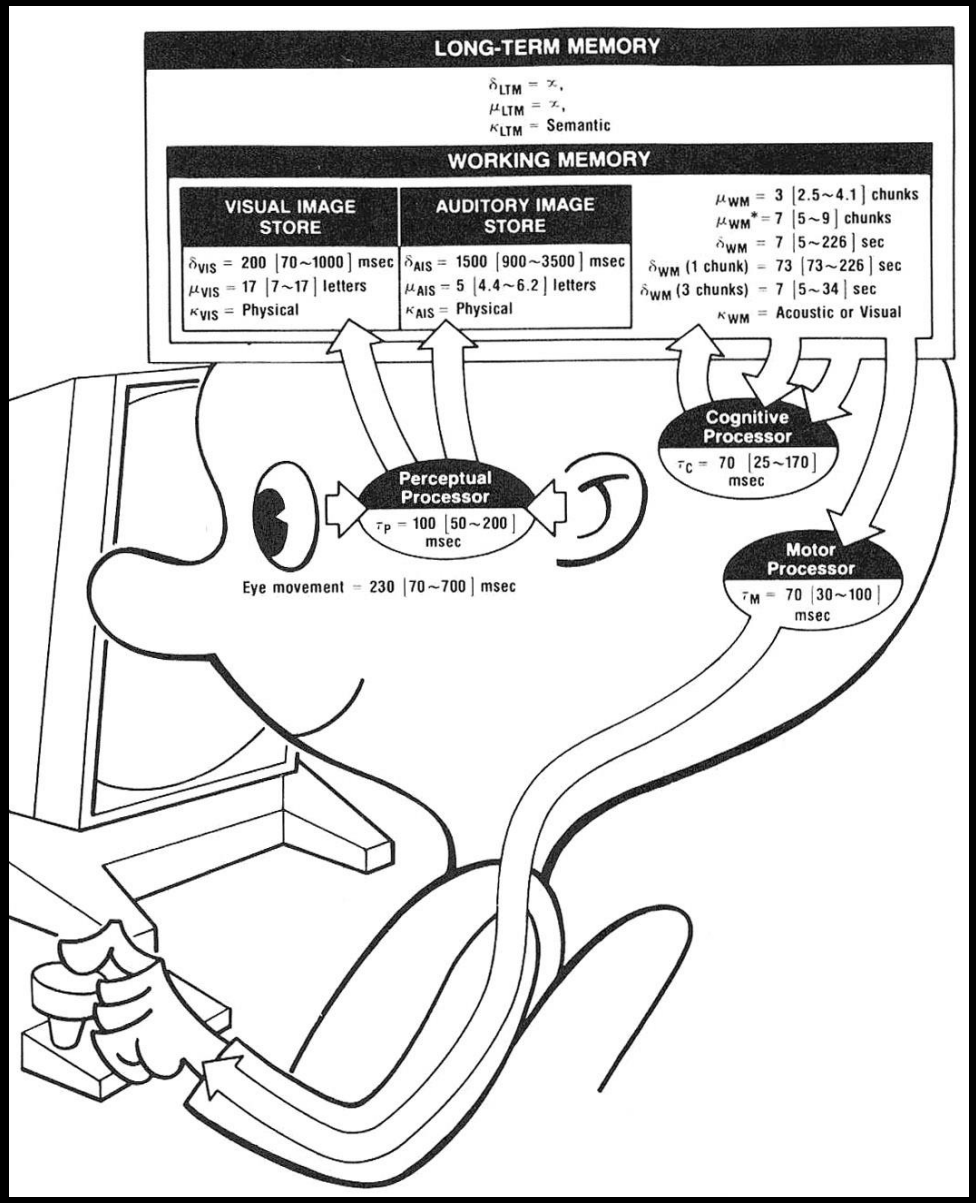
  κ_{LTM}=semantic

- How to improve the probability of being retrieved?

  Associate it with items in LTM already

- A fast-read, slow-write system

Summary



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- Three subsystems can work in parallel.

Perception

How fast can a person read text?

Eye-movement: 230 [70-700] ms

Solution. Assuming 230 ms/saccade, a reading rate can be calculated from assumptions about how much the reader sees with each fixation. If he were to make one saccade/letter (5 letters/word), the reading rate would be:

(60 sec/min) / (0.230 sec/saccade X 5 saccade / word) = 52 words/min

Questions

How fast can a person read text?

Eye-movement: 230 [70-700] ms

For one saccade/word, the rate would be:
(60 sec/min) / (0.230 sec/saccade X 1 saccade / word) = 261 words/min.

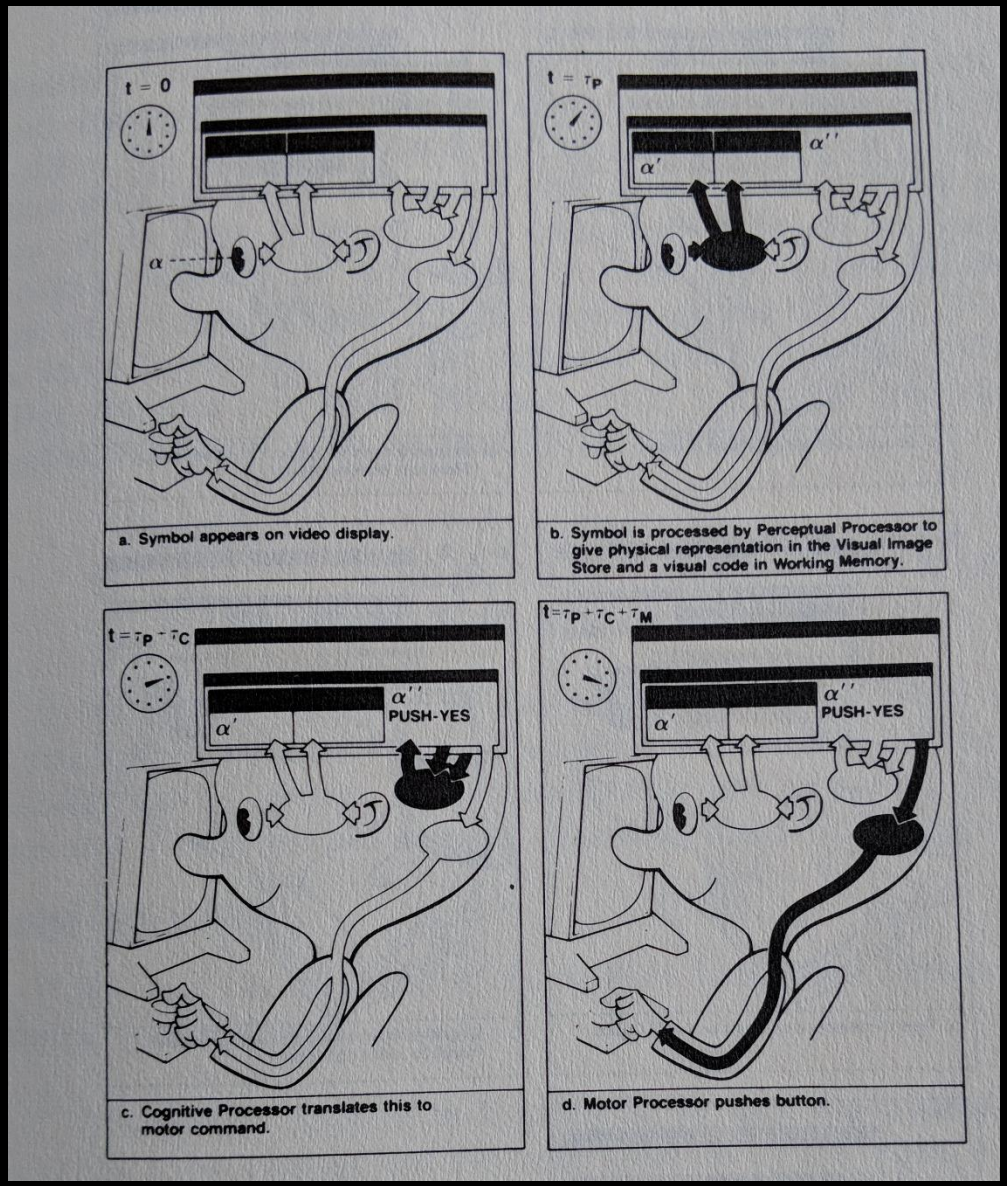
For one saccade/phrase (containing the number of characters/fixation found for good readers, 13 chars = 2.5 words), the rate would be:
(60 sec/min) / (0.230 sec/saccade X 1 / 2.5 saccade / word) = 652 words/min.

Simple Decisions

Questions

A user sits before a computer display terminal. Whenever any symbol appears, he is to press the space bar. What is the time between signal and response?

Questions



Reaction Time =

$\tau_p + \tau_C + \tau_M =$

$100 + 70 + 70 = 240$ ms

Physical Matches

The user is presented with two symbols, one at a time. If the second symbol is identical to the first, he is to push the key labeled YES, otherwise he is to push NO. What is the time between signal and response for the YES case?

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Reaction Time = $\tau_p + 2\tau_C + \tau_M$

$= 100\ [50 \sim 200] + 2 \times (70\ [25 \sim 170]) + 70\ [30 \sim 100]$

$= 310\ [130 \sim 640]$ ms

Name Matches

Suppose in the previous example the user was to press YES if the symbols had the same name (as do the letters A and a), and NO if they did not. What is the time between signal and response for the YES response?

$$\text{Reaction Time} = \tau_p + 3\tau_C + \tau_M$$