

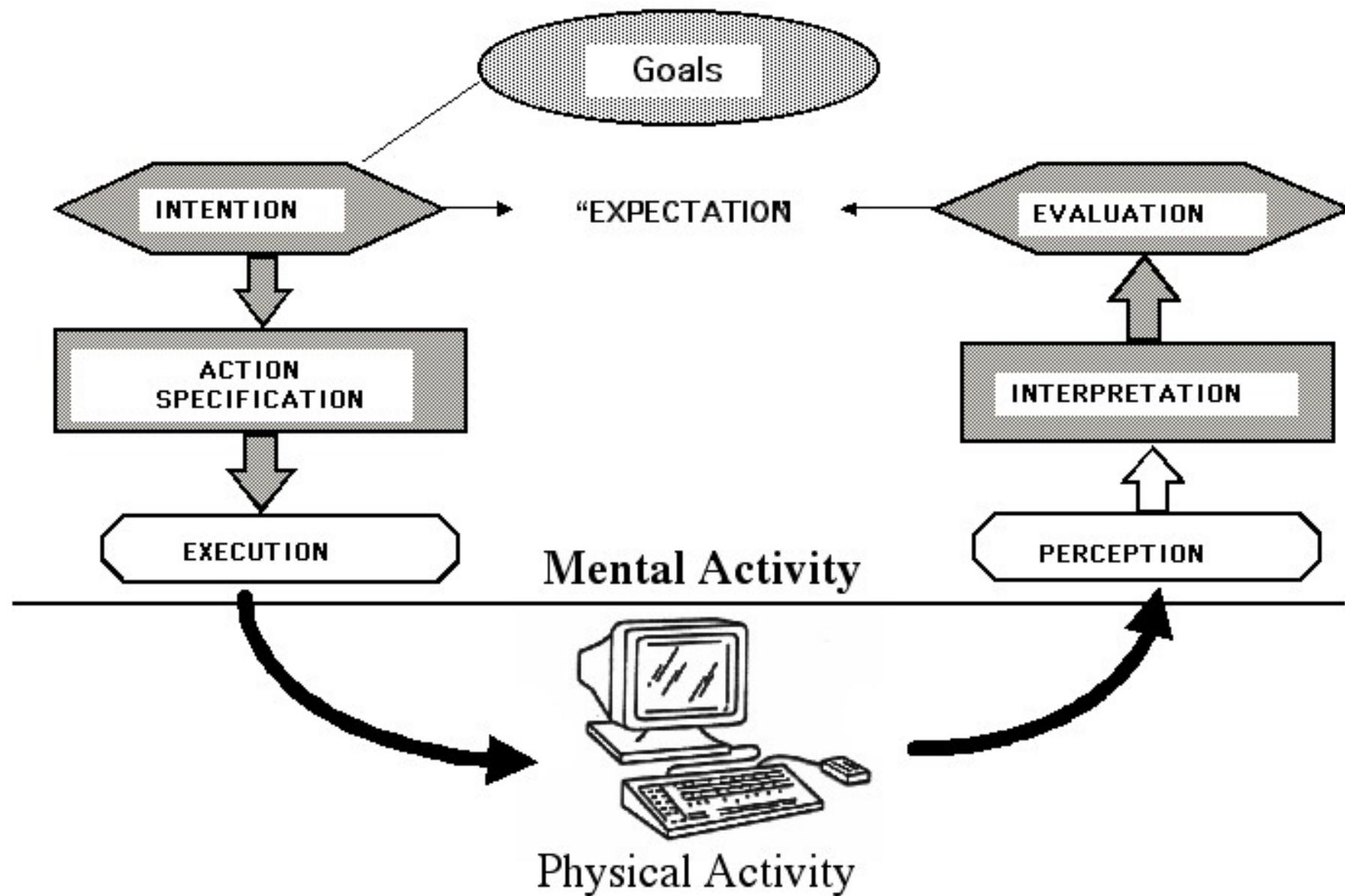
Human Computer Interaction

CS449 – CS549

Week 5-2

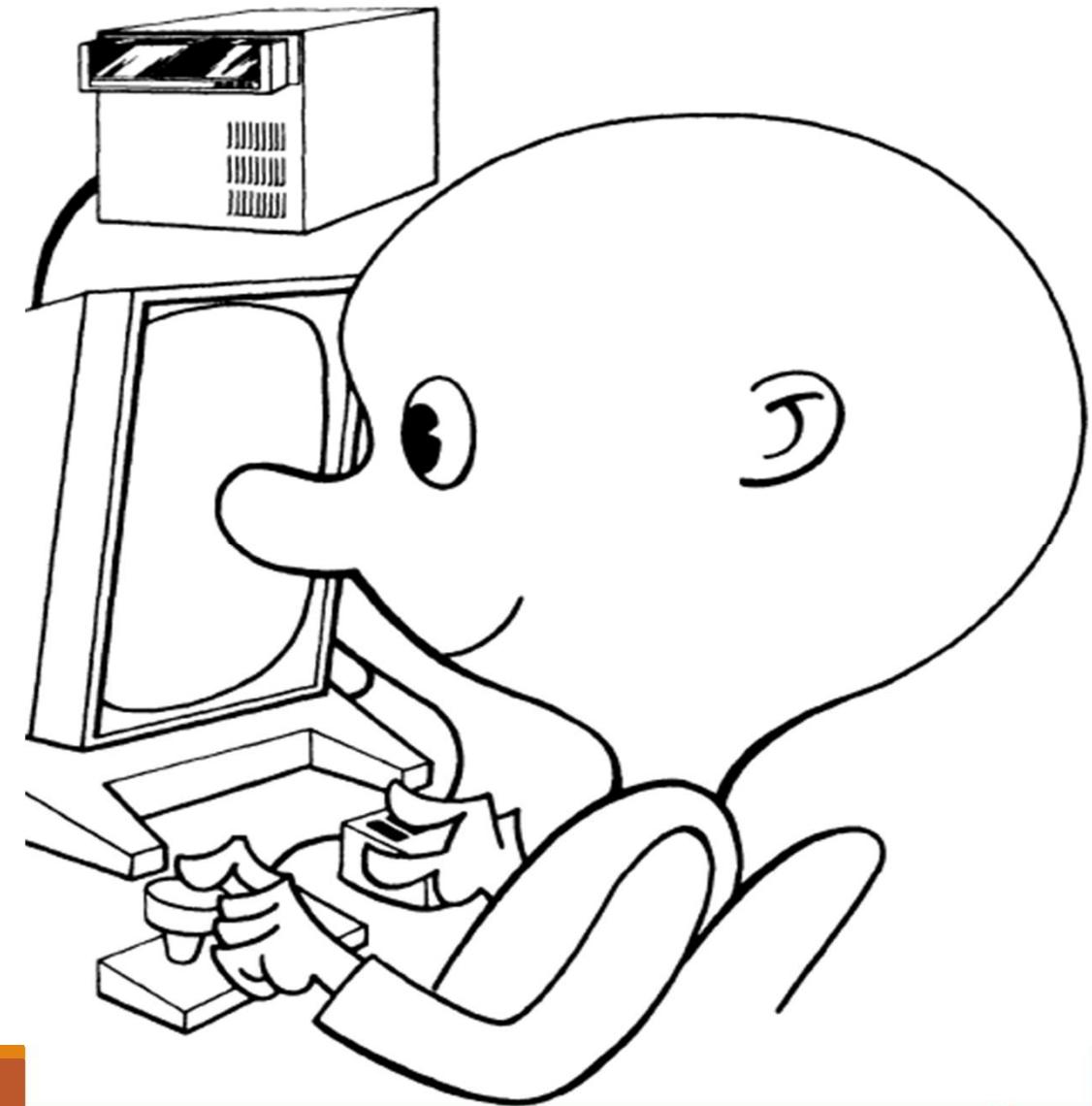
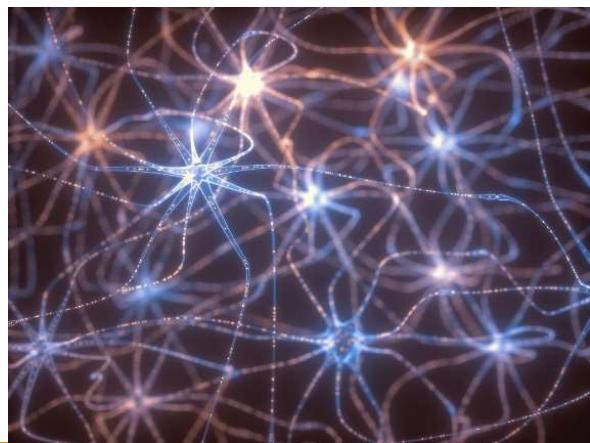
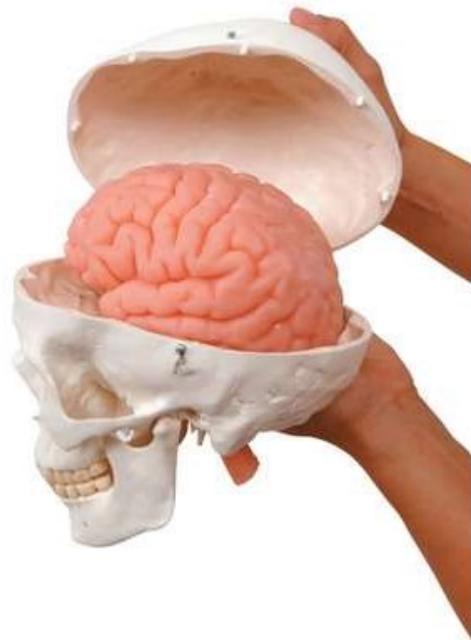
Psychology of HCI-1

KÜRSAT ÇAĞILTAY

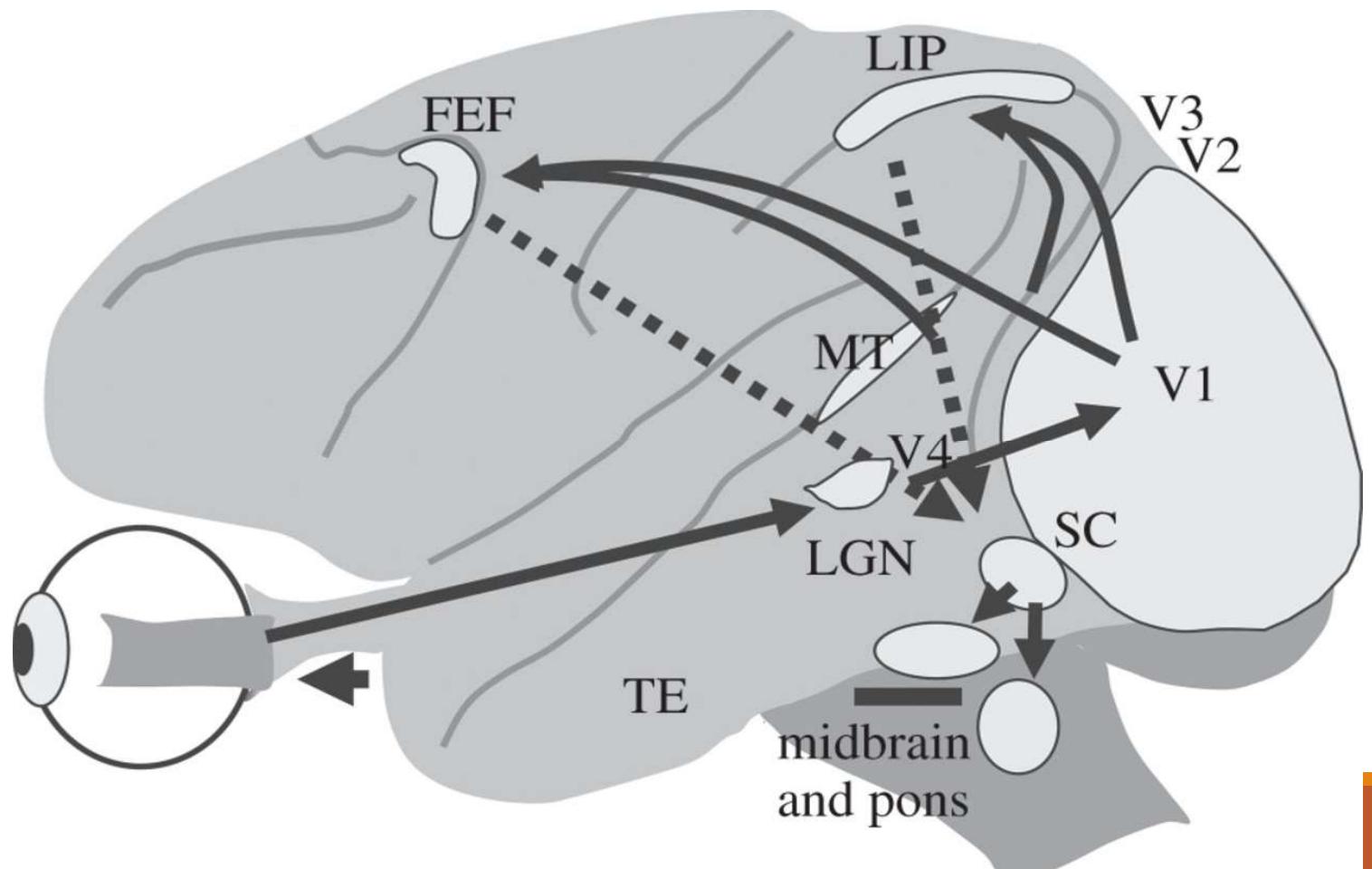
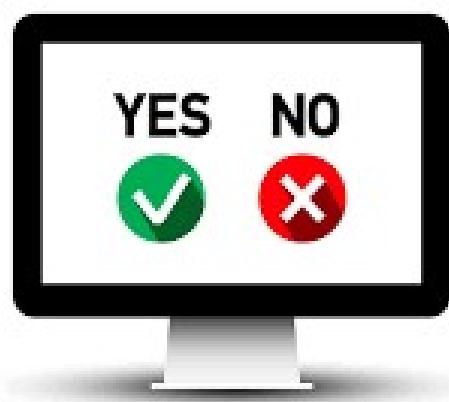


Seven stages of user activities involved in task performance
Don Norman *The Design of Everyday Things*.

Psychology of HCI

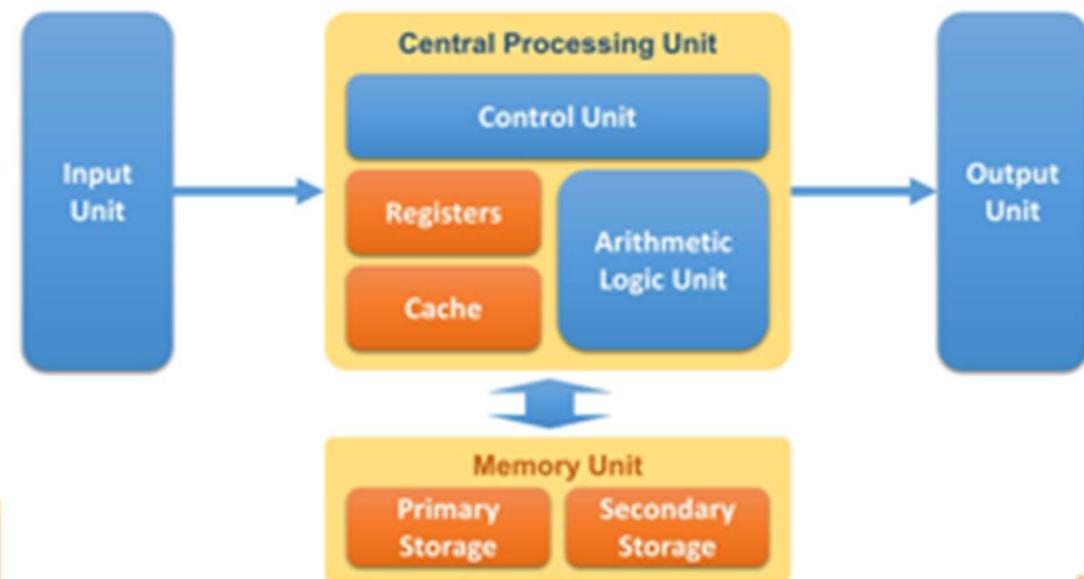
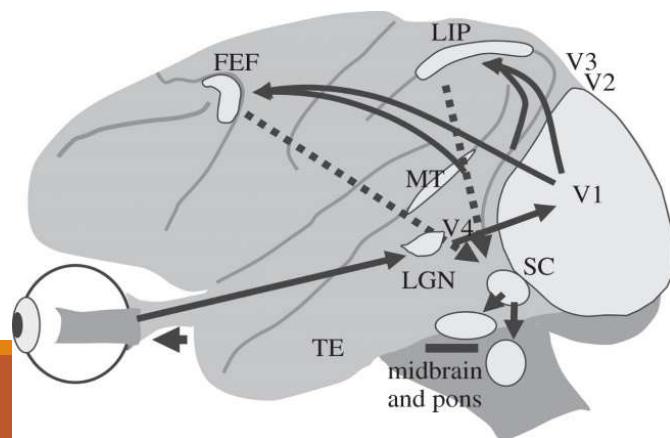


What is happening inside?



Hardware vs Wetware

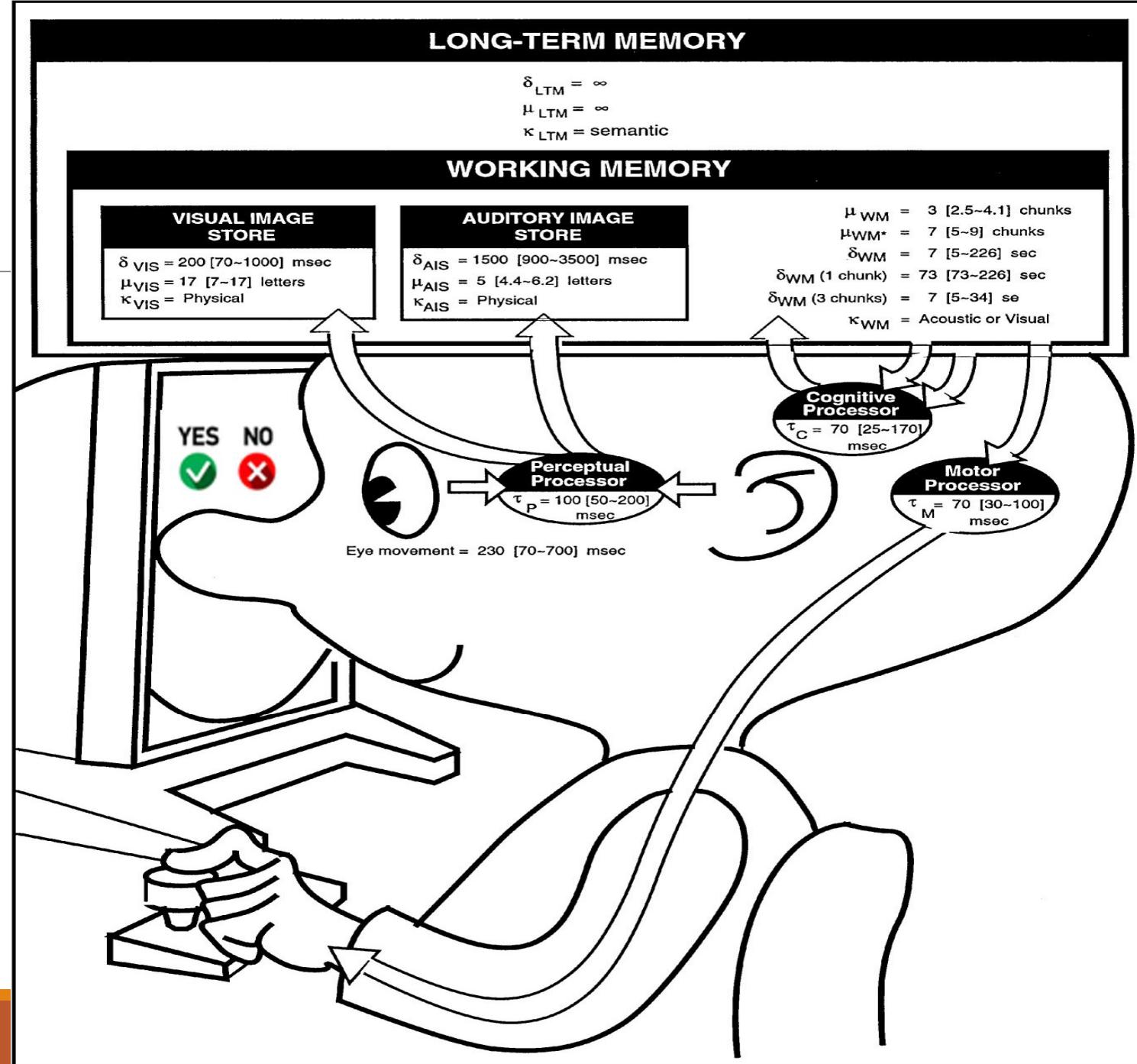
- A computer is an Information Processing System (IPS)
- The human mind is also an Information Processing System
 - Perceptual system/processor
 - Motor system/processor
 - Cognitive system/processor
- Model Human Processor



The Model Human Processor

The Psychology
of
Human-Computer
Interaction

STUART K. CARD
THOMAS P. MORAN
ALLEN NEWELL



LONG-TERM MEMORY

$$\delta_{LTM} = \infty$$

$$\mu_{LTM} = \infty$$

κ_{LTM} = semantic

WORKING MEMORY

VISUAL IMAGE STORE

$\delta_{VIS} = 200$ [70~1000] msec
 $\mu_{VIS} = 17$ [7~17] letters
 κ_{VIS} = Physical

AUDITORY IMAGE STORE

$\delta_{AIS} = 1500$ [900~3500] msec
 $\mu_{AIS} = 5$ [4.4~6.2] letters
 κ_{AIS} = Physical

$$\mu_{WM} = 3$$
 [2.5~4.1] chunks

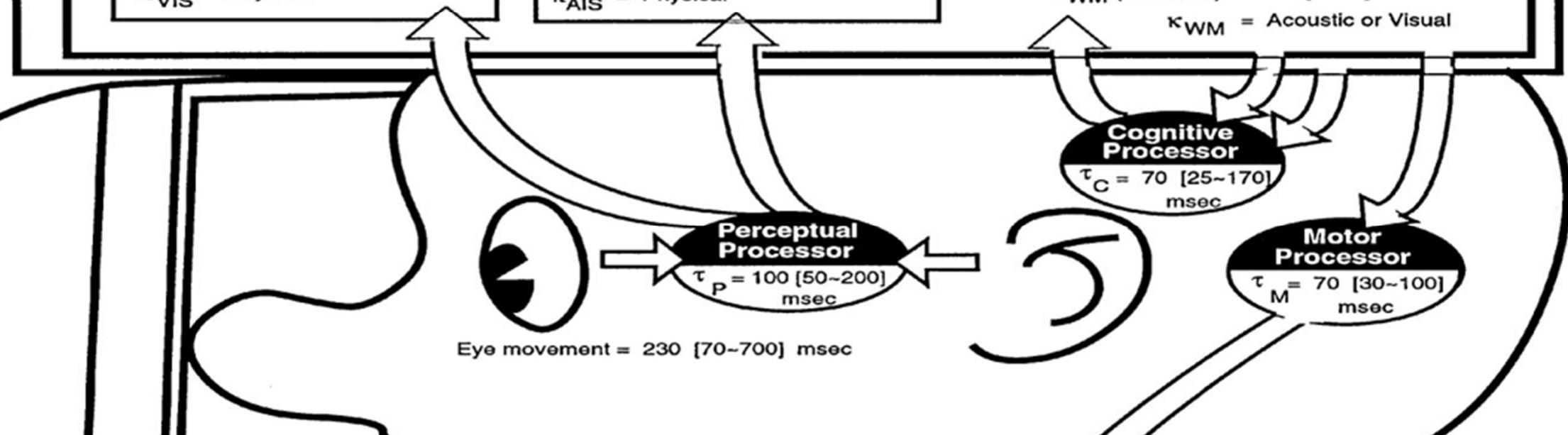
$$\mu_{WM^*} = 7$$
 [5~9] chunks

$$\delta_{WM} = 7$$
 [5~226] sec

$$\delta_{WM}$$
 (1 chunk) = 73 [73~226] sec

$$\delta_{WM}$$
 (3 chunks) = 7 [5~34] sec

κ_{WM} = Acoustic or Visual





Shop by category

 Search for anything

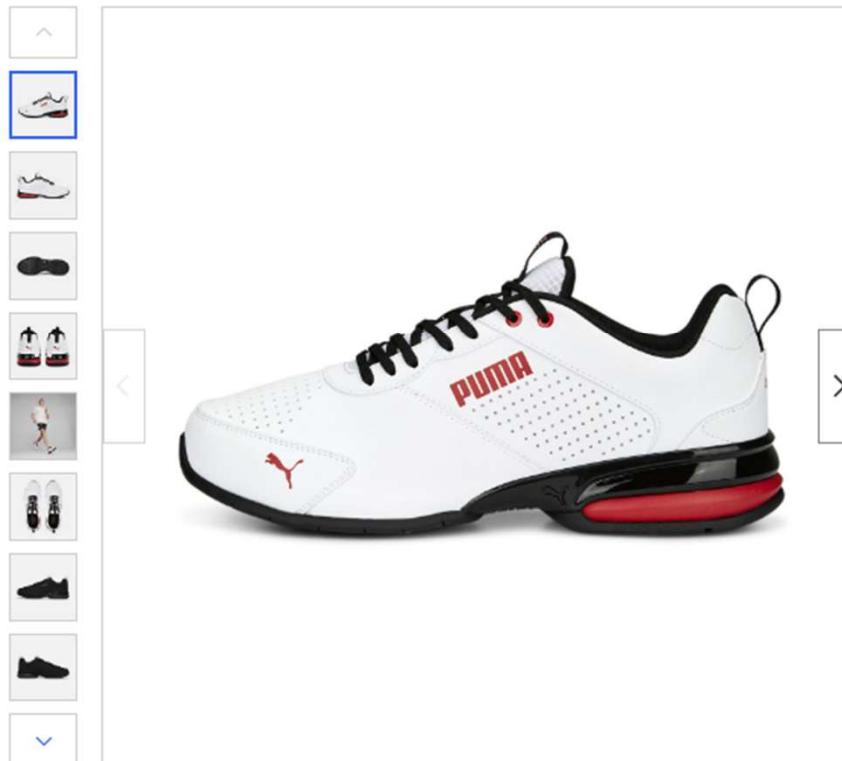
All Categories

Search

Advanced

Back to home page | Listed in category: Clothing, Shoes & Accessories > Men > Men's Shoes > Athletic Shoes

Share | Add to Watchlist

SAVE UP TO 50% [See all eligible items and terms ▾](#)

PUMA Men's Tazon Advance Bold Sneakers

20 sold in last 24 hours

Condition: New with box

US Shoe Size: Color: Quantity: Limited quantity available / 525 soldPrice: **US \$33.99**

List price US \$70.00

Save US \$36.01 (51% off)

This one's trending. 525 have already sold.

Breathe easy. Returns accepted.

Shipping: US \$19.74 eBay International Shipping [See details](#)

Located in: United States, United States

This item may be subject to duties and taxes upon delivery

Delivery: Estimated between Thu, Dec 14 and Thu, Jan 4 to 34365

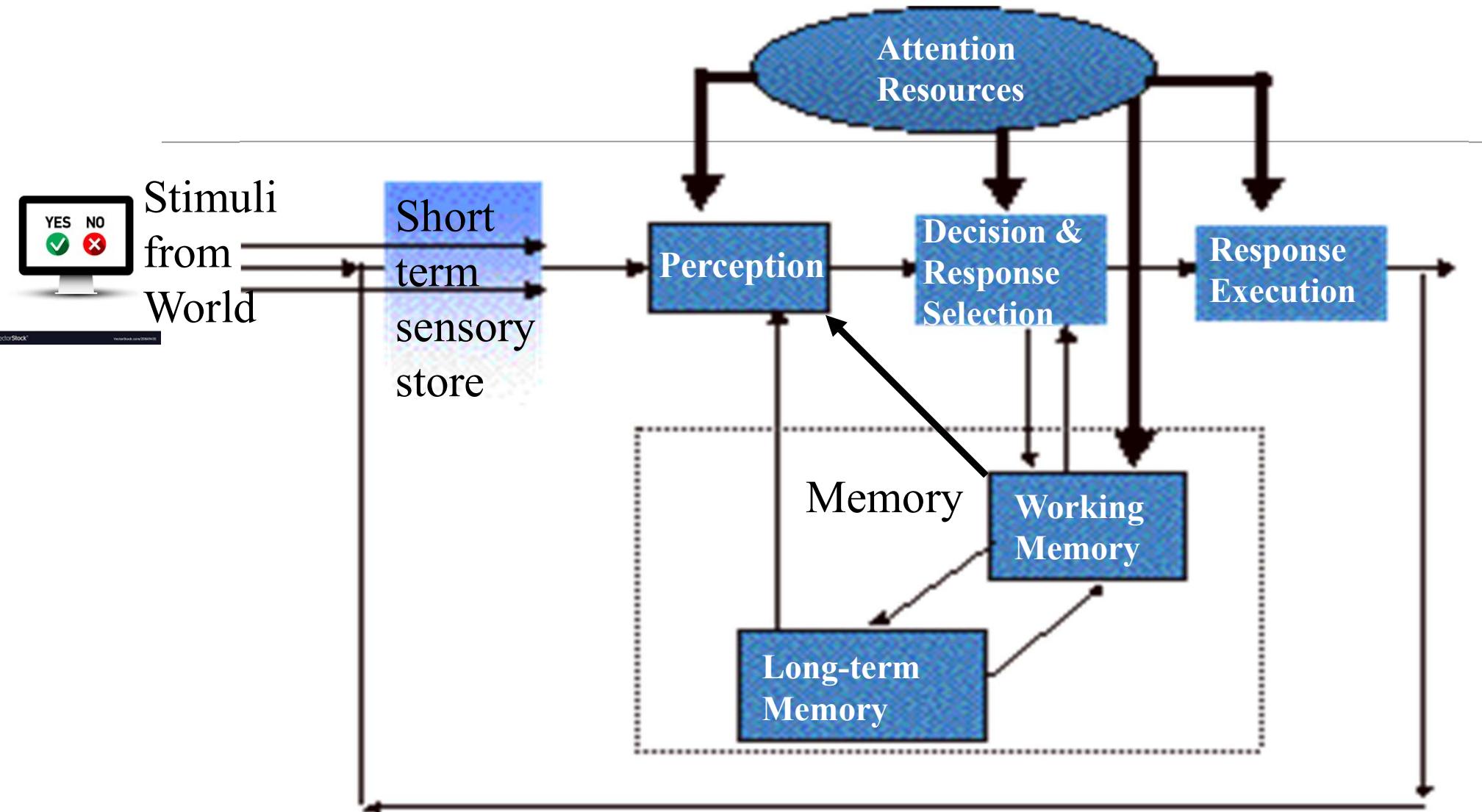
Shop with confidence

 Direct from Puma
Item sold directly by the brand. Top Rated Plus
Trusted seller, fast shipping, and easy returns.
[Learn more](#) eBay Money Back Guarantee
Get the item you ordered or your money back.
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98.5% positive feedback

[Save seller](#)[Contact seller](#)[See other items](#)

Wickens (1992)



Parameters of a memory and processor

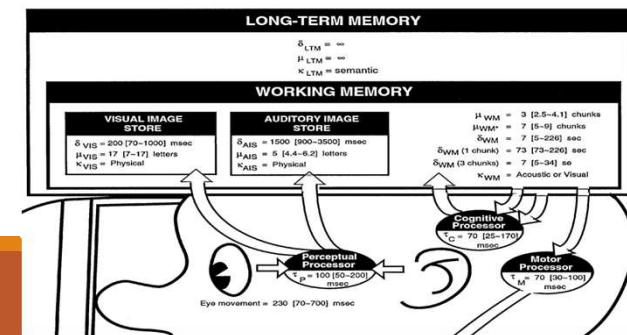
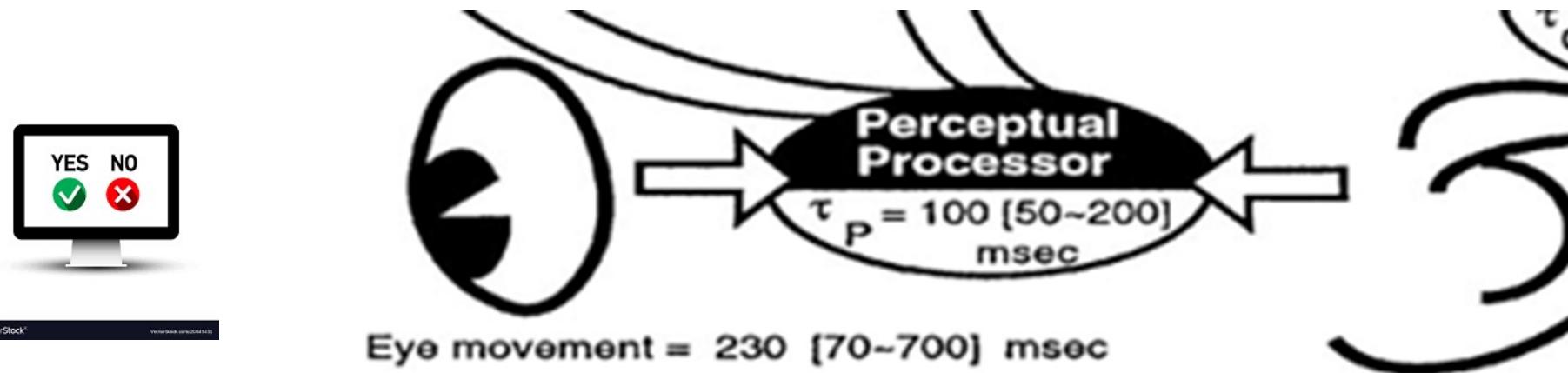
μ = Storage capacity (letter, chunk, etc.)

δ = Decay time (msec)

κ = Code type (physical, visual, auditory, semantic)

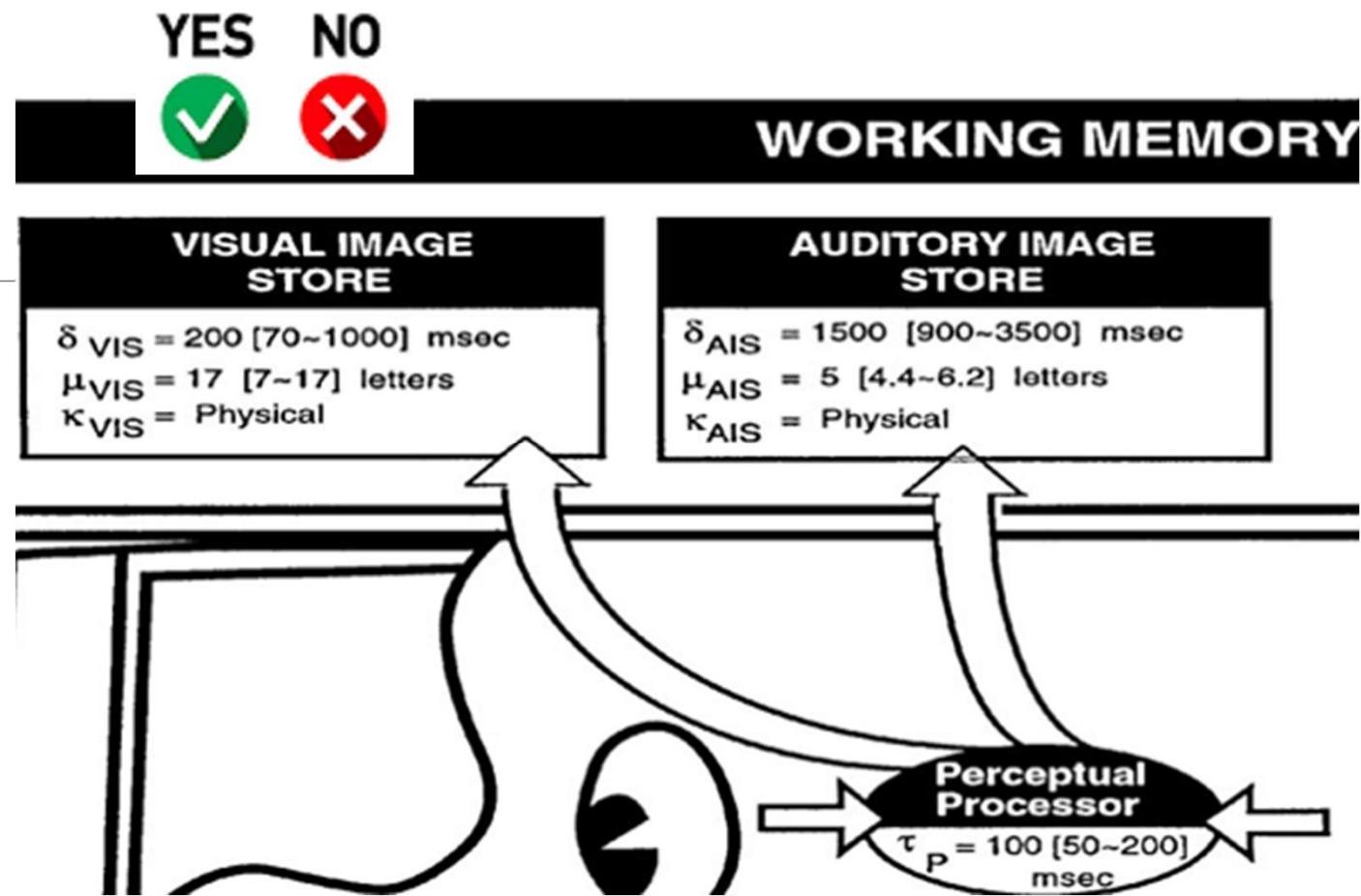
τ = Cycle time (msec)

$$\tau_p = 100 \text{ ms} \quad (\text{Cycle time for perceptual proc})$$



Visual

- $\delta_{\text{vis}} = 200\text{ms}$ (decay)
- $\mu_{\text{vis}} = 17$ letters
- $\kappa_{\text{vis}} = \text{Physical}$



Auditory

- $\delta_{\text{AIS}} = 1500\text{ms}$ (decay)
- $\mu_{\text{AIS}} = 5$ letters
- $\kappa_{\text{AIS}} = \text{Physical}$

WORKING MEMORY

- $\mu_{wm} = 7 \pm 2$ chunks
- $\delta_{wm} = 7$ sec (decay)

$$\mu_{WM} = 3 [2.5 \sim 4.1] \text{ chunks}$$

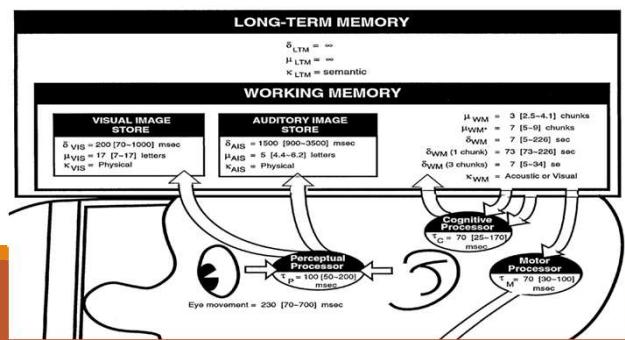
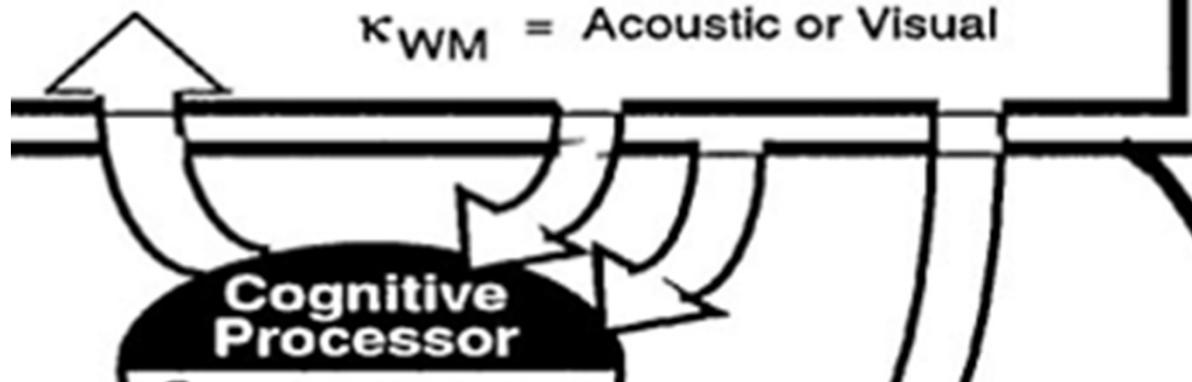
$$\mu_{WM^*} = 7 [5 \sim 9] \text{ chunks}$$

$$\delta_{WM} = 7 [5 \sim 226] \text{ sec}$$

$$\delta_{WM} (1 \text{ chunk}) = 73 [73 \sim 226] \text{ sec}$$

$$\delta_{WM} (3 \text{ chunks}) = 7 [5 \sim 34] \text{ sec}$$

κ_{WM} = Acoustic or Visual



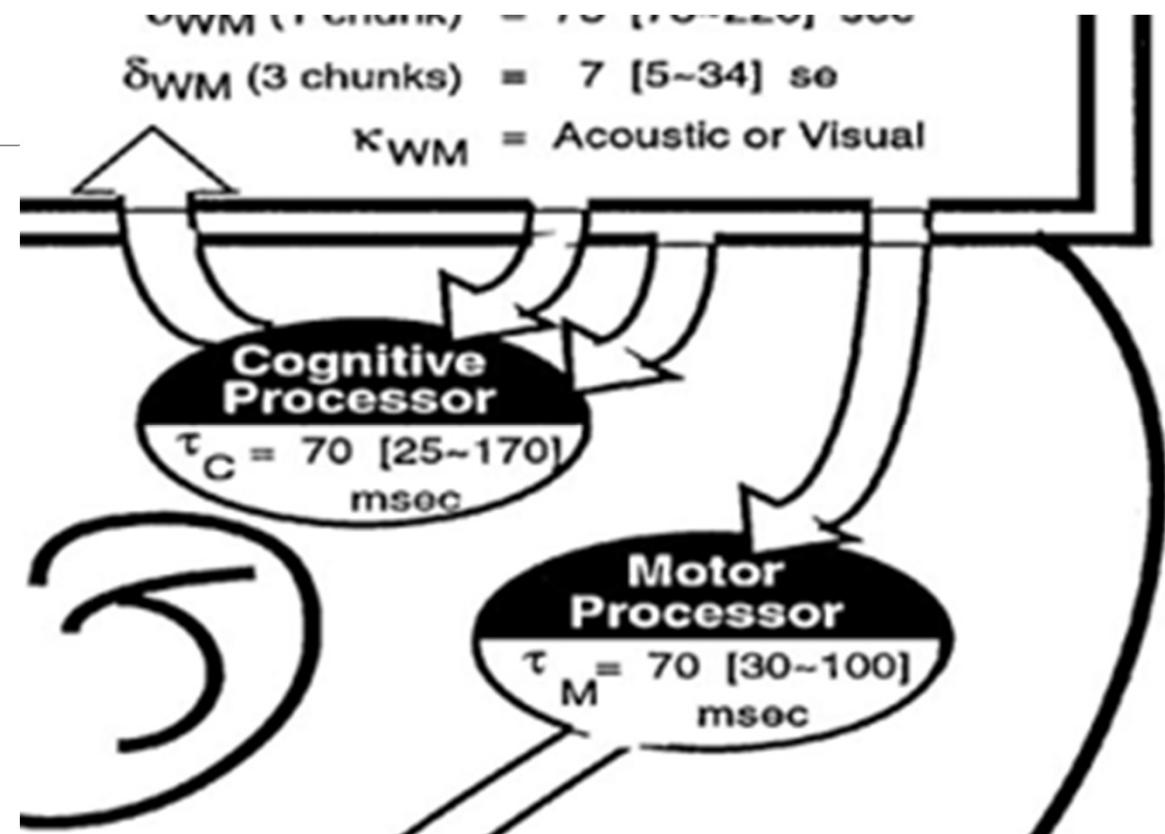
LONG-TERM MEMORY

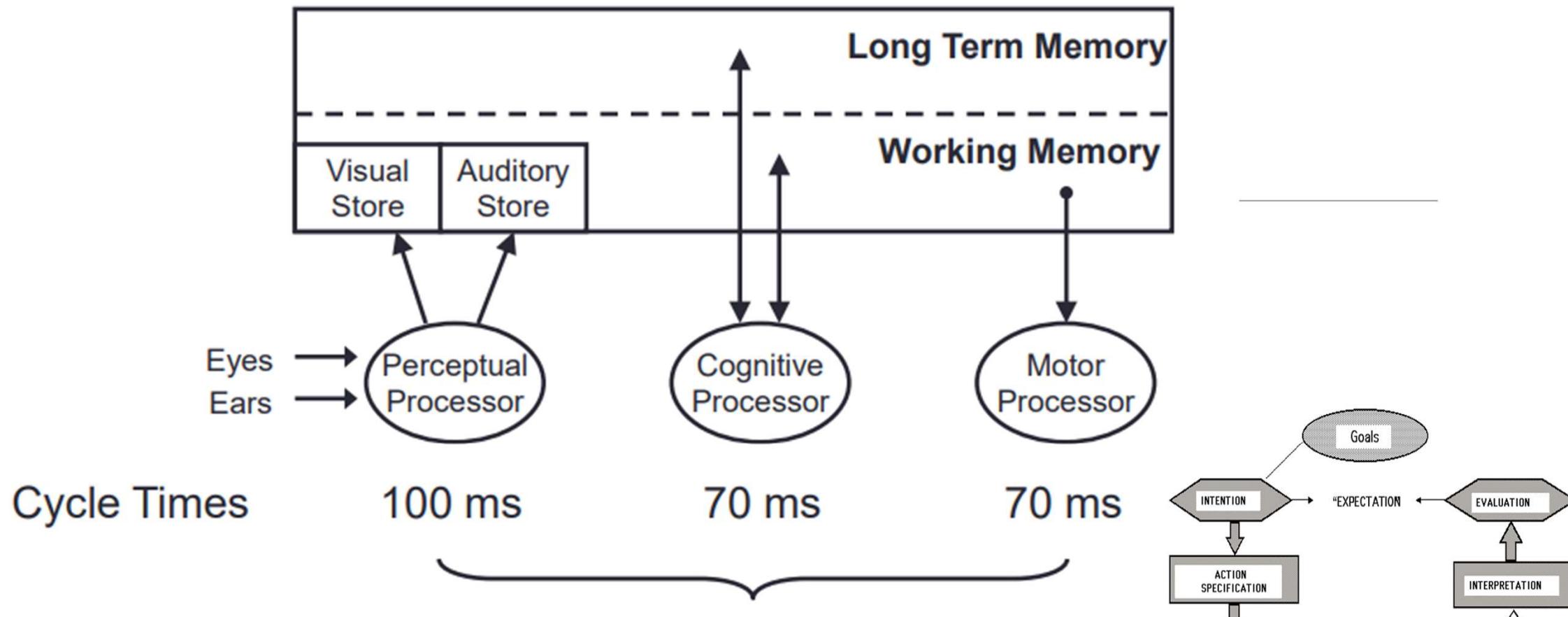
$\delta_{LTM} = \infty$

$\mu_{LTM} = \infty$

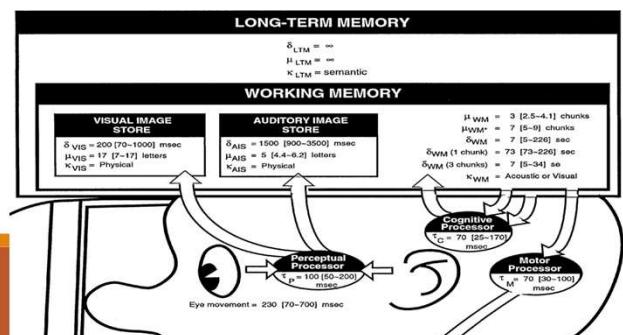
$\kappa_{LTM} = \text{semantic}$

- $\tau_c = 70$ (Cycle time, ms)
- Depending on task:
 - letters 40 ms,
 - words 47ms,
 - 3D shapes 94 ms

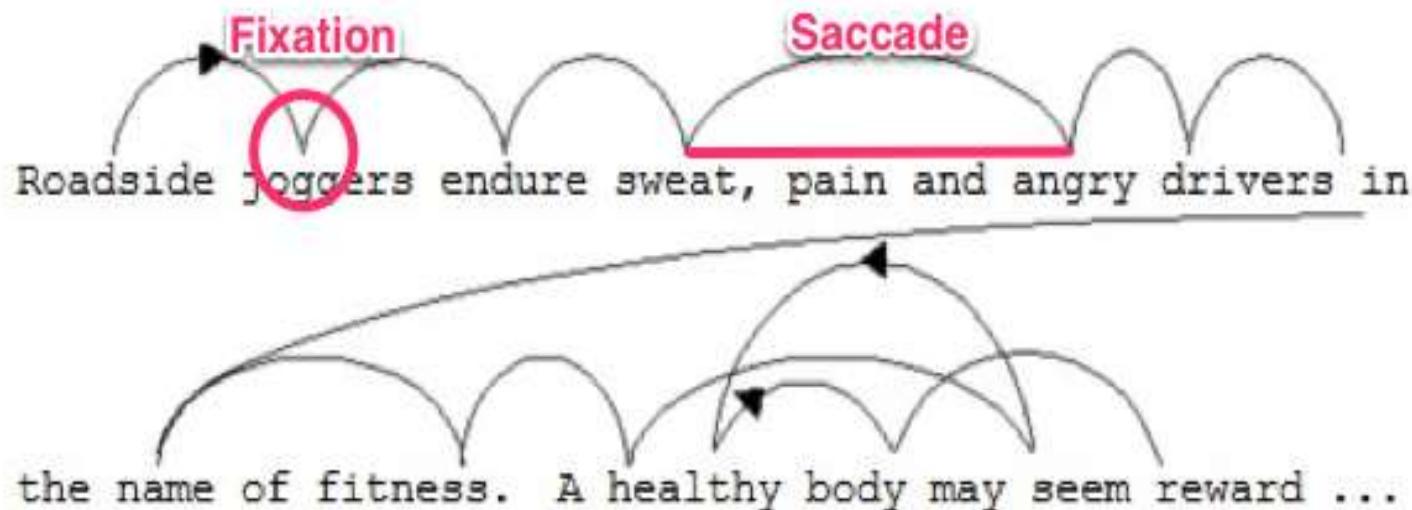


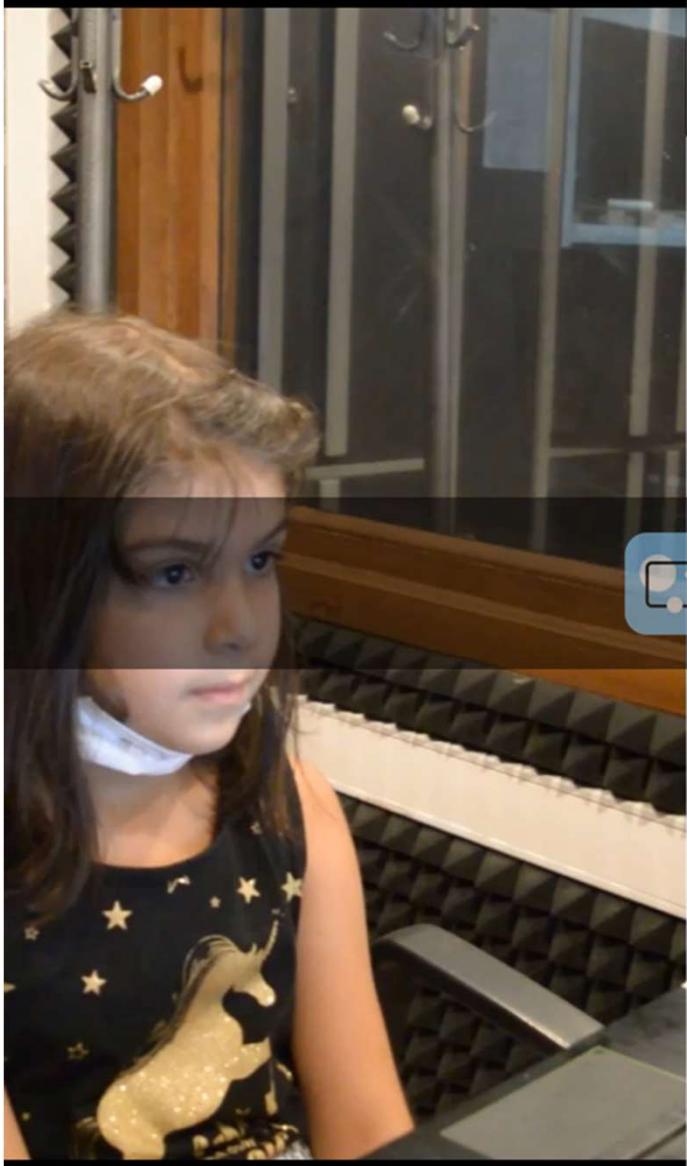


Perceive-Recognize-Act cycle ≈ 240 ms



Example: How fast do we read? Wpm?





GazePlot
Media: 2Final.png
Time: 00:00:00,000 - 00:02:24,884
Participant filter: All Participants
Number of participants included: 1/5 (20%)

Gamze ve Arkadaşı

Cumartesi günü hava çok güzeldi. Gamze sabah ödev yaptı, sonra biraz kitap okudu. Öğleden sonra canı sıkıldı. O sırada kapı çaldı, Gamze çok sevindi. Hemen koştu ve kapıyı açtı. Arkadaşı Ece gelmişti. Ece:

- Beraber parka gidelim mi? diye sordu. Gamze sevinçle:
- Hemen gidelim, ama önce annemden izin alayım, dedi.

Movavi Video Editor Plus

Gamze annesinden izin aldı. Gamze ve Ece parka gittiler. Parkta birçok çocuk vardı. Gamze önce salıncağa binmek istedİ. Birlikte salıncağa bindiler, sonra kaydıraktan kaydilar. Birden yağmur yağmaya başladı. Gamze ve Ece islandilar, koşarak eve gittiler. Gamze'nin annesi onlara kuru giysiler verdi, çay ve pasta ikram etti. Çocuklar çay içtiler, pasta yediler. Sonra Gamze oyuncaklarını çıkarttı, onlar akşamda kadar beraber oynadılar.

Akşam olunca Ece eve gitti. Çocuklar cumartesi günü çok eğlendiler.



GazePlot
Media: 2Final.png
Time: 00:00:00.000 - 00:08:41.537
Participant filter: All Participants
Number of participants included: 1/5 (20%)

Gamze ve Arkadaşı

Cumartesi günü hava çok güzeldi. Gamze sabah ödev yaptı, sonra biraz kitap okudu. Öğleden sonra canı sıkıldı. O sırada kapı çaldı, Gamze çok sevindi. Hemen koştu ve kapıyı açtı. Arkadaşı Ece gelmişti. Ece:

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Example: How fast do we read

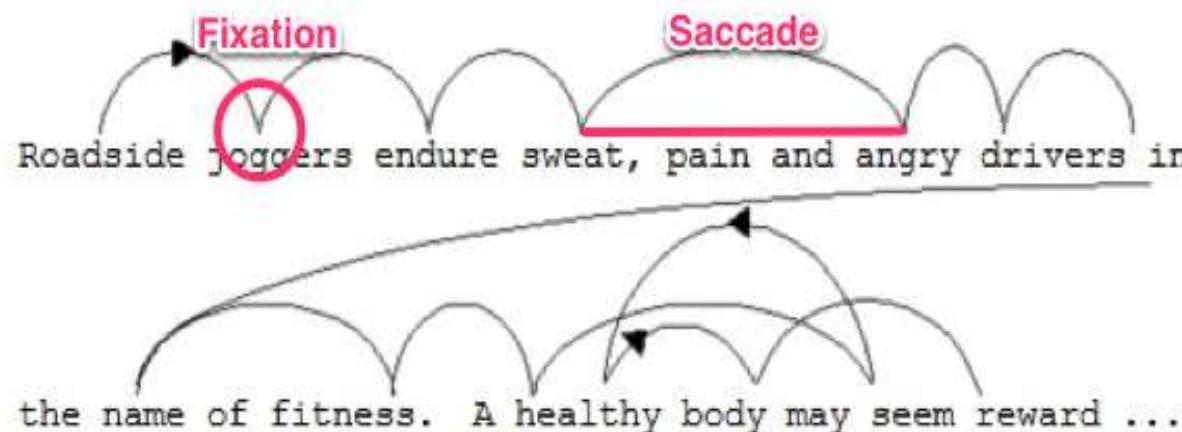
- Slow reader-kids:

$$\frac{60 \text{ sec (1 min)}}{0.230\text{sec} * 5 \text{ saccade/word}} = 52 \text{ wpm}$$

- Normal reader:

$$\frac{60 \text{ sec (1 min)}}{0.230\text{sec} * 1 \text{ saccade/word}} = 261 \text{ wpm}$$

- What if someone makes 400 wpm ?



Eye Fixations biased towards start
of words:

_he ____tion _f ____tions ____ies _n ____ding

As opposed to:

Th_ loca_____ o_ fixa_____ var_____ i_ rea_____

Fi yuo cna raed tihs, yuo hvaе a sotnrg mnid.
Sduties swohs taht popele wtih an ineqltience
Iveel aovbe namrol cna raed wrods wohitut hvaing
teh ltetres in teh crorcet oedrr.
In fcat, olny teh fsrit adn teh lsat leterts nedes to be
in pcale, tehn yuor brian wlil tkae crae of teh rset.
If yuo can raed tihs, share it.



İngliiz Üineveerdtserinin bir teñsai hrarlefin
hgnai salıyra dmiziilş olğunduun öemnisz
oludğnuu oayrta kydou. Bduara tek ömlnei
ntoka ilk ve son hfiarn dğrou ydere
osmildaiır. Gsreii tmaamen salmçaık olbaiilr,
ve sen ynie de pbromlseiz okyailusbirin. Bu
haeflrii hraf oralak okumzdaimdğıian ve
kmellireei bütün oalark alamidılgzdgıian
kanakyanolr.

Reading as Perceptual chunking

- Most words are fixated at least partially
- Need to fixate closely (less than 10 characters taken in per fixation)
- Unusual words are fixated longer
- Skilled readers fixate and regress less

Typing?

Cognitive parameters

From: Olson and Olson, 1990

Name	Action	Time (msec)
K	Enter a keystroke	230
M	Point with the mouse	1500
Hm	Move hands to mouse	360
P	Perceive	100
R	Retrieve from memory	1200
Ex	Execute a mental step	70
Ch	Choose among methods	1250

Lets have a test

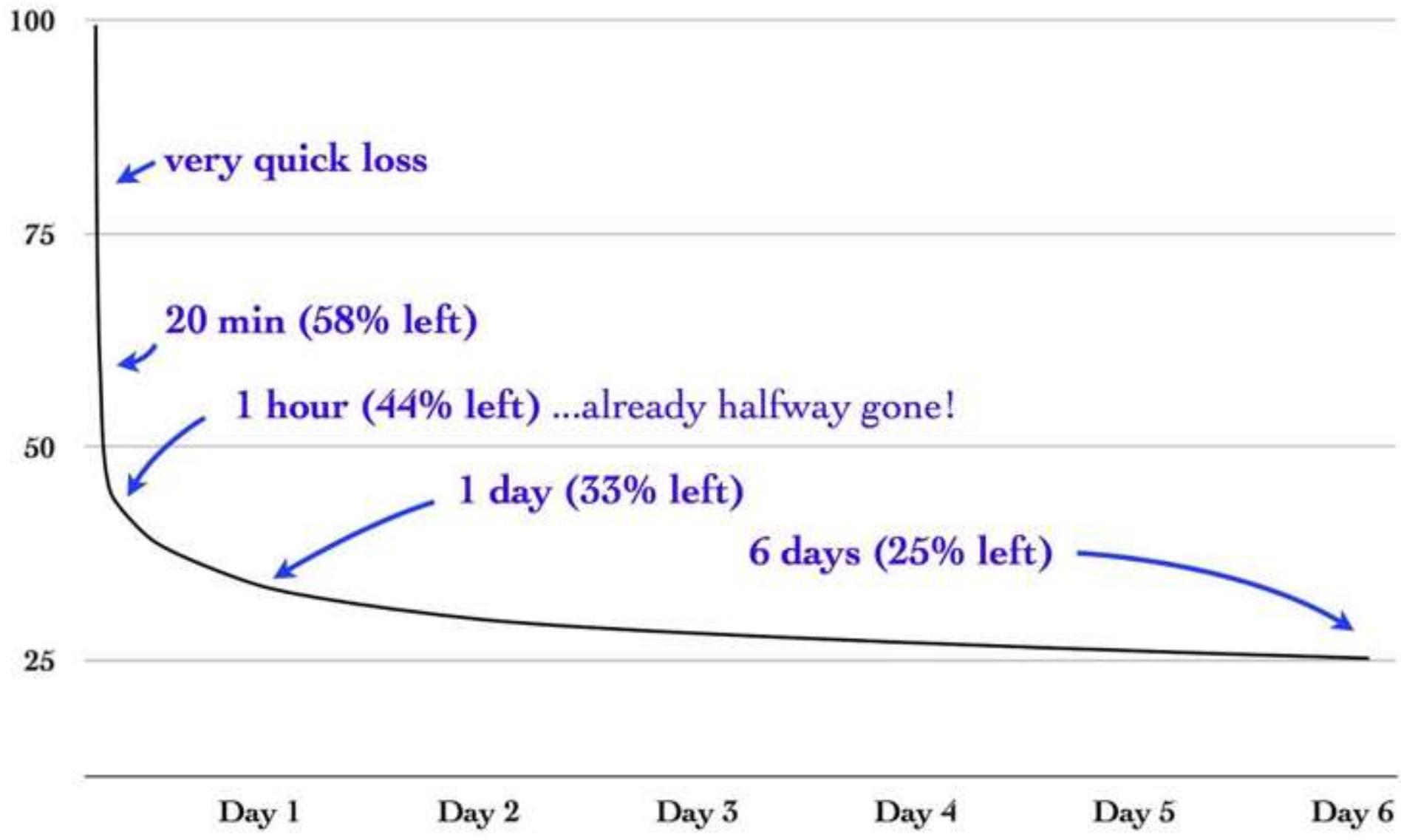
- Save a file
- Name of file MYFILE
- Do not use shortcuts, use mouse and keyboard

Save file <MYFILE>

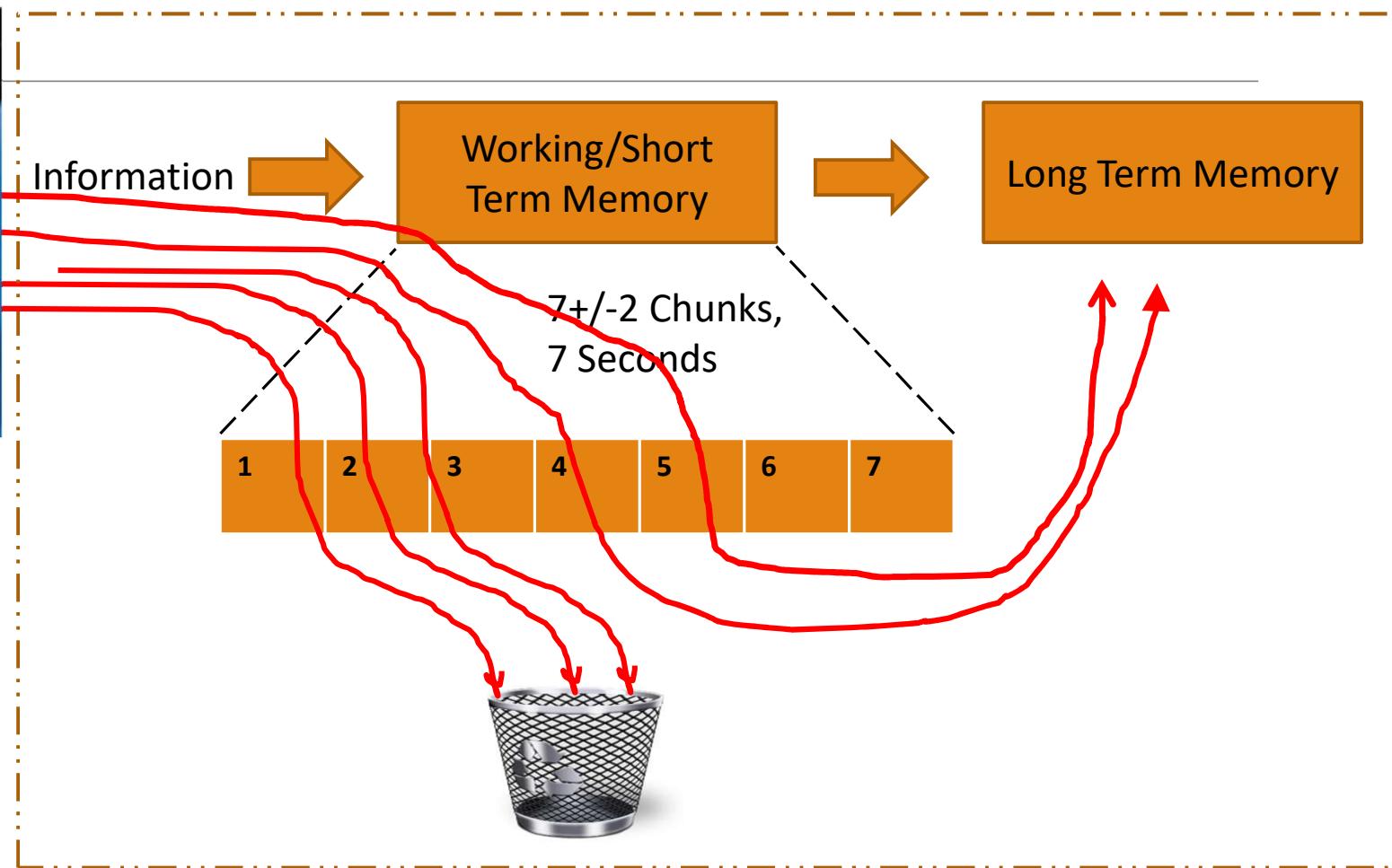
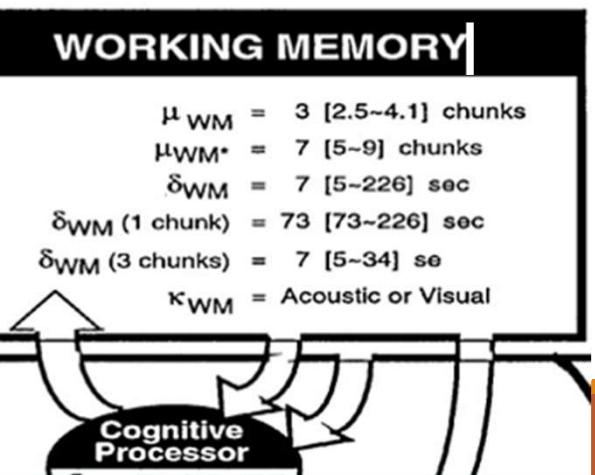
Initial homing of hand	(Hm=0.36 sec)
Move cursor to file menu, + Retrieve from memory	(M =1.5) (R=1.2)
Click file menu	(K =0.23)
move down menu + retrieve from memory	(M=1.5) (R=1.2)
click 'save as'	(K=0.23)
System reacts	(Sys=1.2),
user types name and hits return	(R =1.2 + (nk= 6(0.23)) <u>(K=0.23)</u>
total:	10.23 secs

And forgetting – Decay - δ

WM and Ebbinghaus's Forgetting Curve



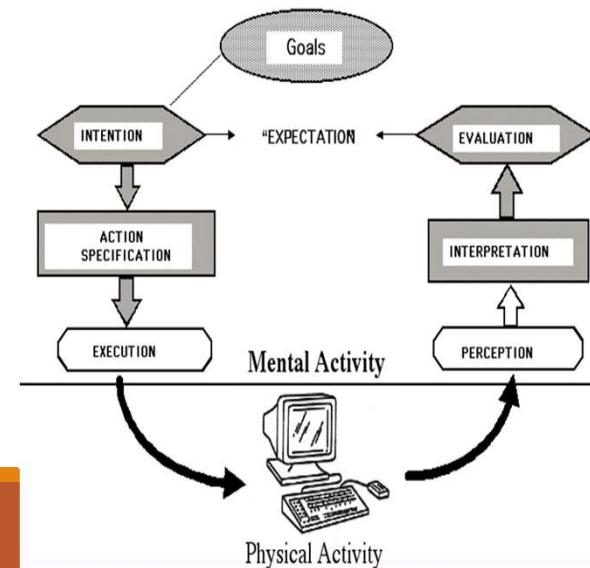
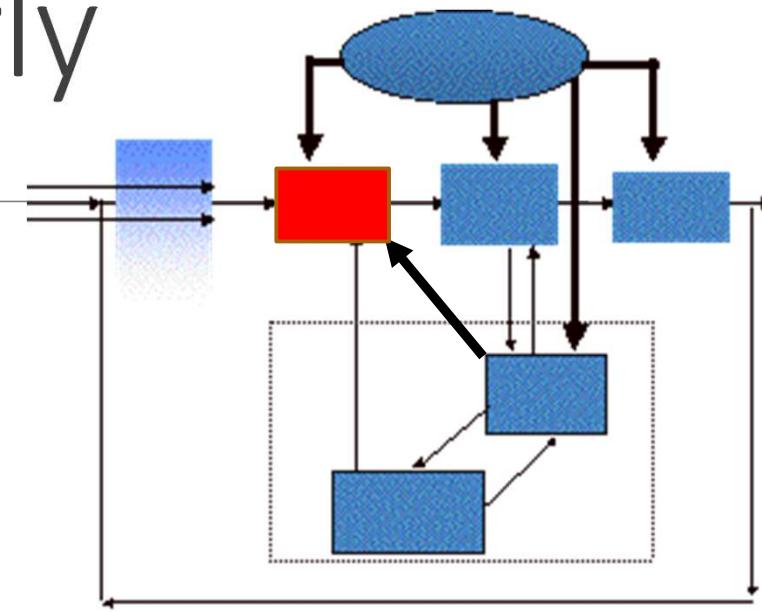
WM, LTM, Chunking, Forgetting



Miller, G. A. (1956). "The magical number seven, plus or minus two: Some limits on our capacity for processing information". *Psychological Review*. 63 (2): 81–97

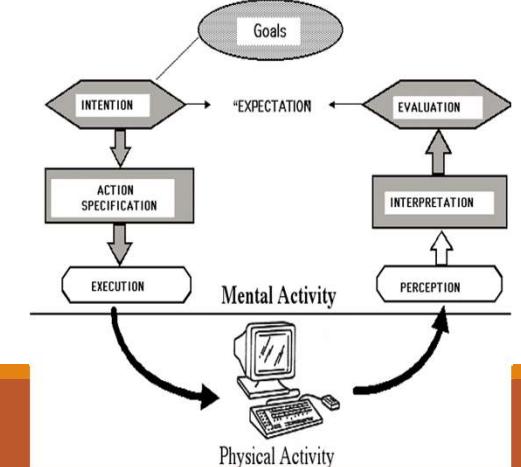
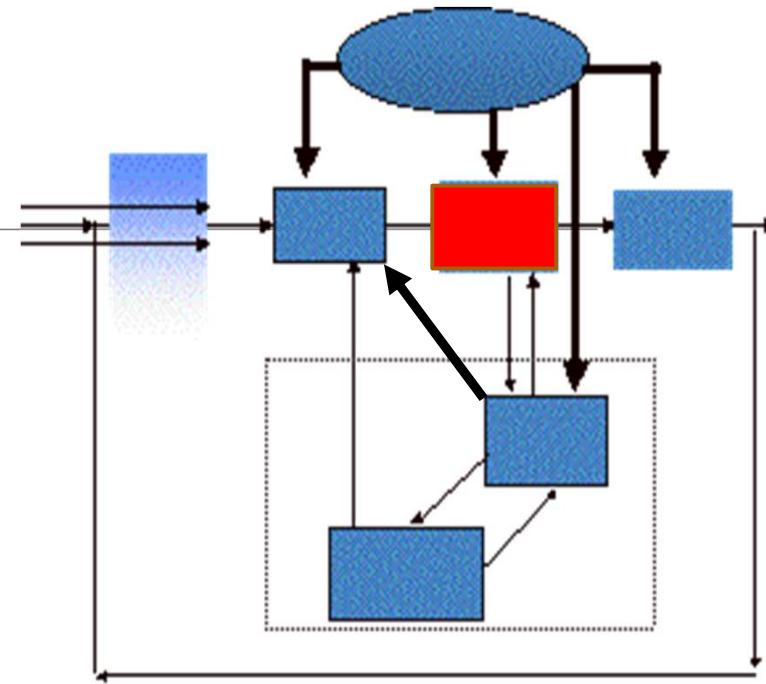
Cognition is fast & orderly

- Short-term sensory store (STSS)
 - rapidly decays (<1sec)
 - sensitive to physical characteristics of signal
 - Pre-attentive (unconscious)
- Perception
 - many-to-one category mapping
 - detection, recognition, categorization cycle
 - stimulus is consciously attended to here



And then....

- Decision and Response selection
 - Once encoded, human must react
 - Can be automatic or controlled response
- Response execution
 - Sequence of behavior follows,
- Feedback
 - We monitor events and our actions
- Attention is usually required after STSS



Basic properties of all users

- Changes with experience
- Actively learns
- Limited attention (esp. Children)
- Makes mistakes
- Models the system in their mind
- Remains unique
- Goal oriented

Basic attributes

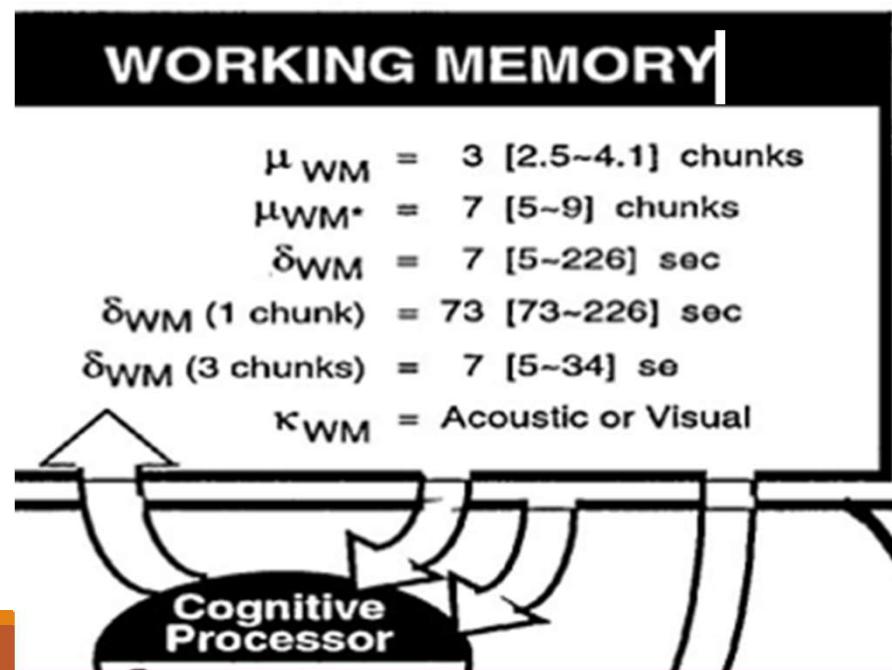
- Human cognitive system consists of structures
 - memory (short and long term), schemata, etc.
- and processes
 - encoding, retrieval, assimilation etc.
- Human cognition is active:
 - we seek meaning and regularity





Working or Short-term memory (STM)

- Finite capacity buffer zone $\mu_{wm} = 7+/-2$ chunks
- Limited duration $\delta_{wm} = 7$ sec (decay)
- New information displaces old
- Rehearsal can maintain contents
- Chunking extends STM capacity



WM test - Put pencils down.....

- I will read 10 numbers
- Remember them

Write them down

Again, put pencils down.....

- Remember these numbers

Write them down

LONG-TERM MEMORY

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$$\mu_{LTM} = \infty$$

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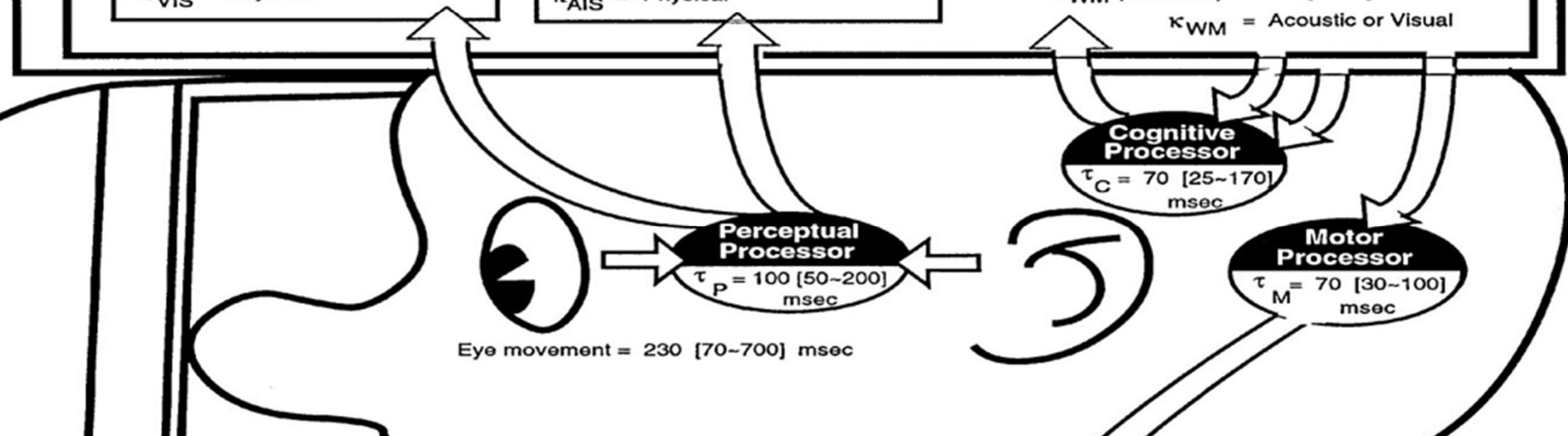
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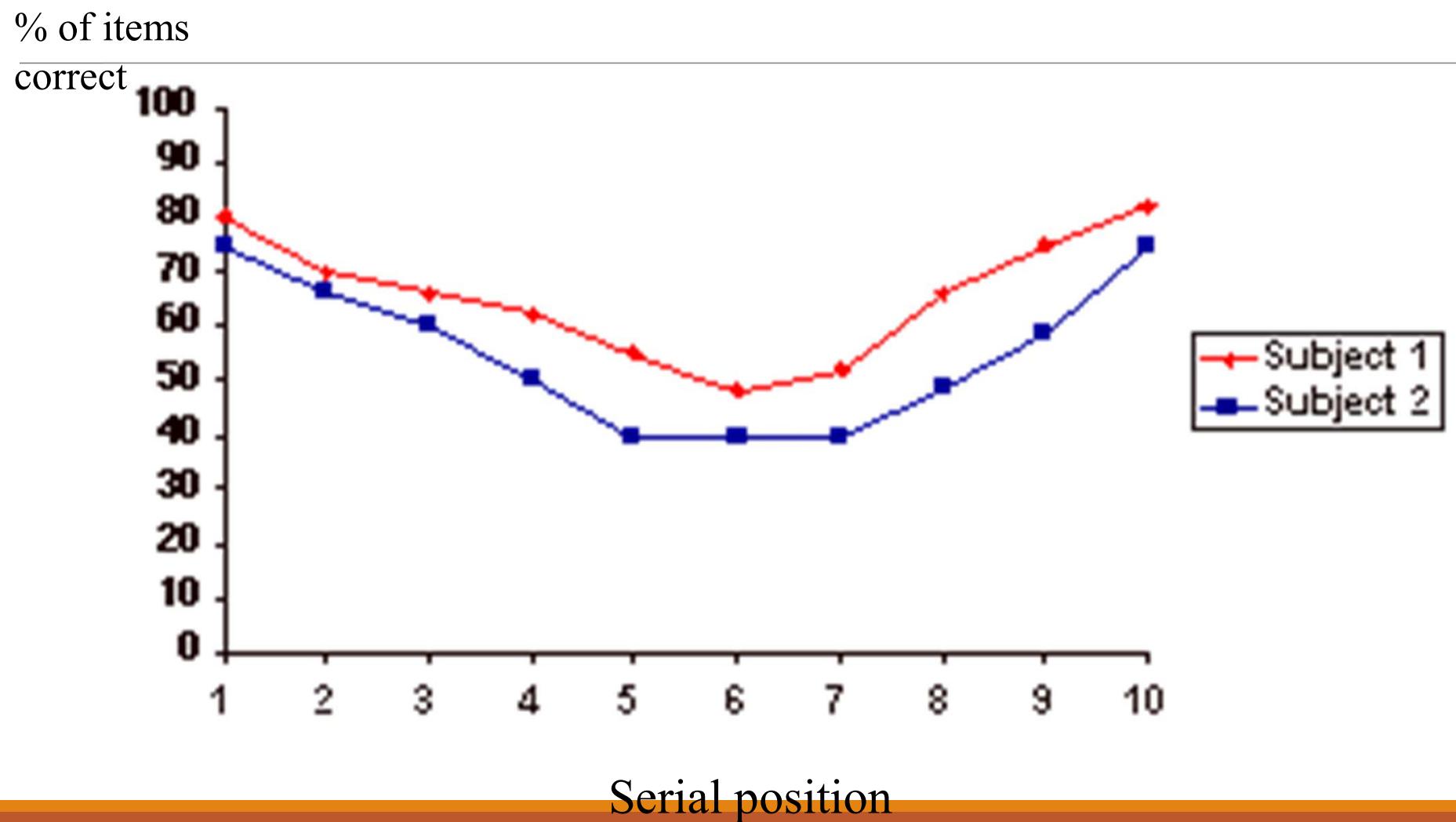
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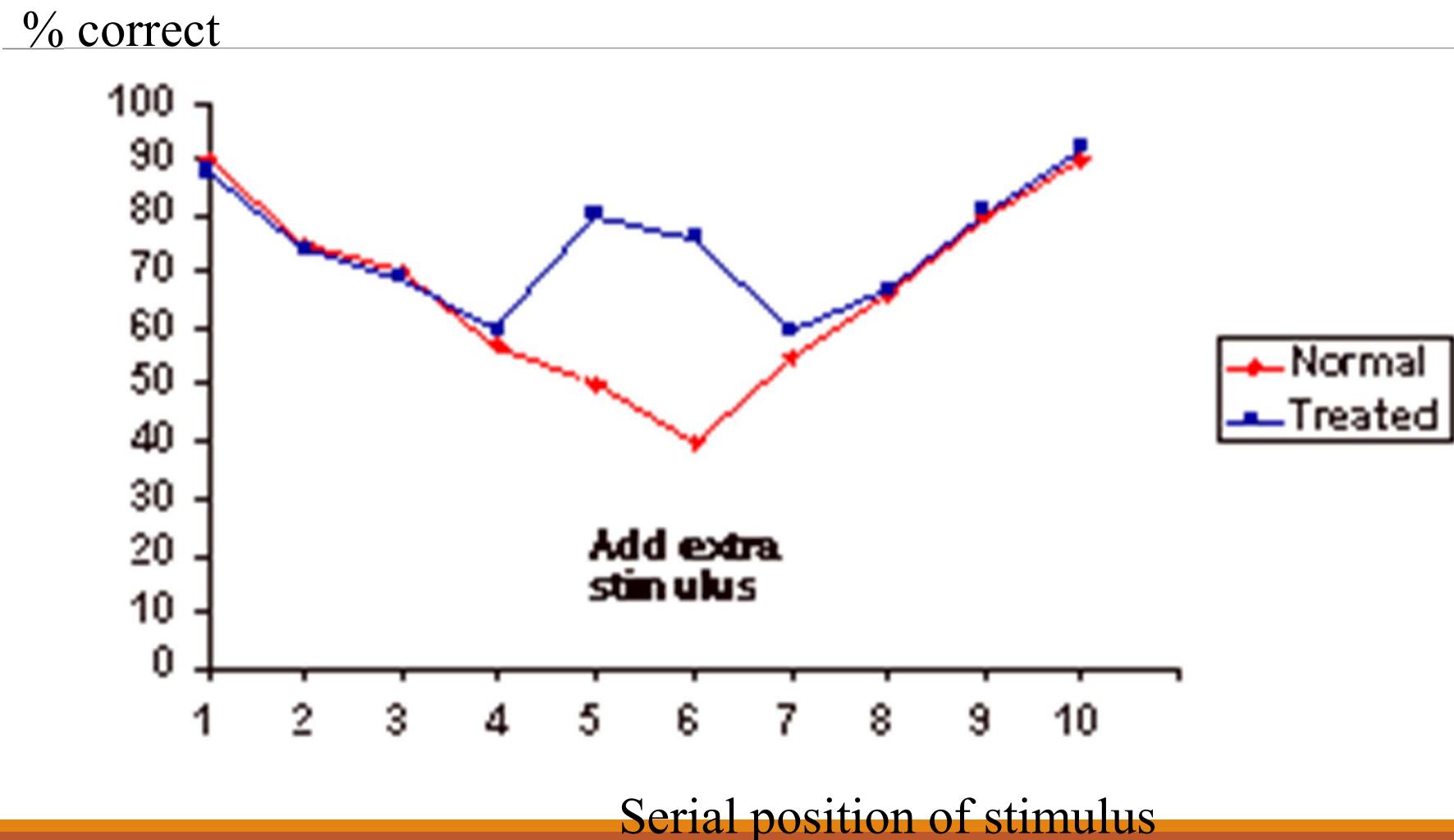
κ_{WM} = Acoustic or Visual



Primacy and Recency effects



Added cues improve recall

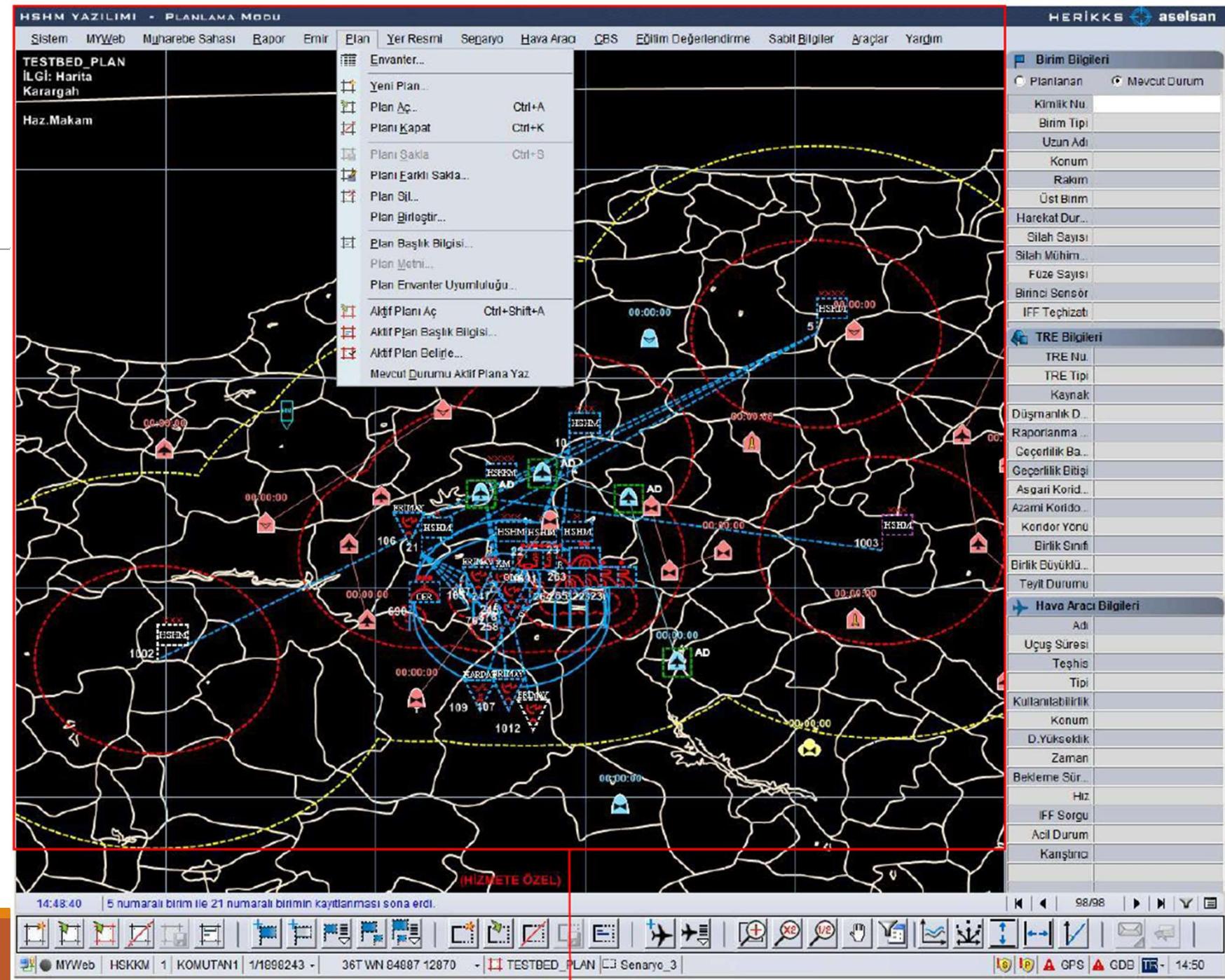


How about visual image store?

- I will show you 3 slides.
- In each slide count the number of objects and keep the time

In Real Life?

- Aselsan
 - HERIKKS
 - Air Defense
Command
Control
Software



Meaningful chunking example

- Try to memorize the following:

Meaningful chunking example

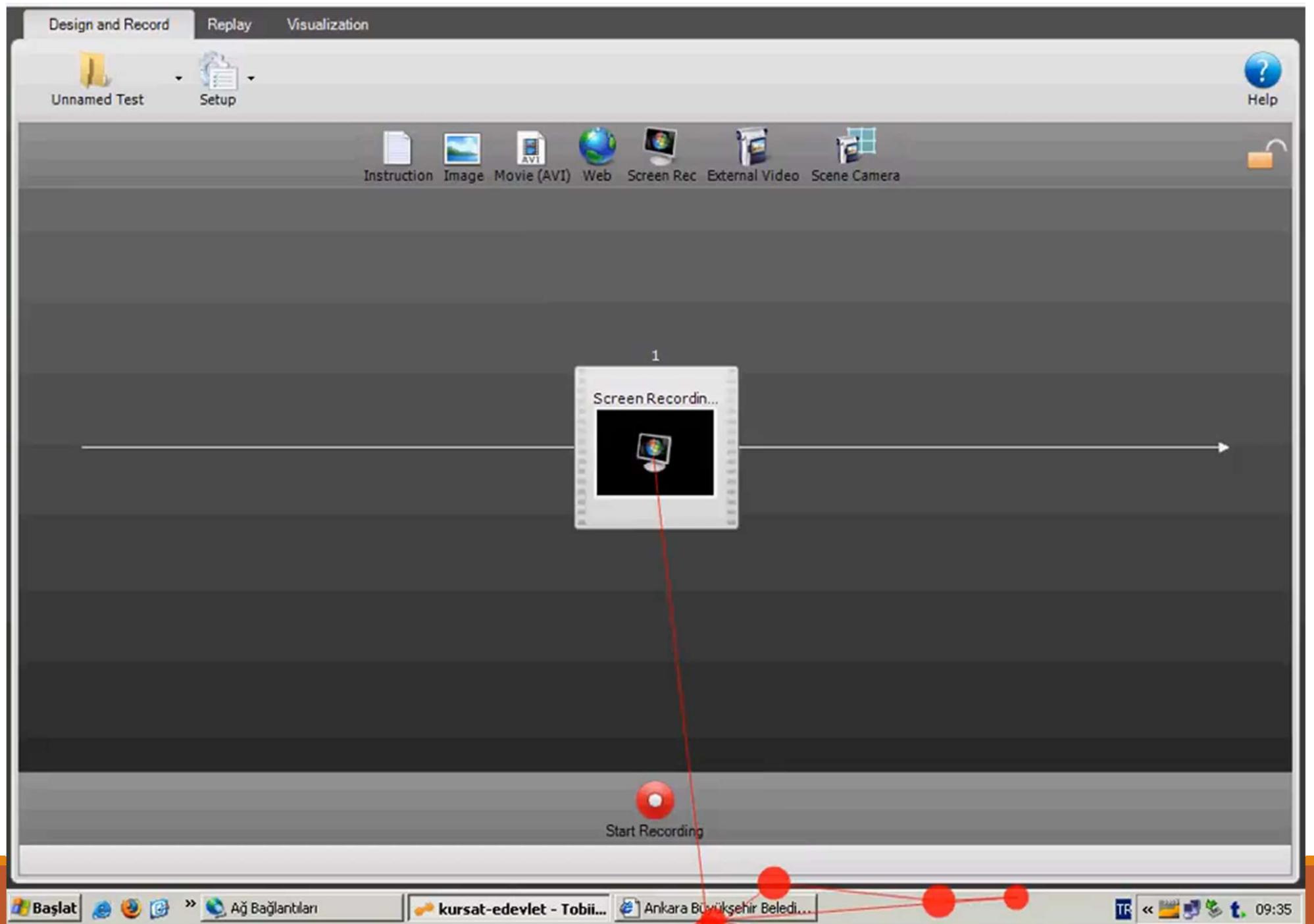
- Try to memorize the following:

ocn, nph, dat, vfb, ith, yso, sib, mus, aat, t

Becomes more memorable as:

- o cnn, phd, atv, fbi, thy, sos, ibm, usa, att

- ocn, nph, dat, vfb, ith, yso, sib, mus, aat, t



Your upcoming assignment

- Evaluation of an interface by Cognitive modeling

<https://www.cogtool.org/>

CogTool — Predictive human performance modeling for UI design

[Home](#) [Blog](#) [Tutorial](#) [Videos](#) [Publications](#) [FAQs](#) [Forums](#) 



CogTool is a general purpose UI prototyping tool with a difference – it automatically evaluates your design with a predictive human performance model (a “cognitive crash dummy”).

[Download for Windows](#)

[Download for macOS](#)



General



CS449_549 Term Project Groups



!

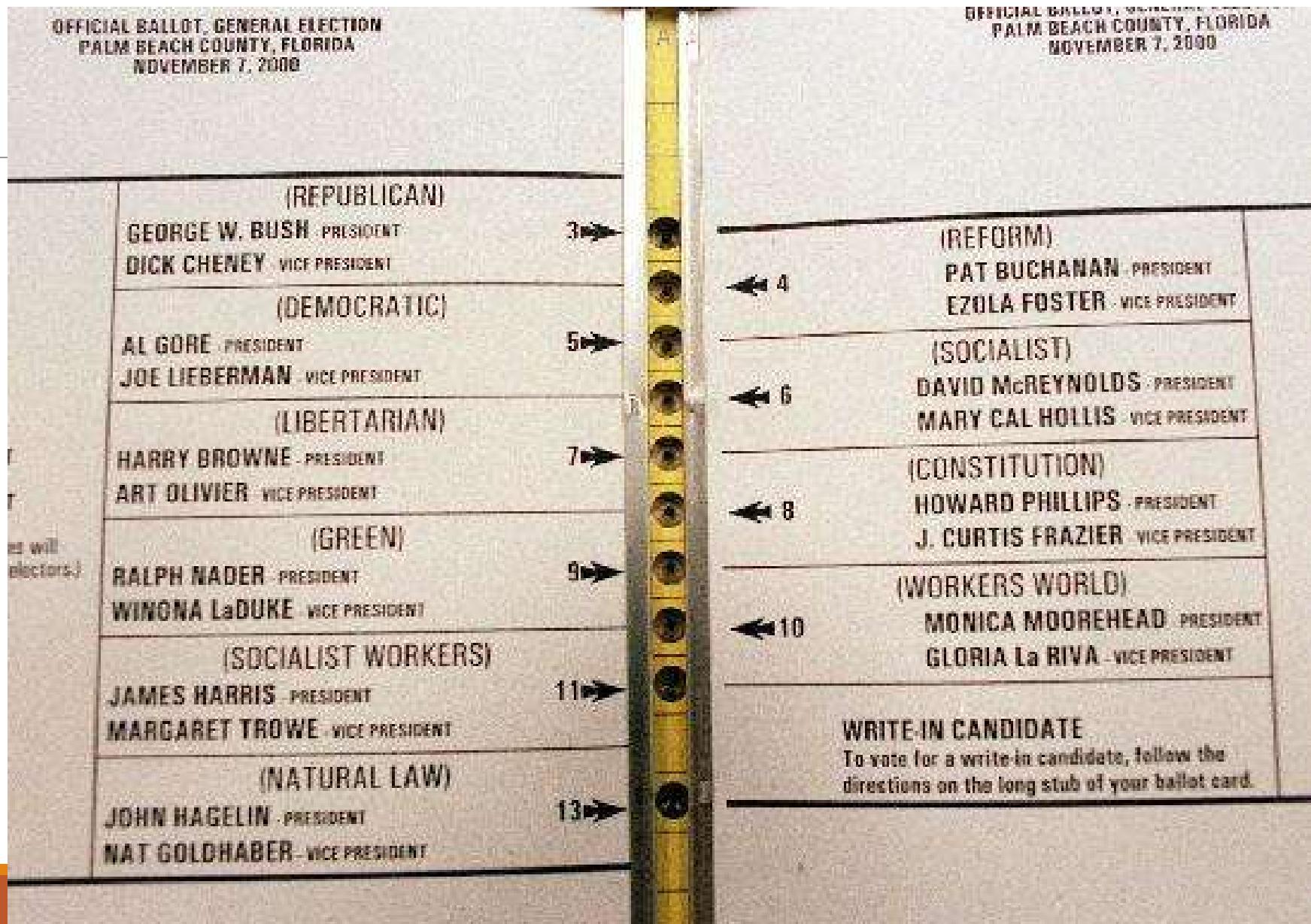


Assignment-2 Fitts's Law

Identify design problem(s) that can be measured by Fitts' Law. Due November 6th Monday, Midnight

Deadliest Design Problem

US elections - Palm Beach County



1
OFFICIAL BALLOT, GENERAL ELECTION
PALM BEACH COUNTY, FLORIDA
NOVEMBER 7, 2000

ELECTORS
FOR PRESIDENT
AND
VICE PRESIDENT

(A vote for the candidates will
actually be a vote for their electors.)

(Vote for Group)

(REPUBLICAN)

GEORGE W. BUSH - PRESIDENT

DICK CHENEY - VICE PRESIDENT

3 →

(DEMOCRATIC)

AL GORE - PRESIDENT

JOE LIEBERMAN

5 →

**Where people
voted for Al Gore**

HARRY BROWN
ART OLIVIER - VICE PRESIDENT

(GREEN)

RALPH NADER - PRESIDENT

WINONA LaDUKE - VICE PRESIDENT

9 →

(SOCIALIST WORKERS)

JAMES HARRIS - PRESIDENT

MARGARET TROWE - VICE PRESIDENT

11 →

(NATURAL LAW)

JOHN HAGELIN - PRESIDENT

NAT GOLDHABER - VICE PRESIDENT

13 →

A

OFFICIAL BALLOT, GENERAL ELECTION
PALM BEACH COUNTY, FLORIDA
NOVEMBER 7, 2000

(REFORM)
PAT BUCHANAN - PRESIDENT

**Where people
were supposed to
vote for Al Gore**

HOWARD PHILLIPS - PRESIDENT
J. CURTIS FRAZIER - VICE PRESIDENT

(WORKERS WORLD)

MONICA MOOREHEAD - PRESIDENT

GLORIA La RIVA - VICE PRESIDENT

WRITE-IN CANDIDATE

To vote for a write-in candidate, follow the
directions on the long stub of your ballot card.

Ballot problems

- Al Gore and Joe Lieberman are the second names on the ballot, but the third hole to punch
- Alignment of the text in each column
- The layout of double pages with punch holes in between was novel & unfamiliar. Ballots in previous elections had used only a single column with punch holes on the right.
- Confusing arrows and numbers
- Stress induced by the voting process
- “It was so hard to tell who and what you were voting for. I couldn’t figure it out, and I have a doctorate,” voter Eileen Klasfeld said.
- <http://danbricklin.com/log/ballotusability.htm>
- <http://www.humanfactors.com/library/election.asp>