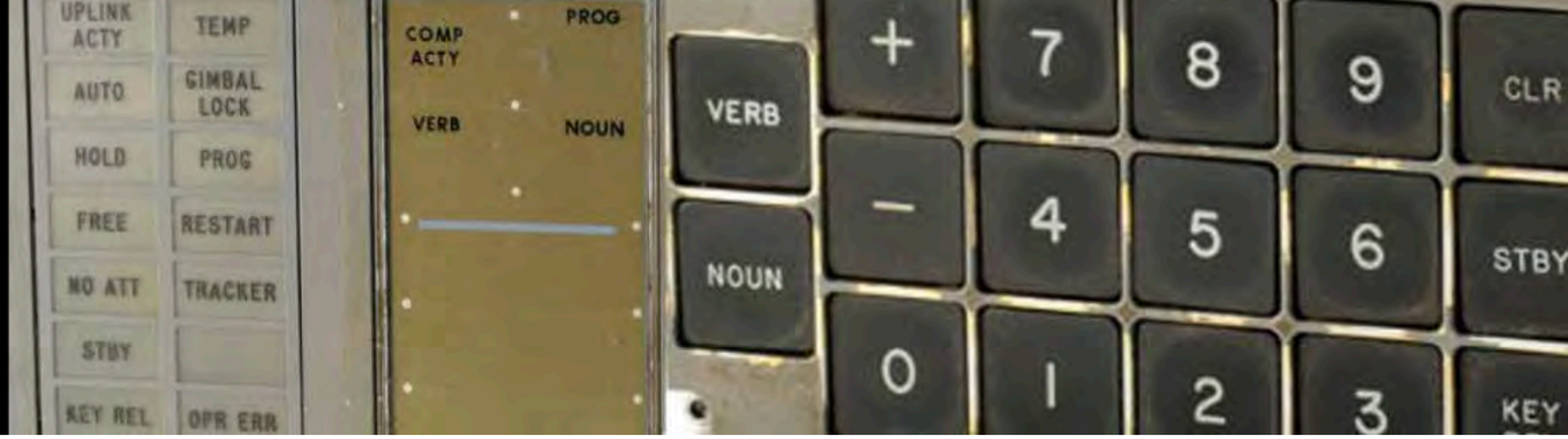
CS160

USER INTERFACE DESIGN

FALL 2020



HUMAN MODELS

30 SEP 2020

ERIC PAULOS
www.paulos.net

UNIVERSITY OF CALIFORNIA Berkeley

ANNOUNCEMENTS

TEAMS & PROJECTS

DESIGN 03 — Due TODAY

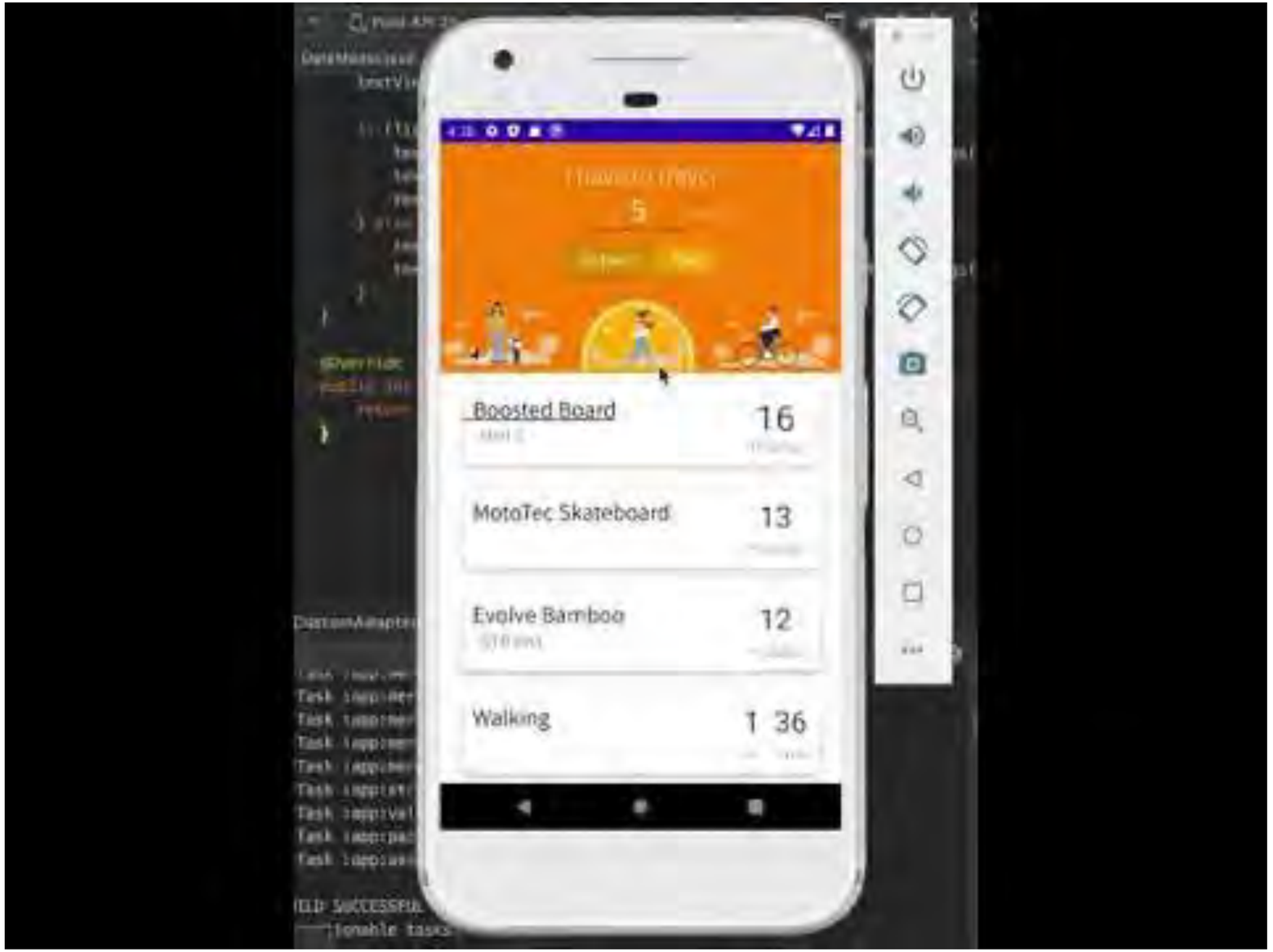
PROG 02A — Due TODAY

PROG 02B — Due 16 OCT

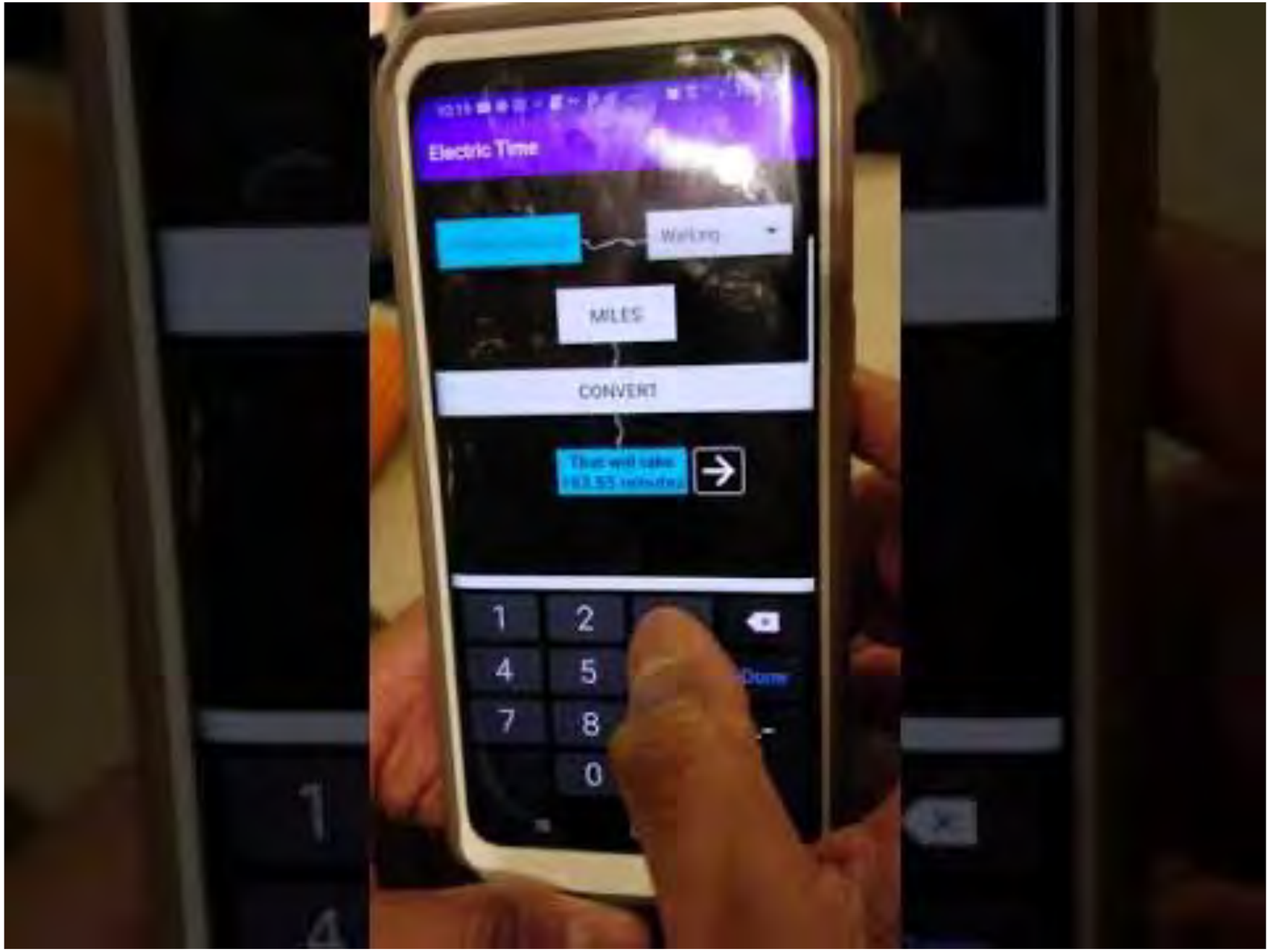
Group chat for womxn taking this class ▪ contact Swetha Prabakaran
swethapraba@berkeley.edu

FEEDBACK ON CLASS SO FAR

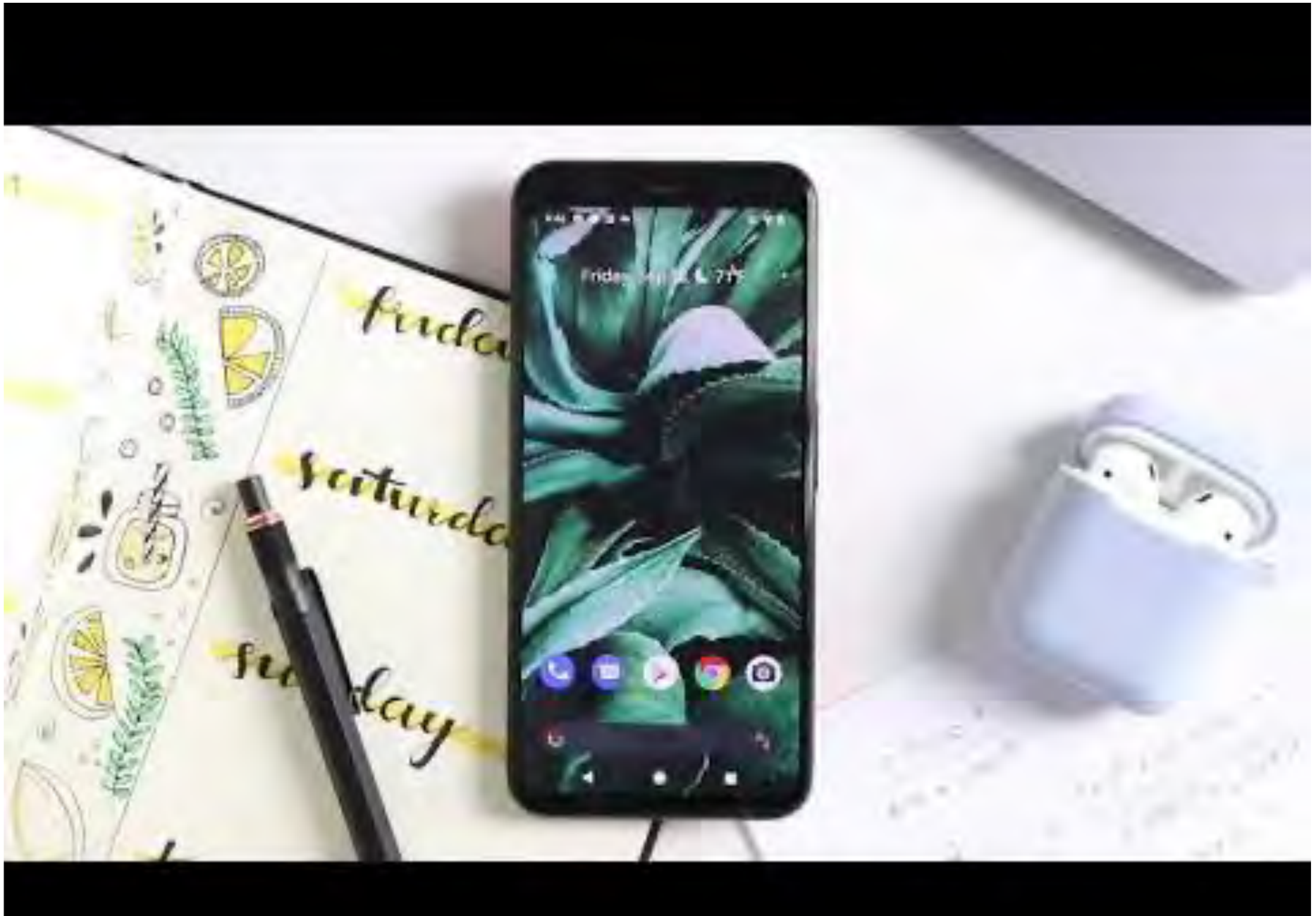
PROG 01: STEPHANIE ORTIZ SEVILLA



PROG 01: THADDIOUS KENNEDY



PROG 01: ABISHEK CHOZHAN



WHY MODEL HUMAN PERFORMANCE?

To predict impact of new technology/interface

Apply model to predict effectiveness

We could build a simulator to evaluate user interface designs

HUMAN INFO PROCESSOR

Processors:

- Perceptual
- Cognitive
- Motor

Memory:

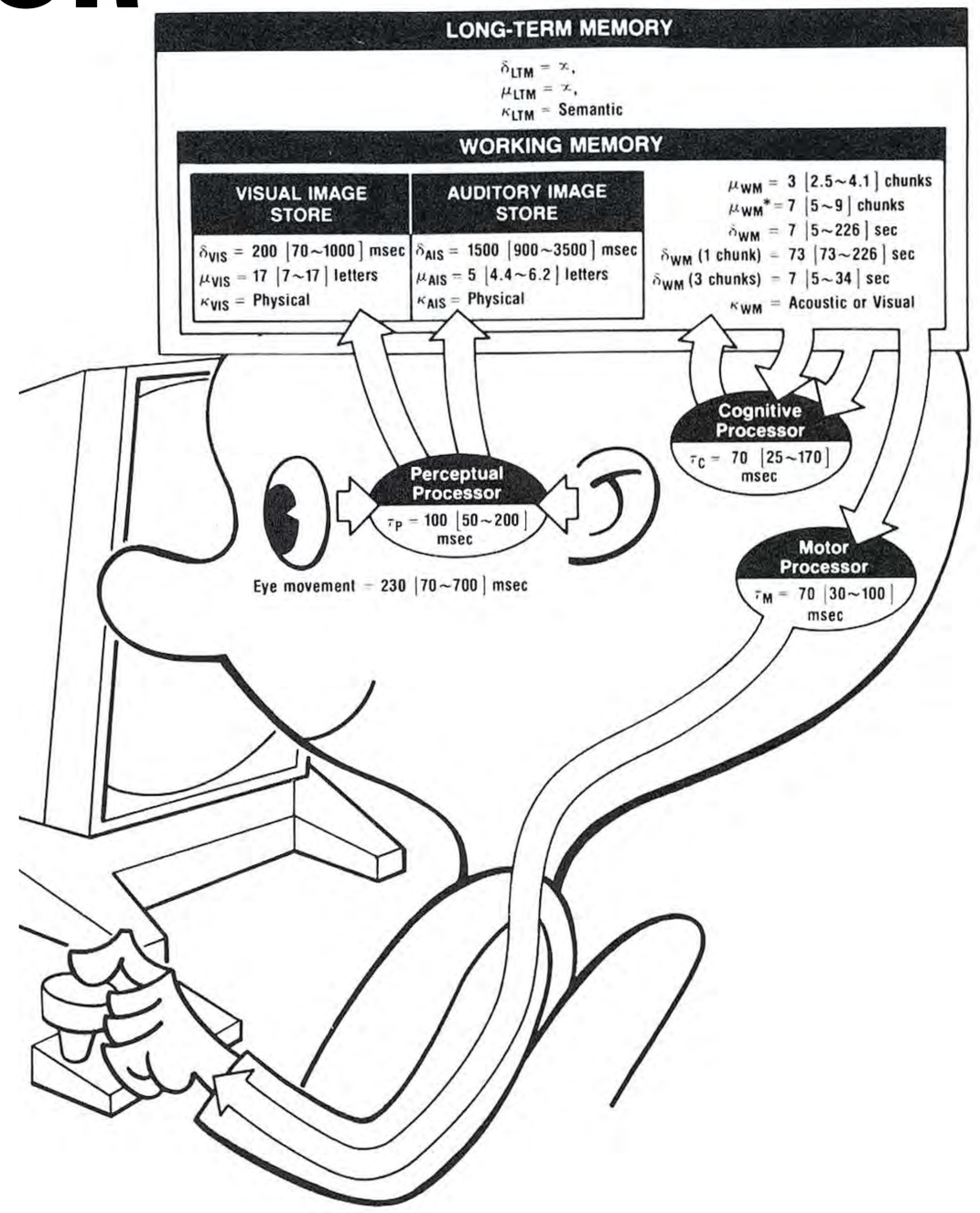
- Working memory
- Long-term memory

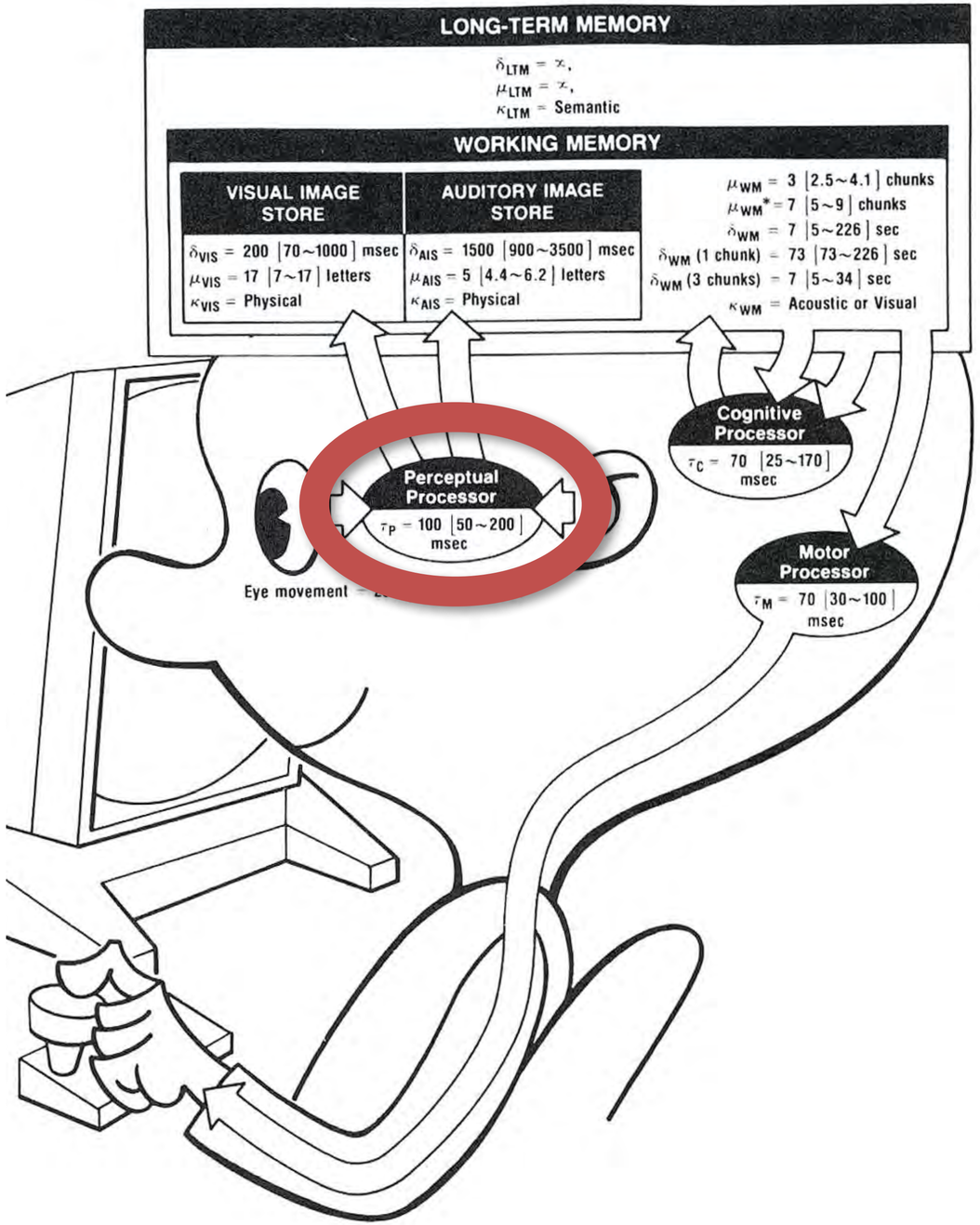
Unified model

Probably inaccurate

Predicts performance well

Very influential

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τ_M = 70 [30~100] msec
Eye movement

PERCEPTUAL PROCESSOR

Physical store from our senses: sight, sound, touch, ...

Code directly based on sense used

Visual, audio, haptic, ... features

Selective

Spatial

Pre-attentive: color, direction...

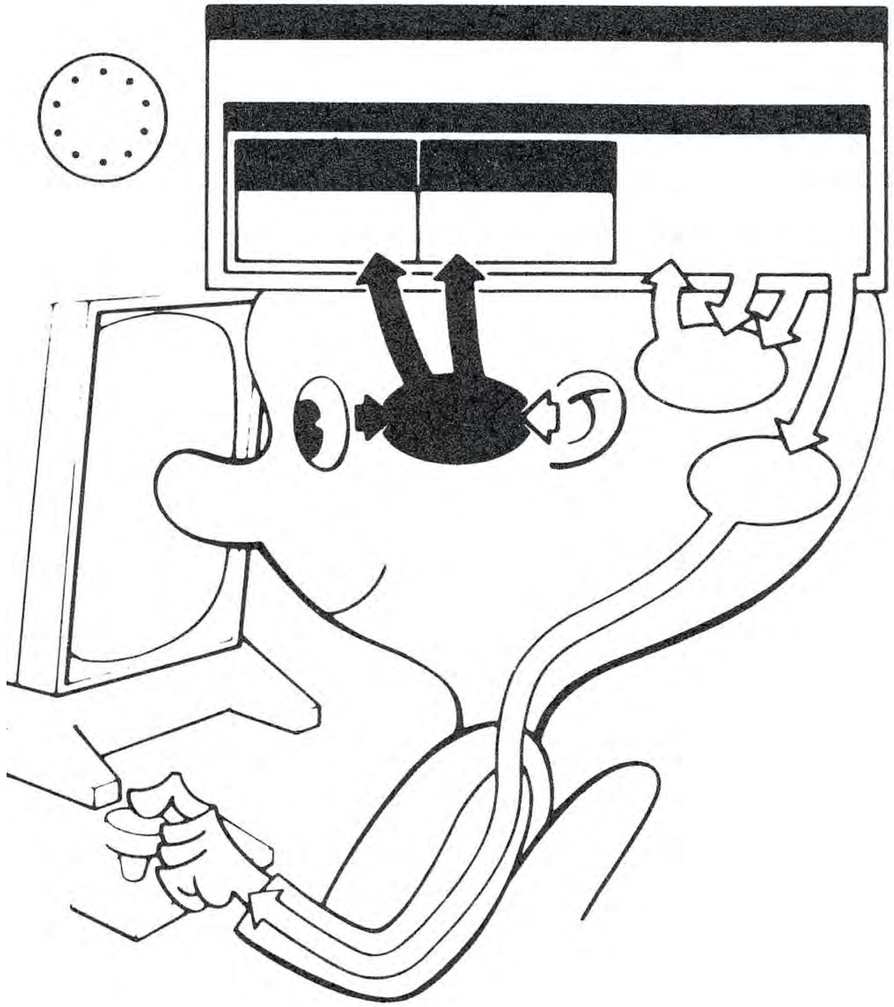
Capacity of visual store

Example: 17 letters

Decay time for working memory: 200ms

Recoded for transfer to working memory

Progressive: 10ms/letter



PRE-ATTENTIVE

Typically, tasks that can be performed on large multi-element displays in less than 200 to 250 milliseconds are considered preattentive.

HOW MANY 3’S

128176875613897654698450698560498282676298098584582245098564589450984509809435859091030209905959595772564675050678904567884578980982167765487636490856091294968 6

HOW MANY 3’S

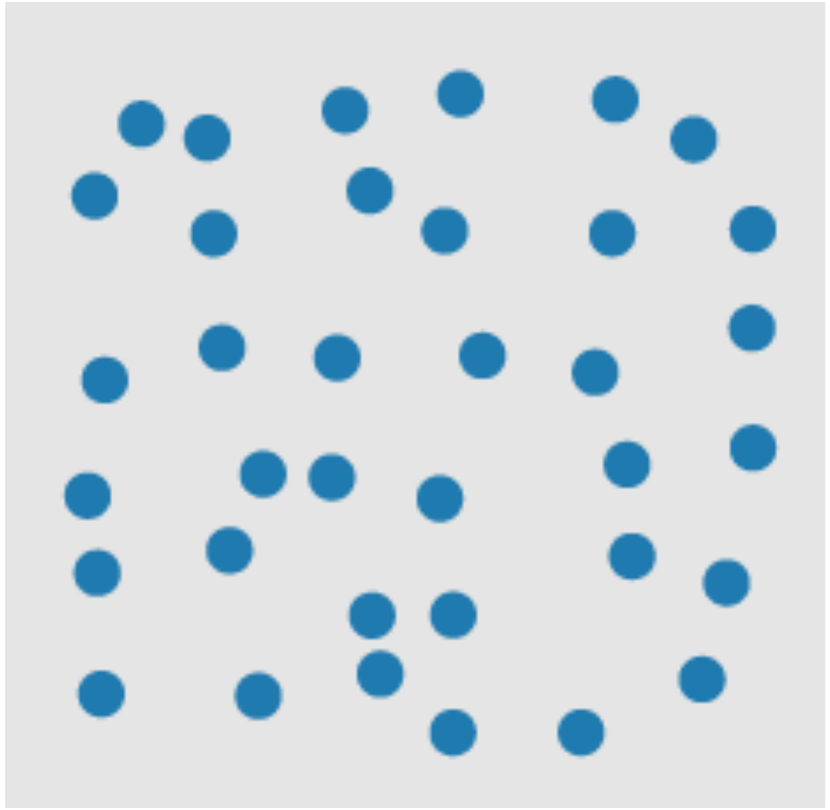
5690859068509681389765469845069856082826
2112091820981209812098465969091030209902
5395959577256445689075469675050678904567
8189457636466695044059868124036091294968 6

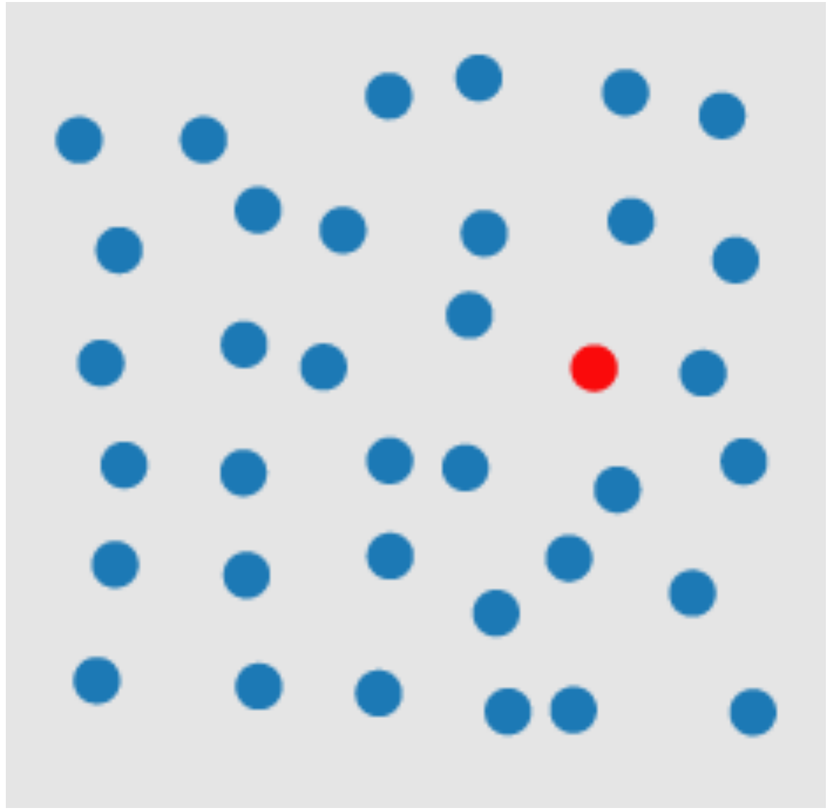
HOW MANY 3’S

1281768756138976546984506985604982826762
9809858458224509856458945098450980943585
9091030209905959595772564675050678904567
8845789809821677654876364908560912949686

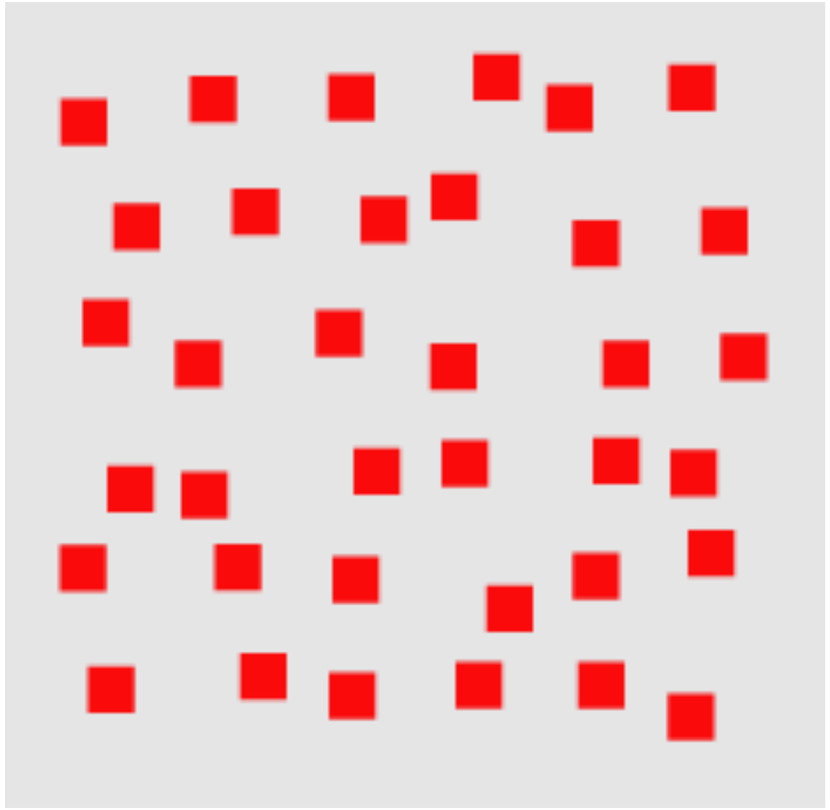
VISUAL POP-OUT: COLOR

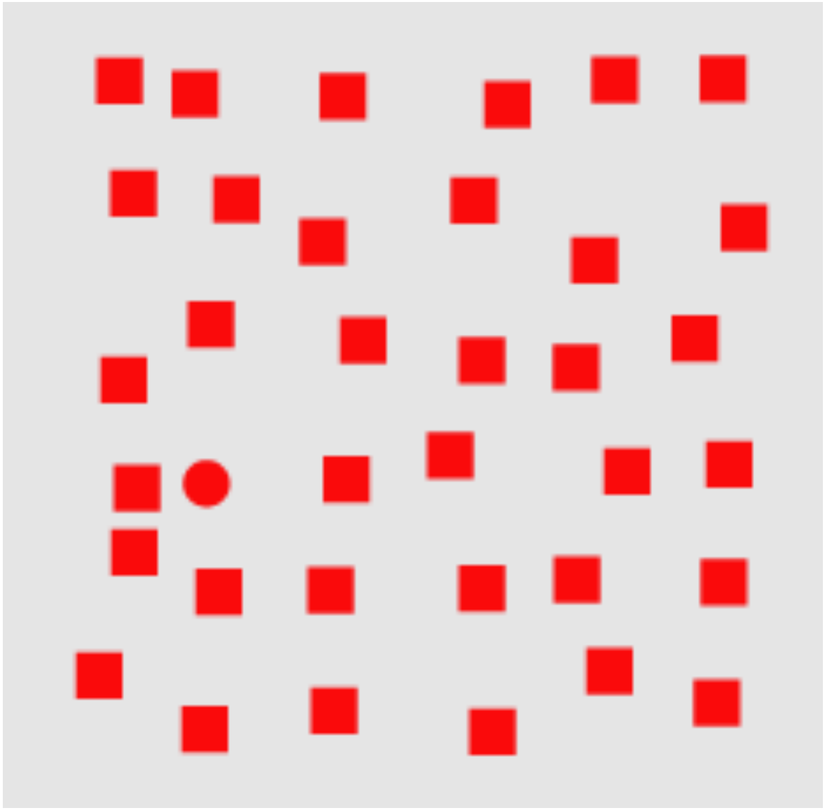
http://www.csc.ncsu.edu/faculty/healey/PP/index.html





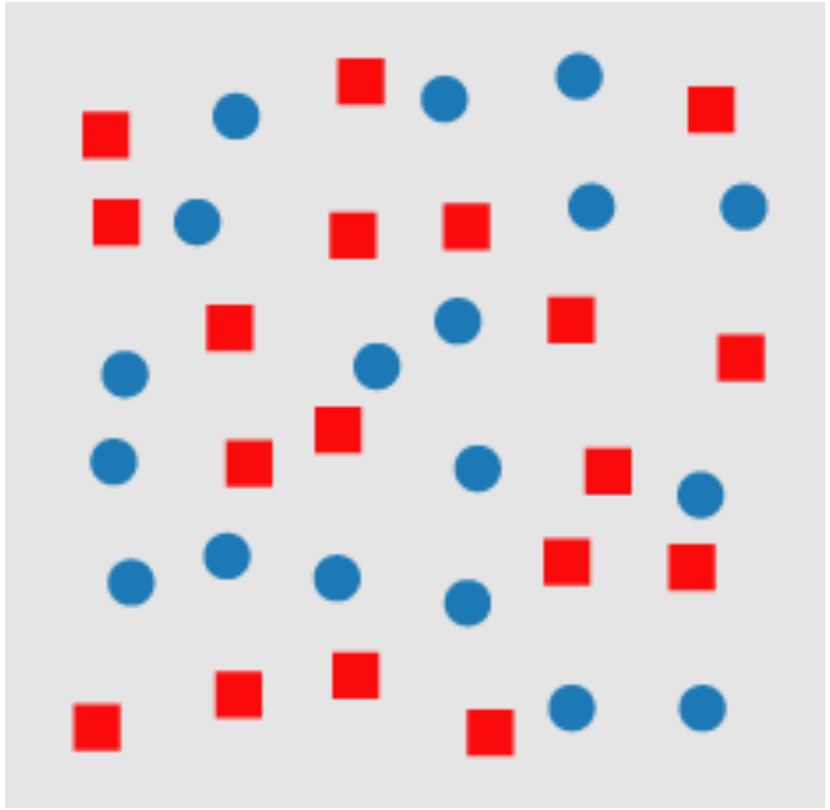
VISUAL POP-OUT: SHAPE

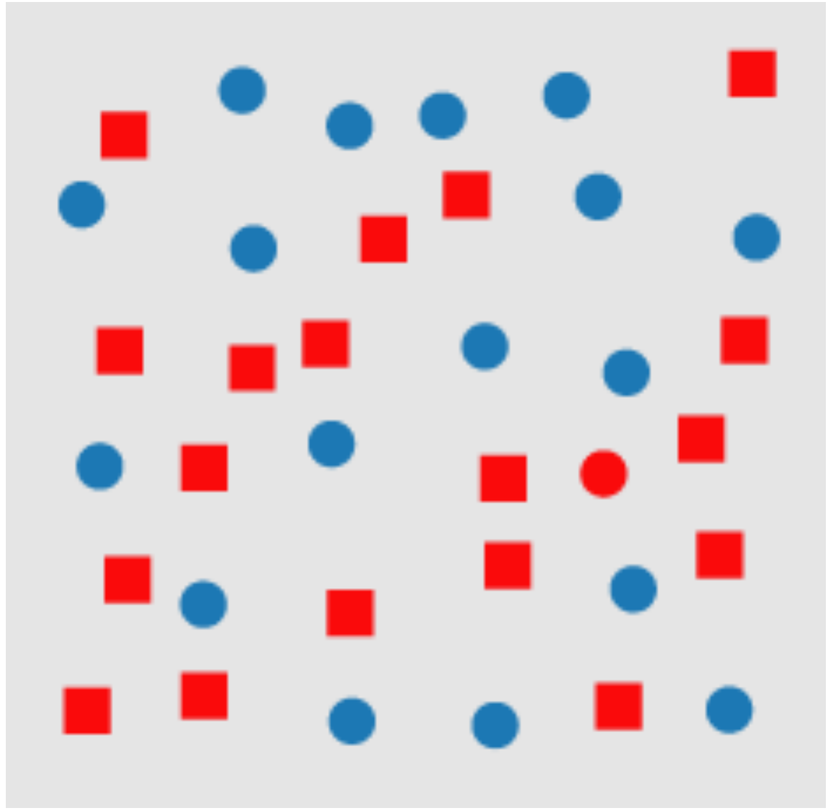




http://www.csc.ncsu.edu/faculty/healey/PP/index.html

FEATURE CONJUNCTIONS

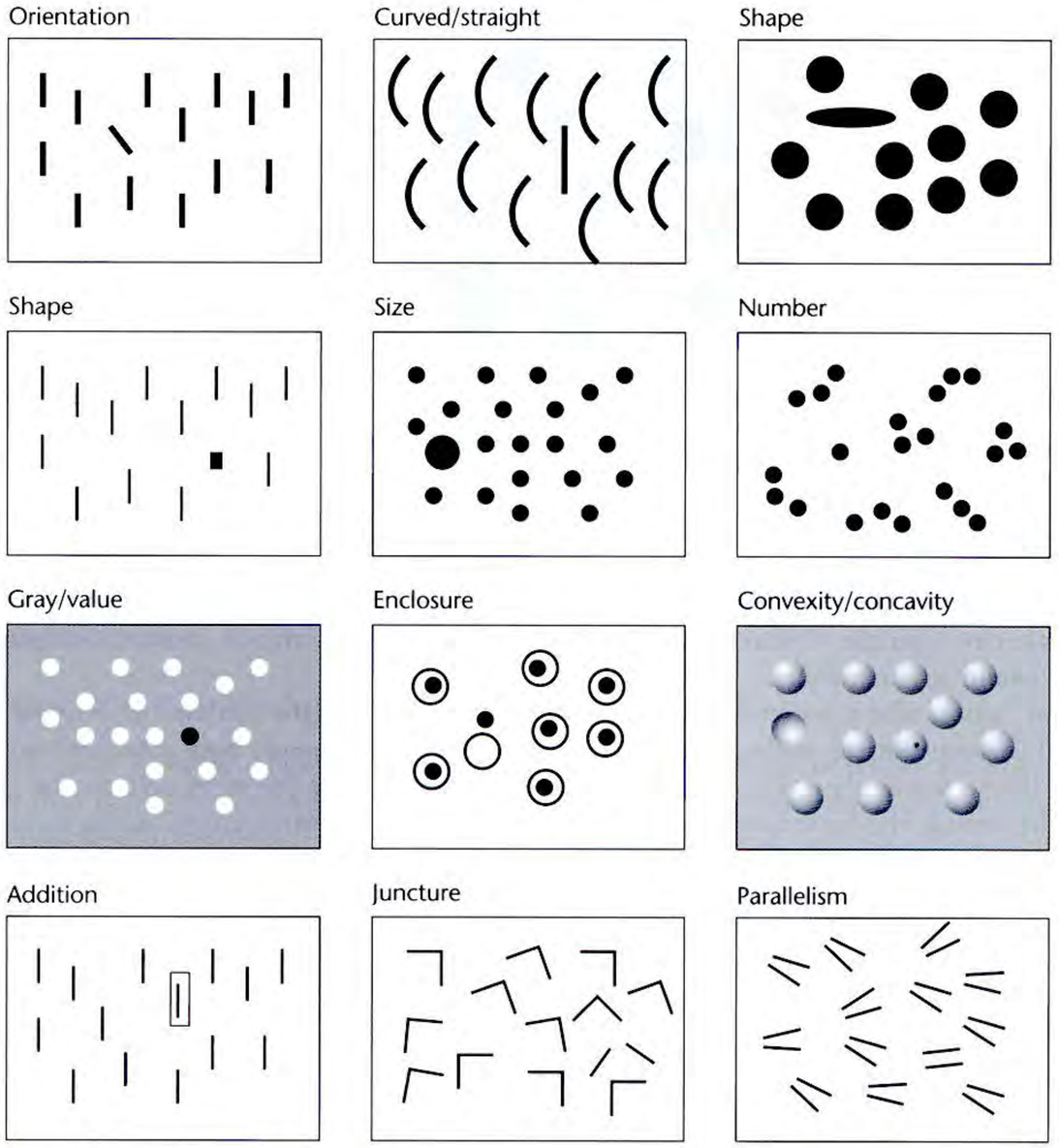




http://www.csc.ncsu.edu/faculty/healey/PP/index.html

http://www.csc.ncsu.edu/faculty/healey/PP/

PRE-ATTENTIVE FEATURES



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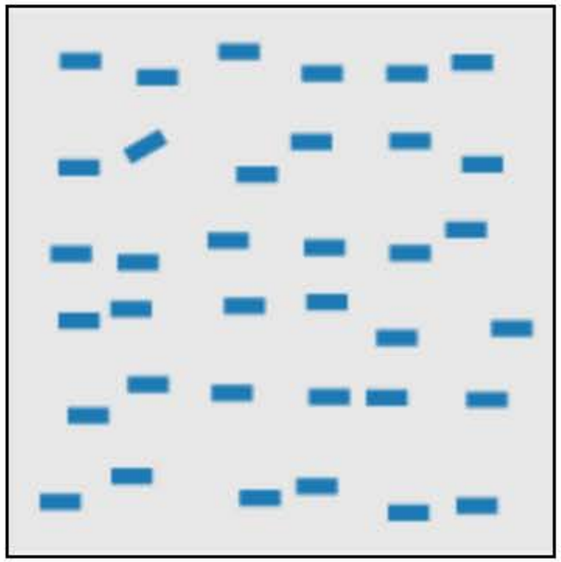
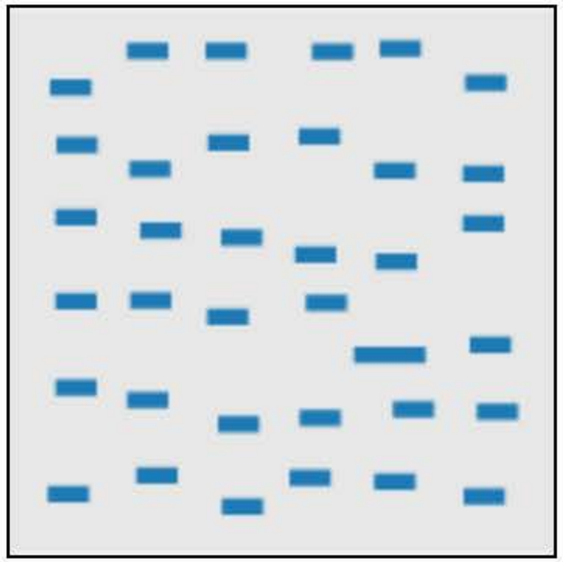
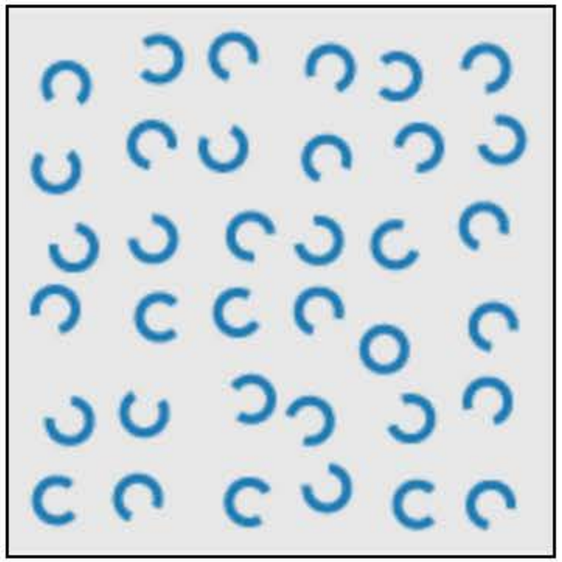


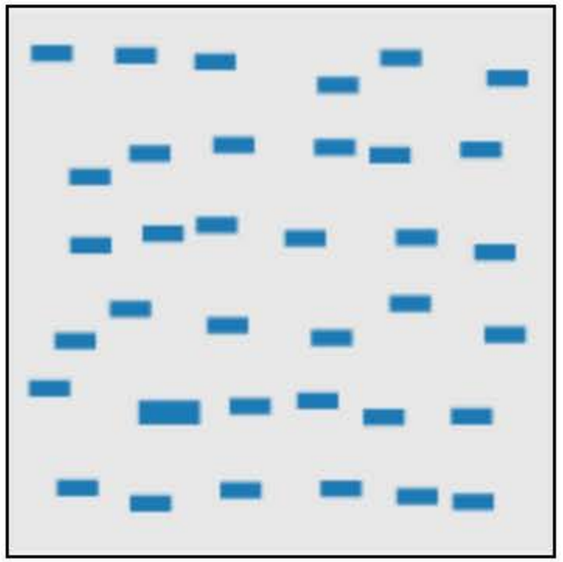
line (blob) orientation



length, width

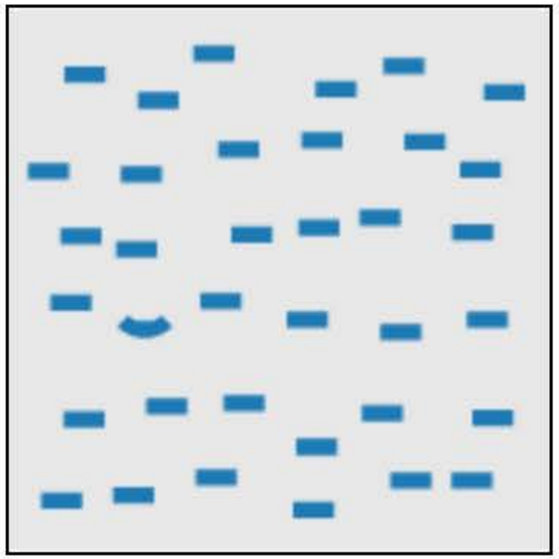


closure

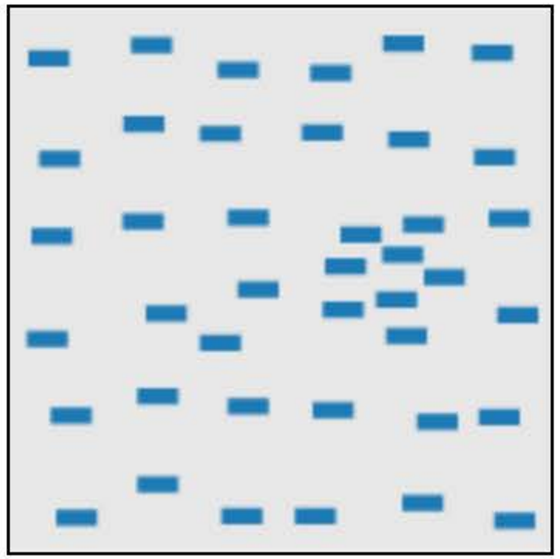


size

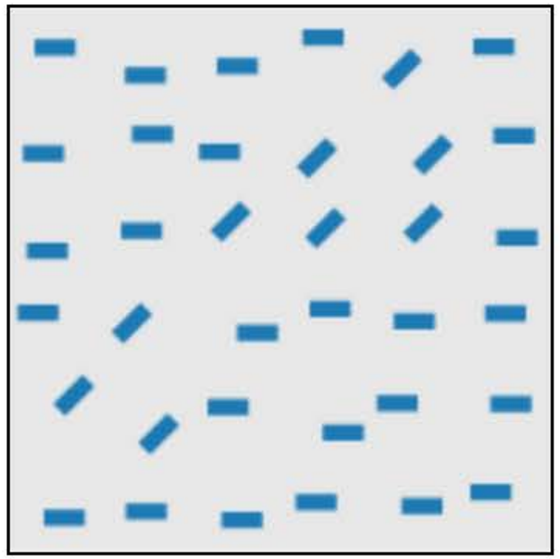
PRE-ATTENTIVE FEATURES



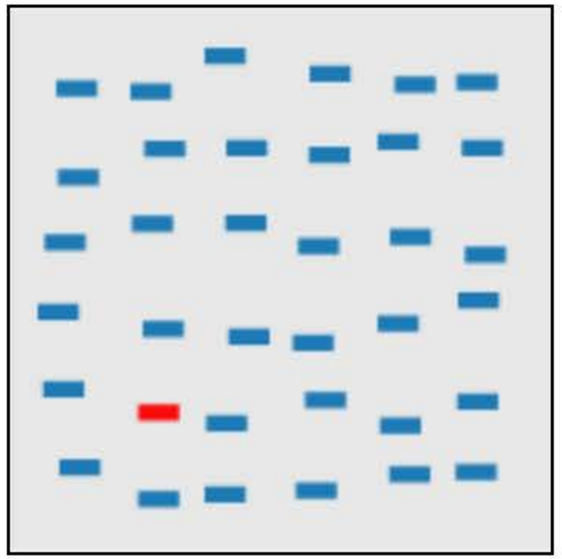
curvature



density, contrast

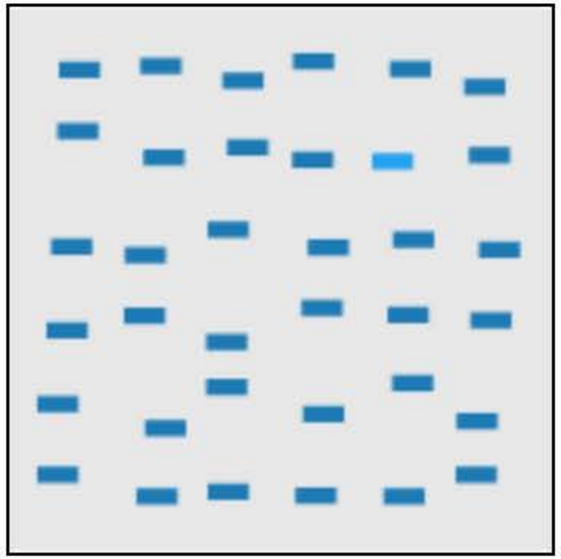


number, estimation

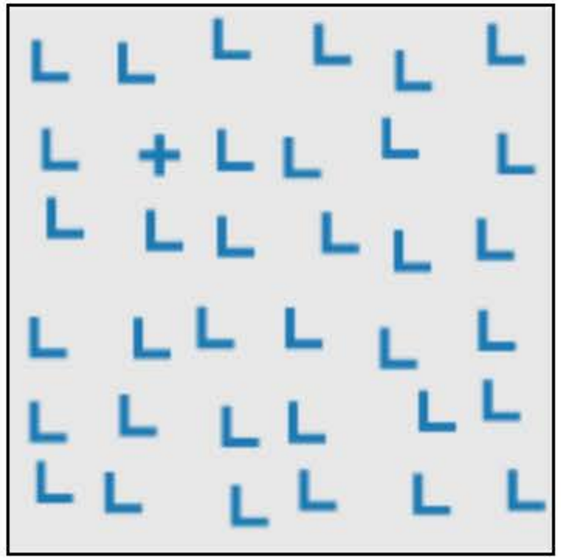


colour (hue)

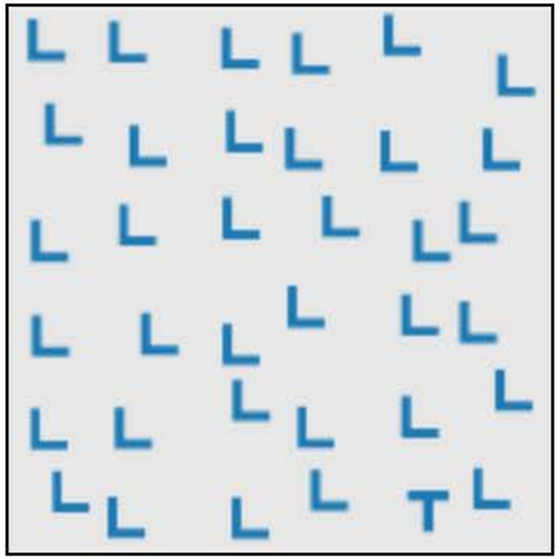
PRE-ATTENTIVE FEATURES



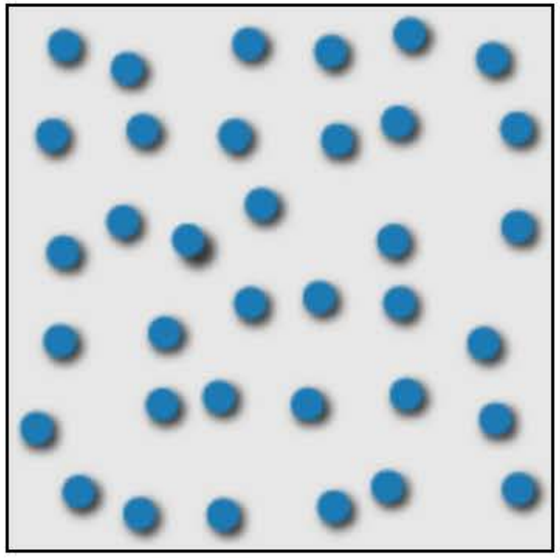
intensity, binocular lustre



intersection



terminators



3D depth cues

http://www.csc.ncsu.edu/faculty/healey/PP/

CHANGE BLINDNESS

Change blindness is a surprising perceptual phenomenon that occurs when a change in a visual stimulus is introduced and the observer does not notice it. For example, observers often fail to notice major differences introduced into an image while it flickers off and on again.

Instructions

Count how many times the players wearing white pass the basketball.

SELECTIVE ATTENTION

Selective attention is simply the act of focusing on a particular object for a period of time while simultaneously ignoring irrelevant information that is also occurring. This occurs on a daily basis and can be seen in basically any of your interactions. Because it is impossible to give attention to every stimulus in our environment, we use selective attention to select what stimuli are important as events occur.

PERCEPTUAL PROCESSOR

Cycle time

Quantum experience: 100ms

Percept fusion

Frame rate necessary for movies to look continuous?

time for 1 frame < Tp (100 msec) -> 10 frame/sec.

Max. morse code rate can be similarly calculated

Perceptual causality

Two distinct stimuli can fuse if the first event appears to ***cause*** the other

Events must occur in the same cycle

Michotte demonstration

What do you see? Most observers report that the red ball hit the blue ball.

The blue ball moved "**because the red ball hit it**." Thus, the red ball is perceived to "**cause**" the blue ball to move, even though the balls are nothing more than color disks on your screen that move according to a program.

http://cogweb.ucla.edu/Discourse/Narrative/Heider_45.html

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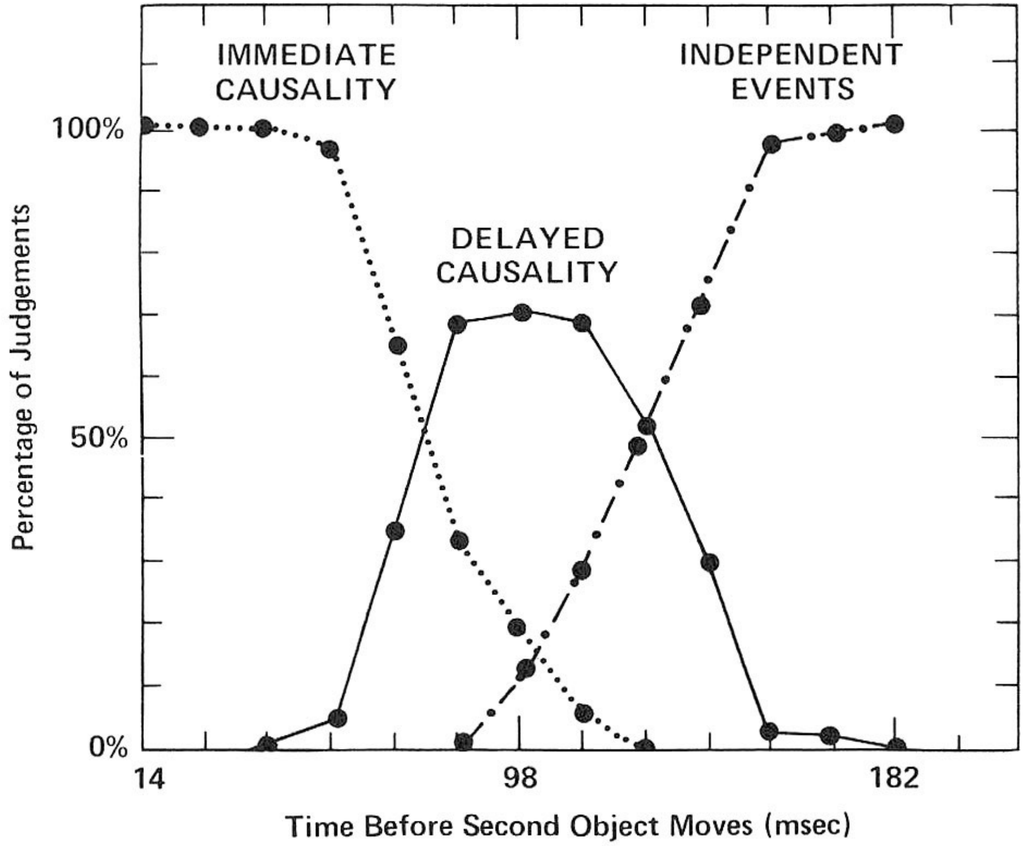


NewScientist

Progress bar illusion

WORKING MEMORY

Access in chunks

Task dependent construct

7 ±2 (Miller)

Decay

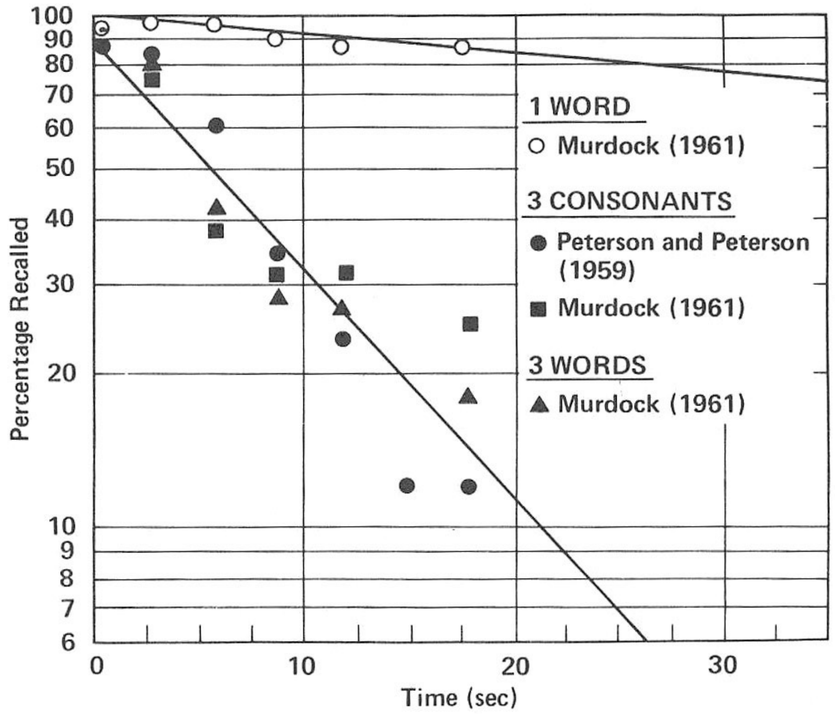
Content dependant

1 chunk 73 sec

3 chunks 7 sec

Attention span

Interruptions > decay time



LONG TERM MEMORY

Very large capacity

Semantic encoding

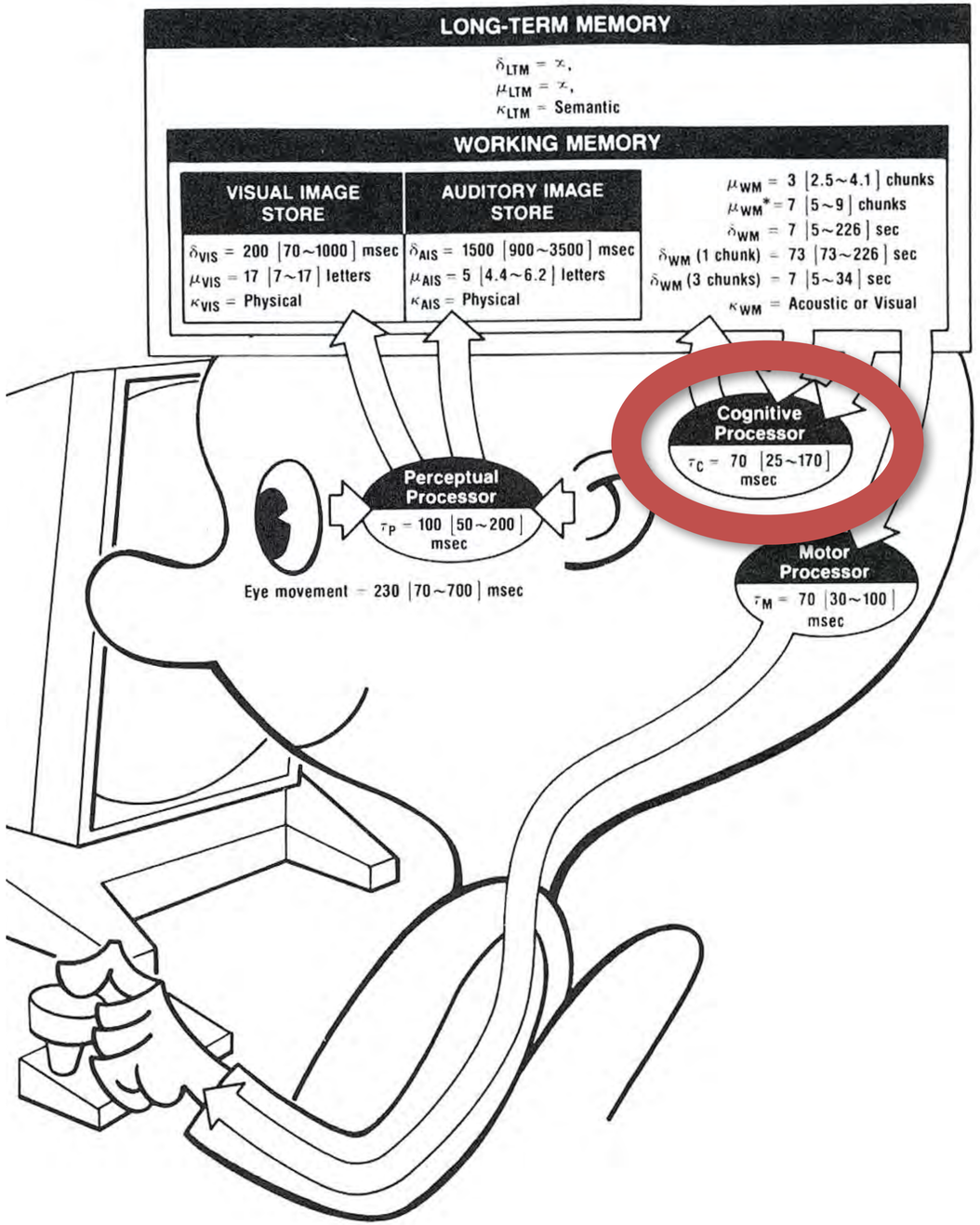
Associative access

Fast read: 70ms

Expensive write: 10s

Can also move from WM to LTM via rehearsal

Context at the time of acquisition key for retrieval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τ_C = 70 [25~170] msec
Perceptual Processor
τ_P = 100 [50~200] msec
Motor Processor
τ_M = 70 [30~100] msec
Eye movement = 230 [70~700] msec

COGNITIVE PROCESSOR

Cycle time: 70ms

Can be modulated

Typical matching time

Digits: 33ms

Colors: 38ms

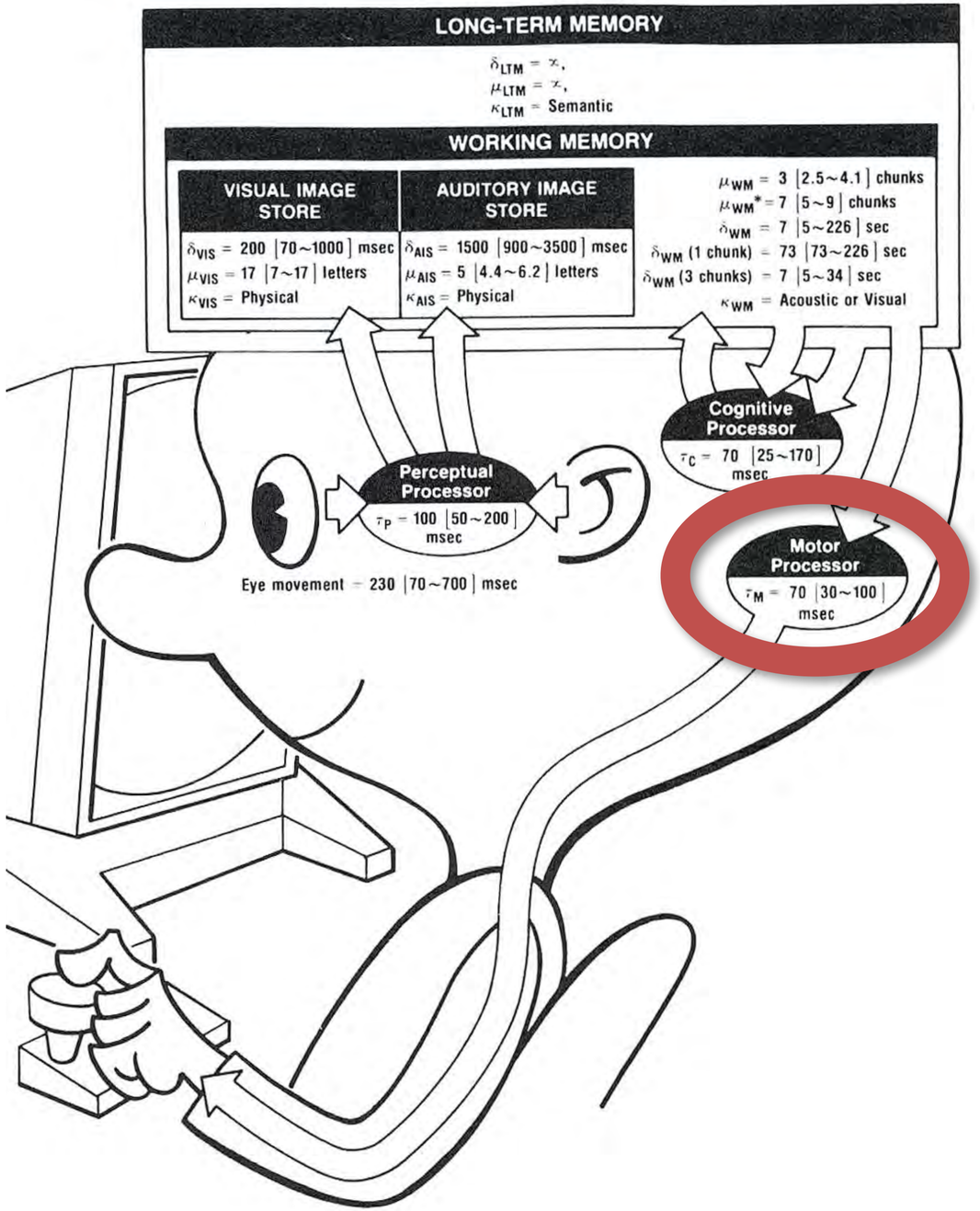
Geometry: 50ms...

Fundamentally serial

One locus of attention at a time

Eastern 401, December 1972

Crew focused on landing gear indicator bulb,
Aircraft is loosing altitude (horn, warning indicator...),
Aircraft crashed in the Everglades
see “The Human Interface” by Raskin, p25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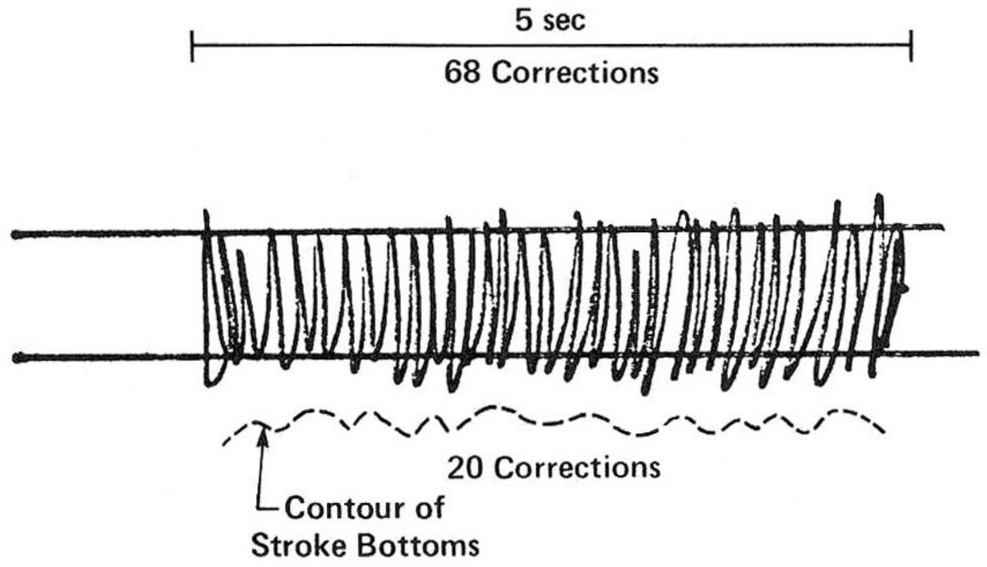
MOTOR PROCESSOR

Receive input from the cognitive processor

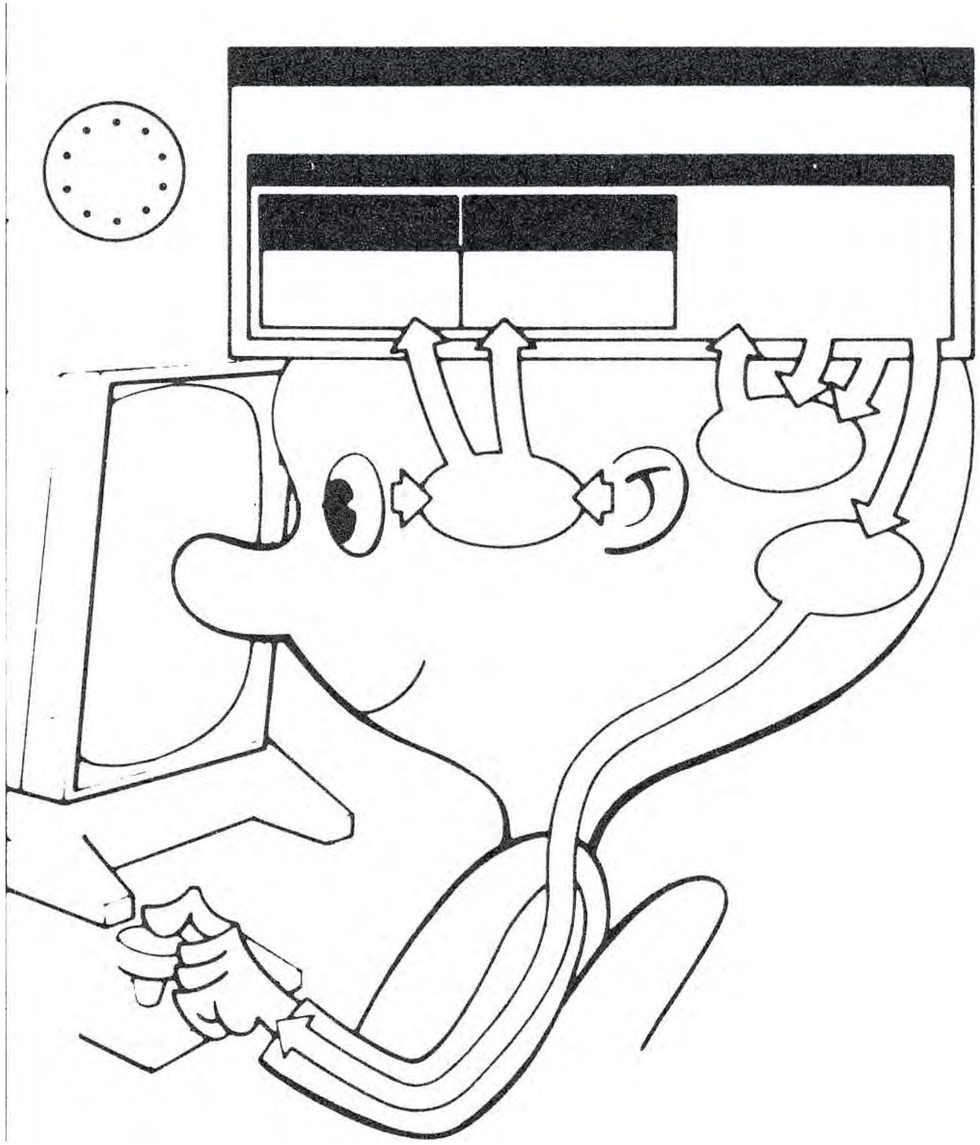
Execute motor programs

Pianist: up to 16 finger movements per second

Point of no-return for muscle action



HIT SPACE WHEN CHARACTER APPEARS



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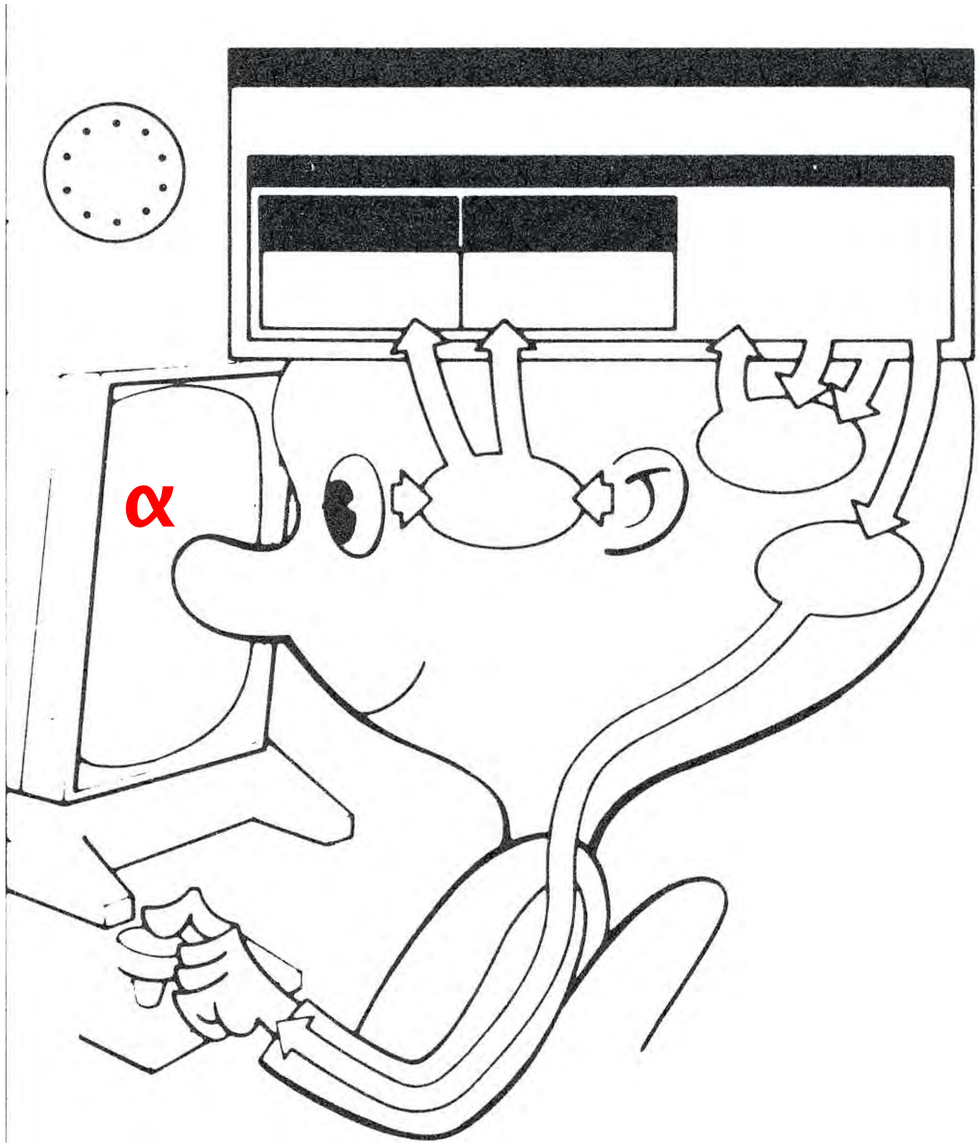

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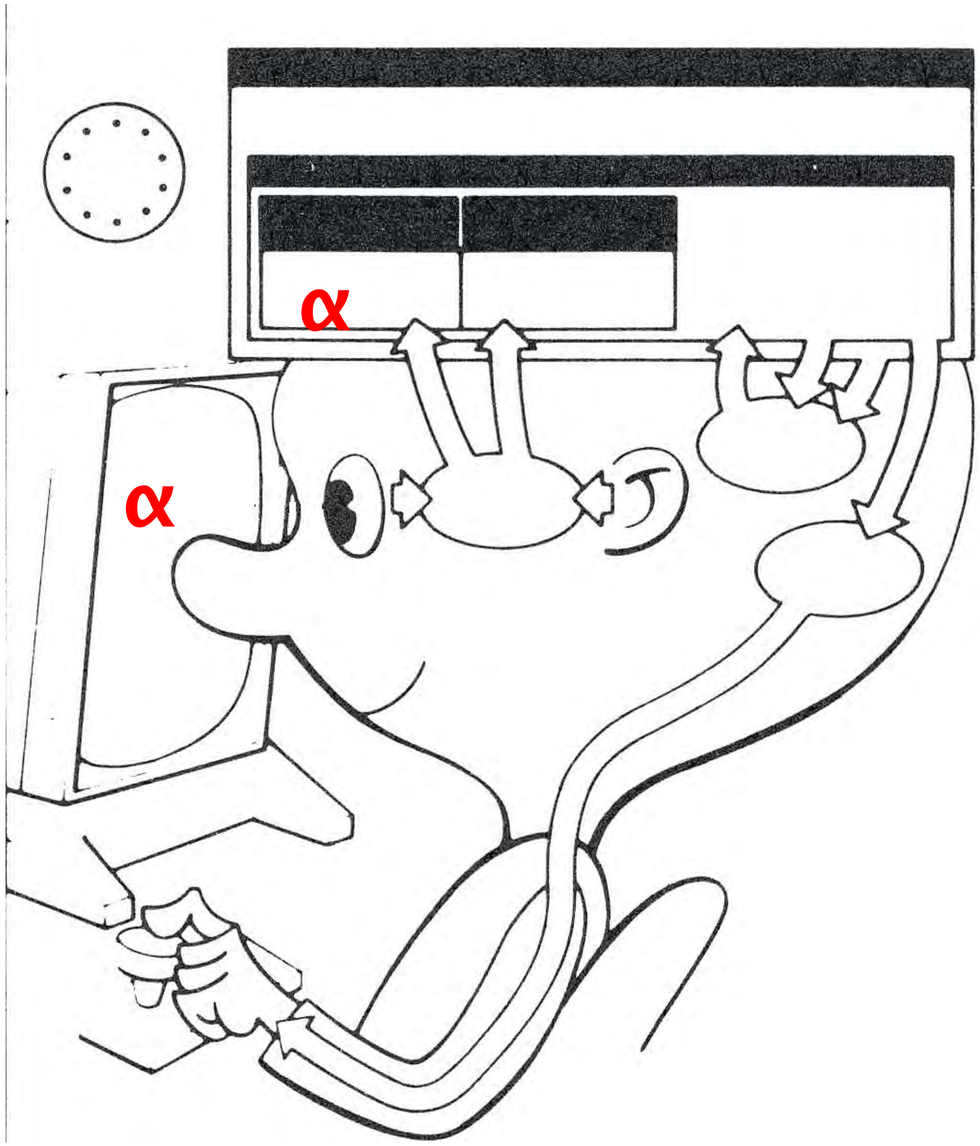

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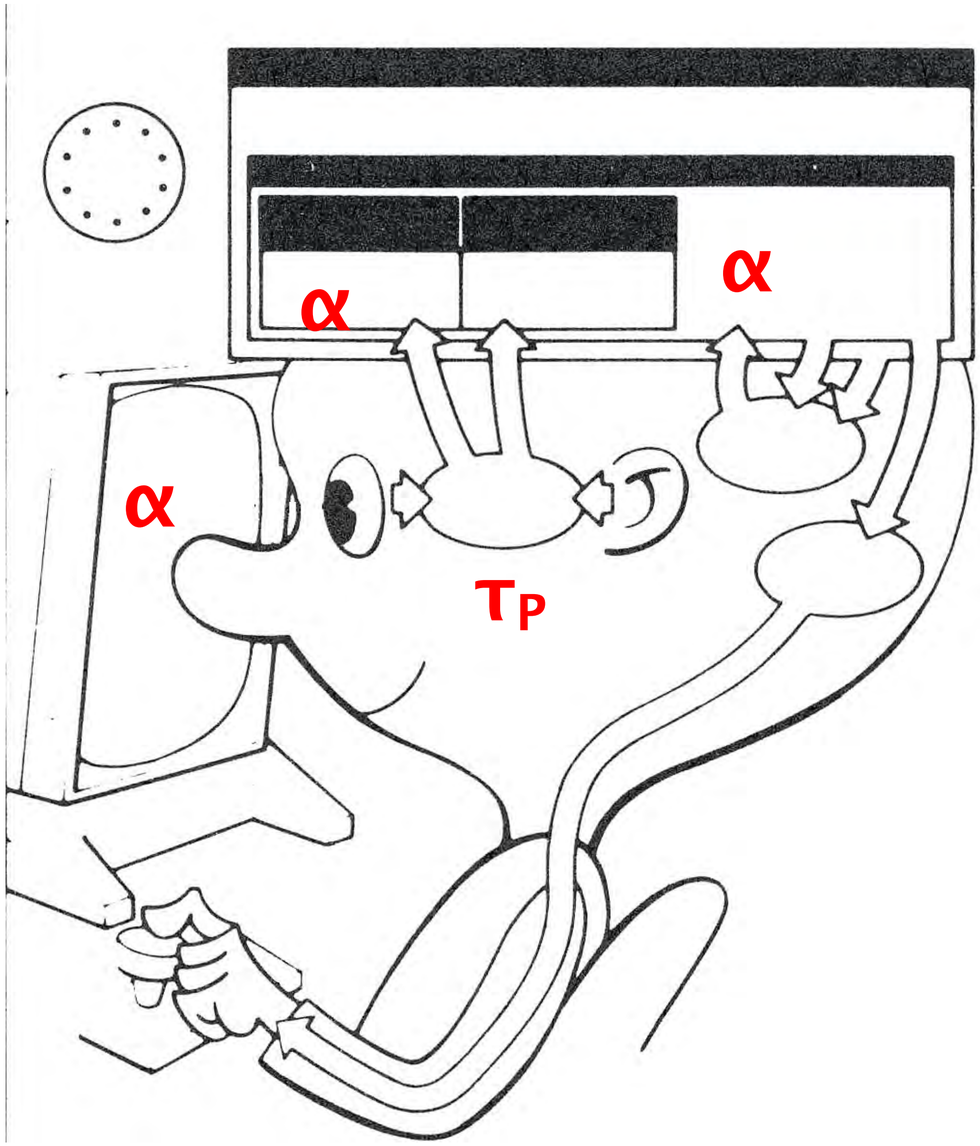

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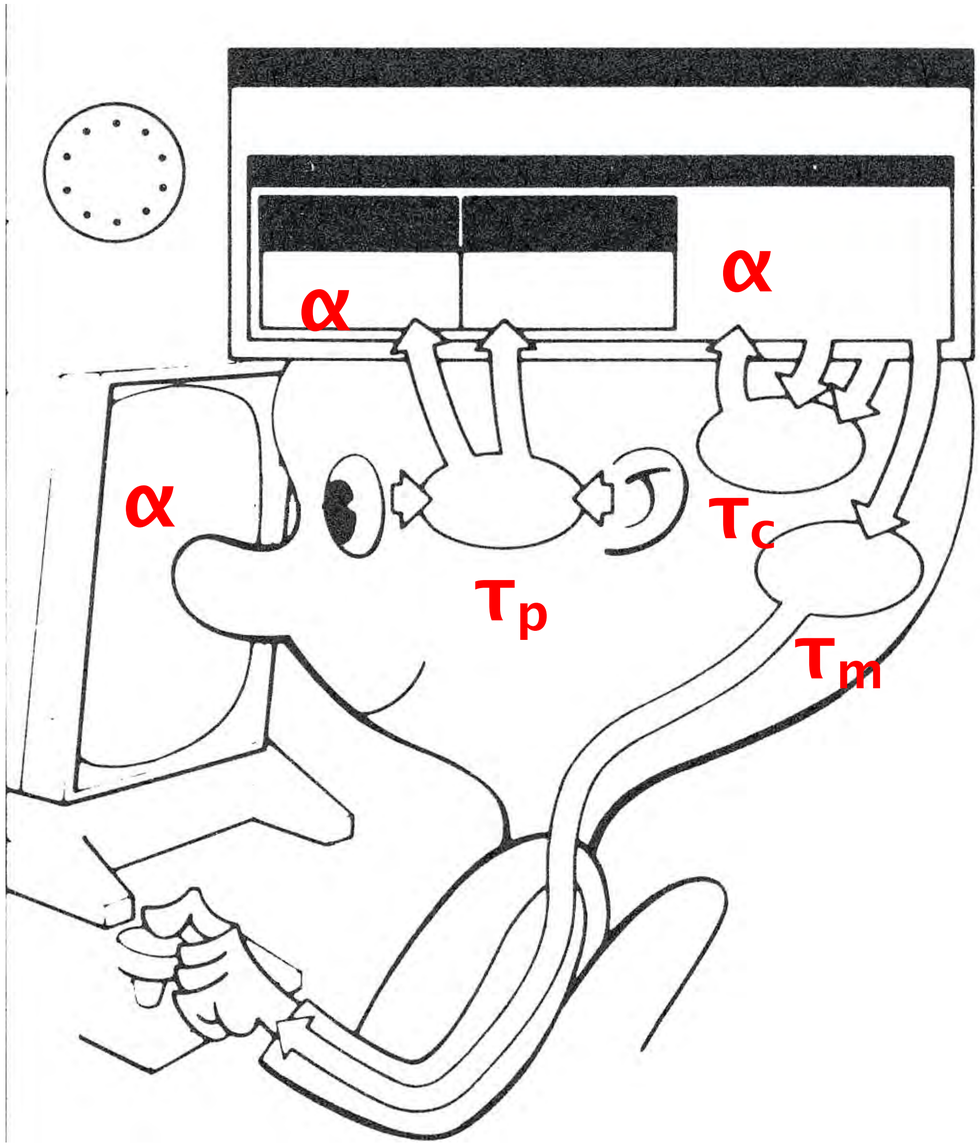

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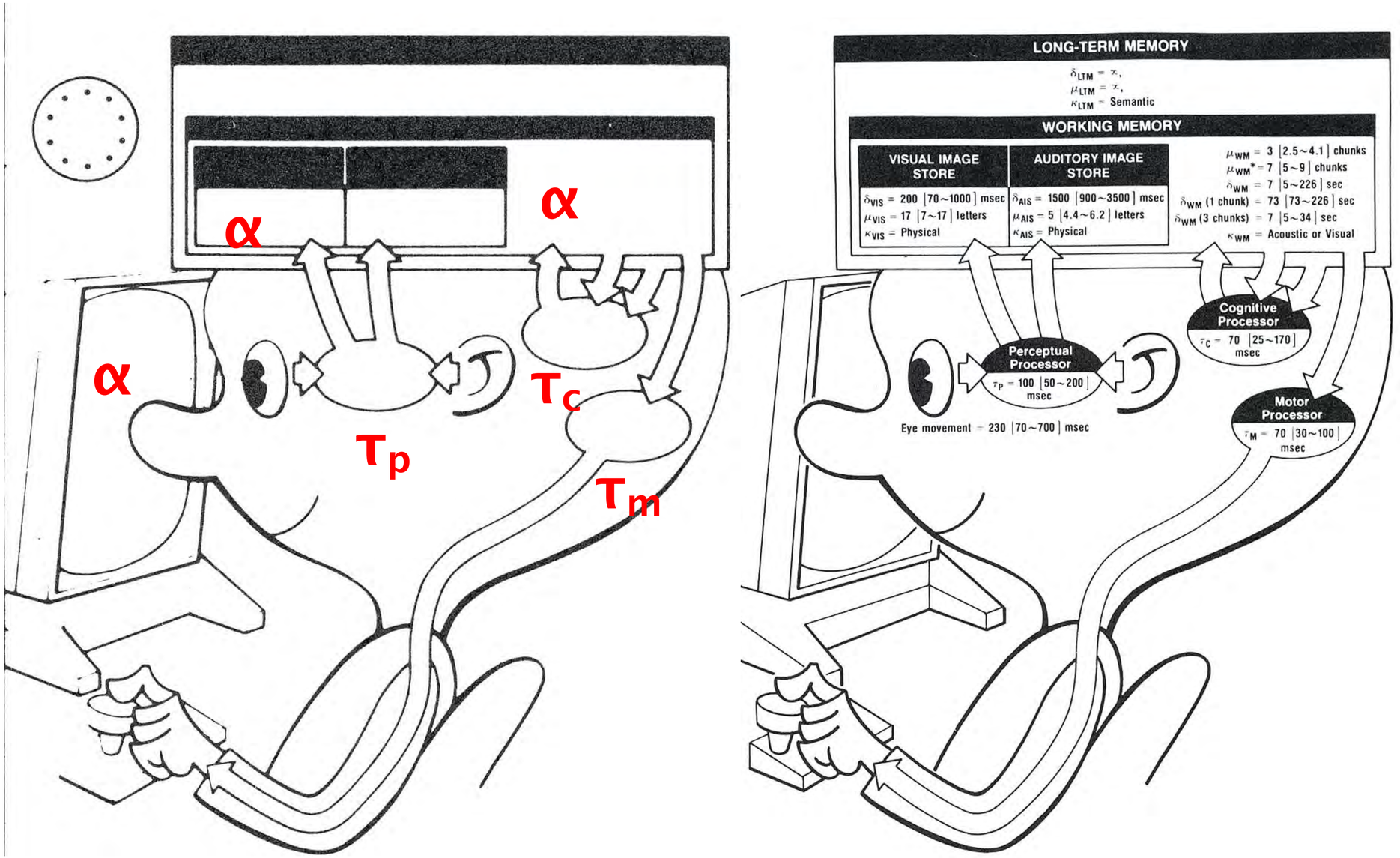
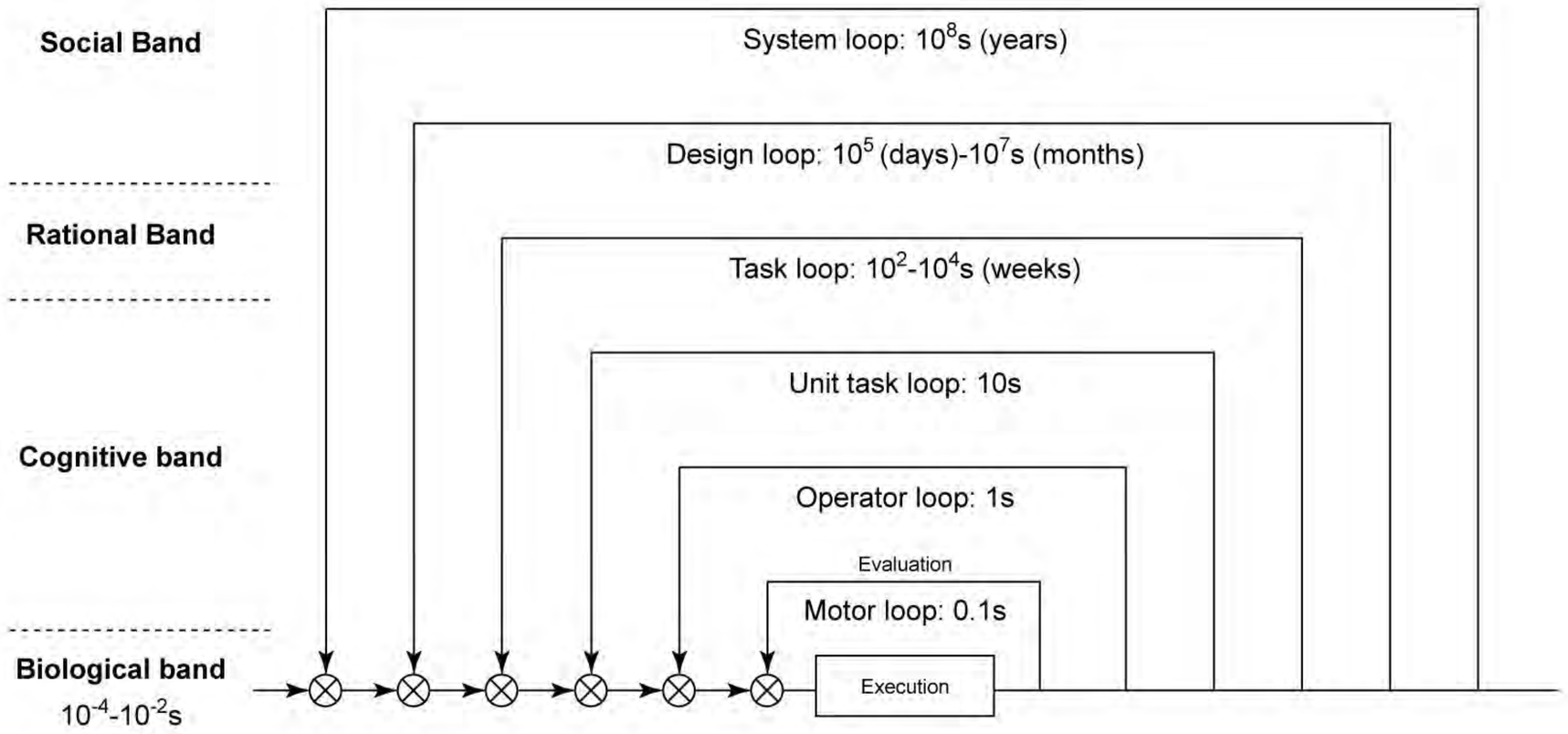


HUMAN INTERACTION LOOPS

(NEWELL)



PRINCIPLES OF OPERATION

Interface should respect limits of human performance

Pre-attentive features pop-out

Events within cycle time fuse together

Causality

Recognize-Act Cycle of the cognitive processor

On each cycle contents in Working Memory initiate cognitive actions

Cognitive actions modify the contents of Working Memory


UPLINK ACTY
TEMP
AUTO
GIMBAL LOCK
HOLD
PROG
FREE
RESTART
NO ATT
TRACKER
STBY
KEY REL
OPR ERR
COMP ACTY
PROG
VERB
NOUN
VERB
NOUN
+
7
8
9
CLR
−
4
5
6
STBY
0
1
2
3
KEY

MEMORY

SIMPLE EXPERIMENT

Volunteer

Start saying colors you see in list of words

When slide comes up

As fast as you can

Say “done” when finished

Schedule

Paper

Page

Back

Change

Home

SIMPLE EXPERIMENT

Do it again

Say “done” when finished

Blue

Red

Black

White

Green

Yellow

INTERFERENCE

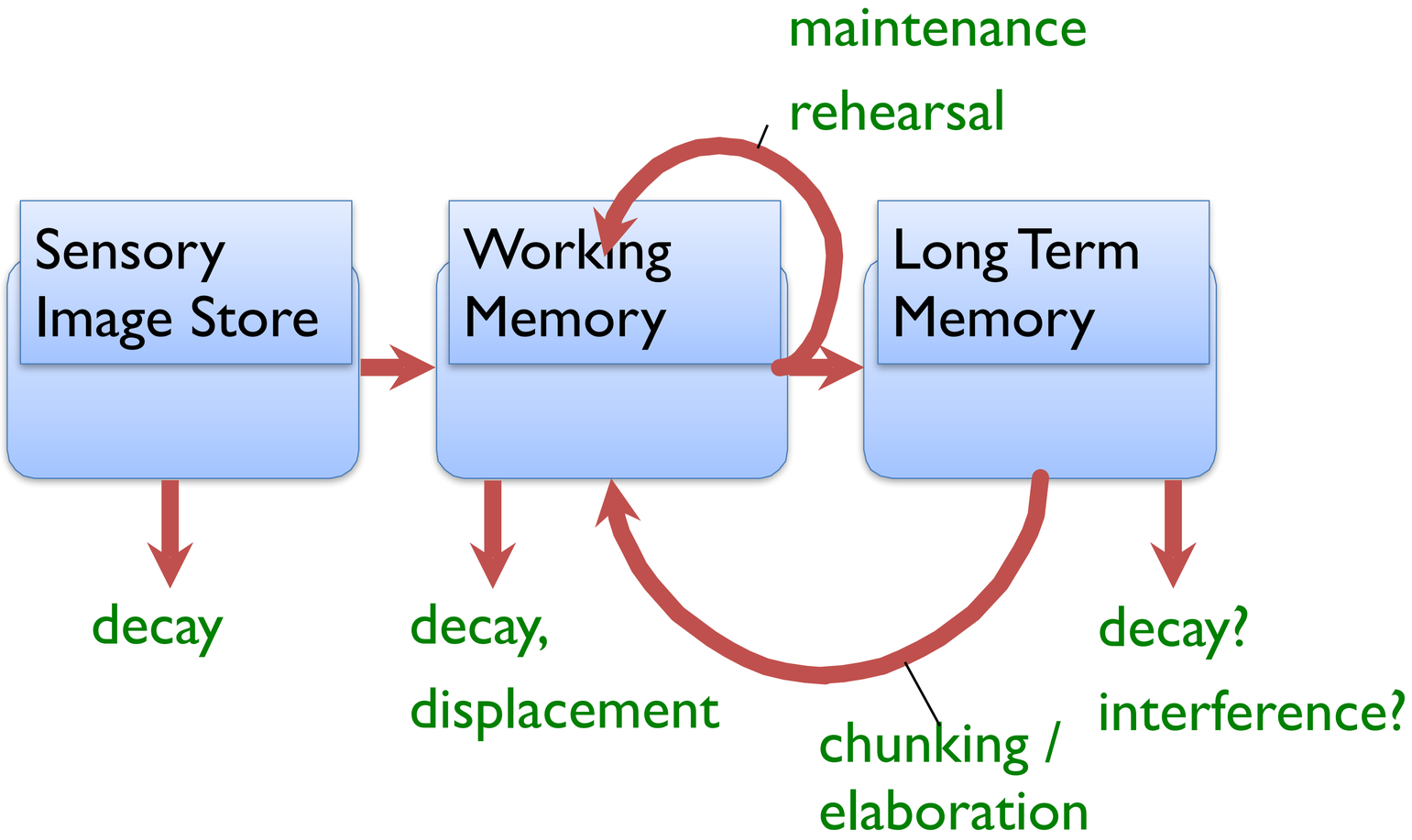
Stroop Effect

When the color spelled out by a word is incongruent with the color used to show that word, naming the word color is slower and more error prone.

Explanation:

Relationship between meaning and physical form of stimulus are in conflict.

STAGE THEORY



STAGE THEORY

Working memory is small

Temporary storage

decay

displacement

Maintenance rehearsal

Rote repetition

Not enough to learn information well

LONG TERM MEMORY AND ELABORATION

Recodes information

Organize (chunking)

Relate new material to already learned material

Link to existing knowledge, categories

Attach meaning

Make a story

RECOGNITION OVER RECALL

Recall

Info reproduced from memory

Recognition

Presentation of info helps retrieve info (helps remember it was seen before)

Easier because of cues to retrieval

We want to design UIs that rely on recognition!

FACILITATING RETRIEVAL: CUES

Any stimulus that improves retrieval

Example: giving hints

Other examples in software?

icons, labels, menu names, etc.

Anything related to

Item or situation where it was learned

SUMMARY

Model human processor

5 parts

Perceptual processor

Working memory

Long term memory

Cognitive processor

Motor processor

May not be biologically accurate

But ...

Provides rough estimate of performance

Can help us compare and evaluate interfaces

Interfaces should both aid and exploit human capabilities

WAIT ... MEMORY AGAIN...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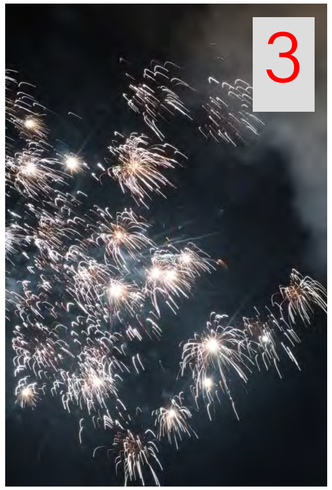
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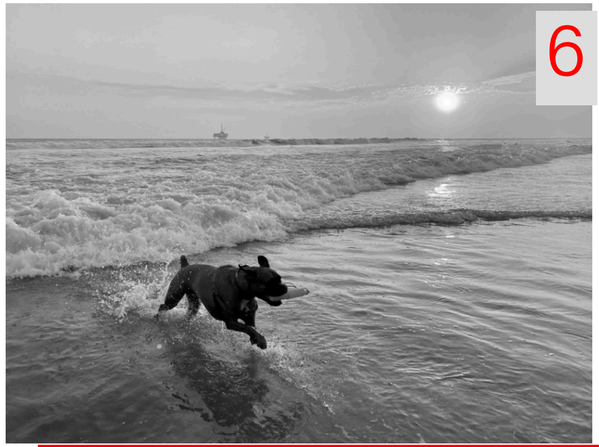
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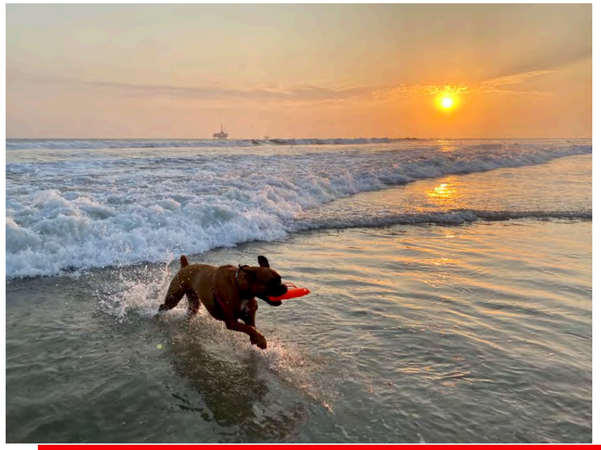


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