HUMAN MODELS

31 SEPT 2015

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www.paulos.net

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ANNOUNCEMENTS

Brainstorming Check in

Groups and Group Dynamics

Assign lead (coordination)

Setting up times to meet weekly

Tell us your role

Problems … private piazza post to all instructors

Framer in section

Download Framer

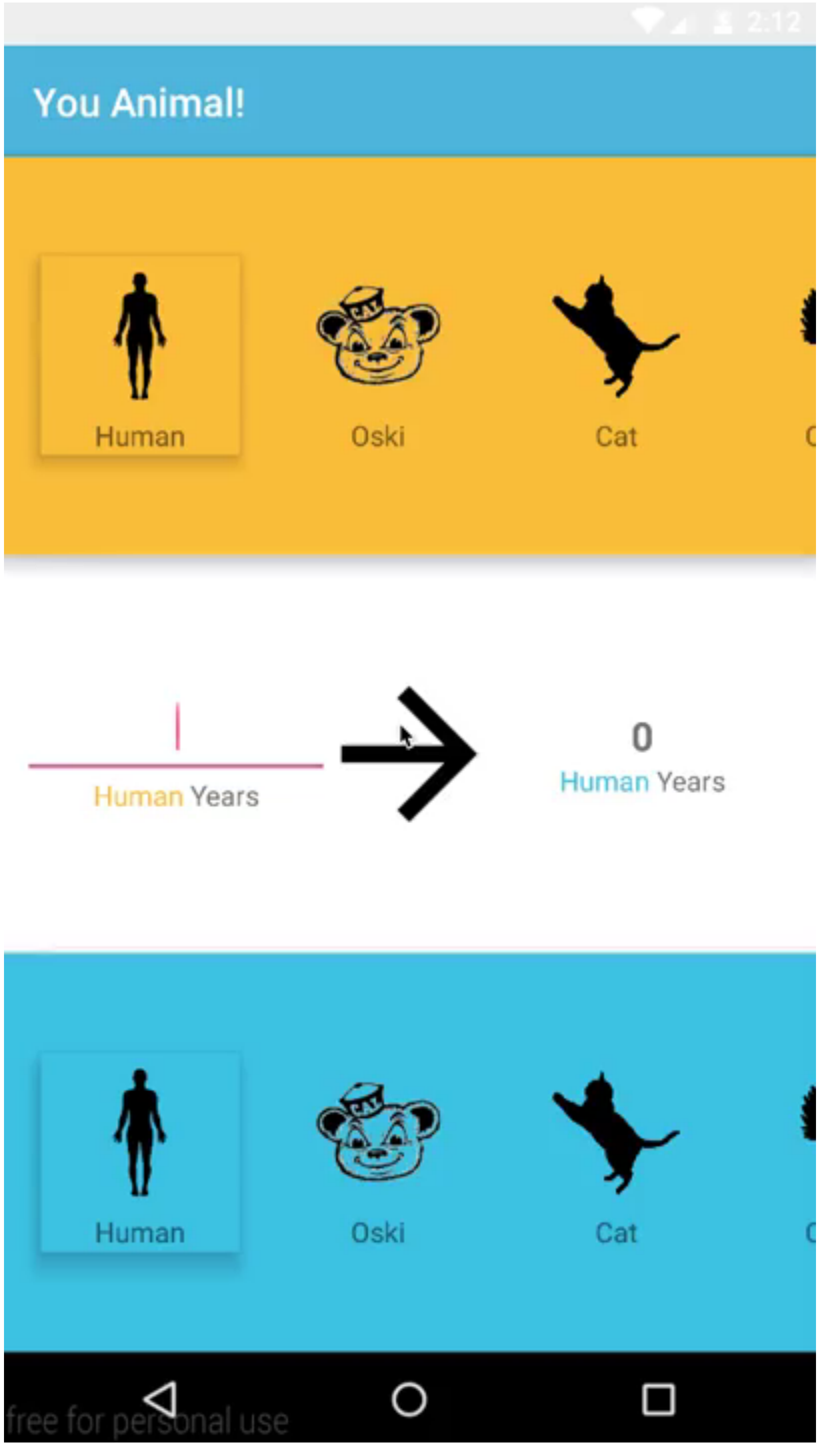
Buy License (use coupon code to get it free!)

Bring Laptops

Watches to Groups / check $150 / Look for email Friday

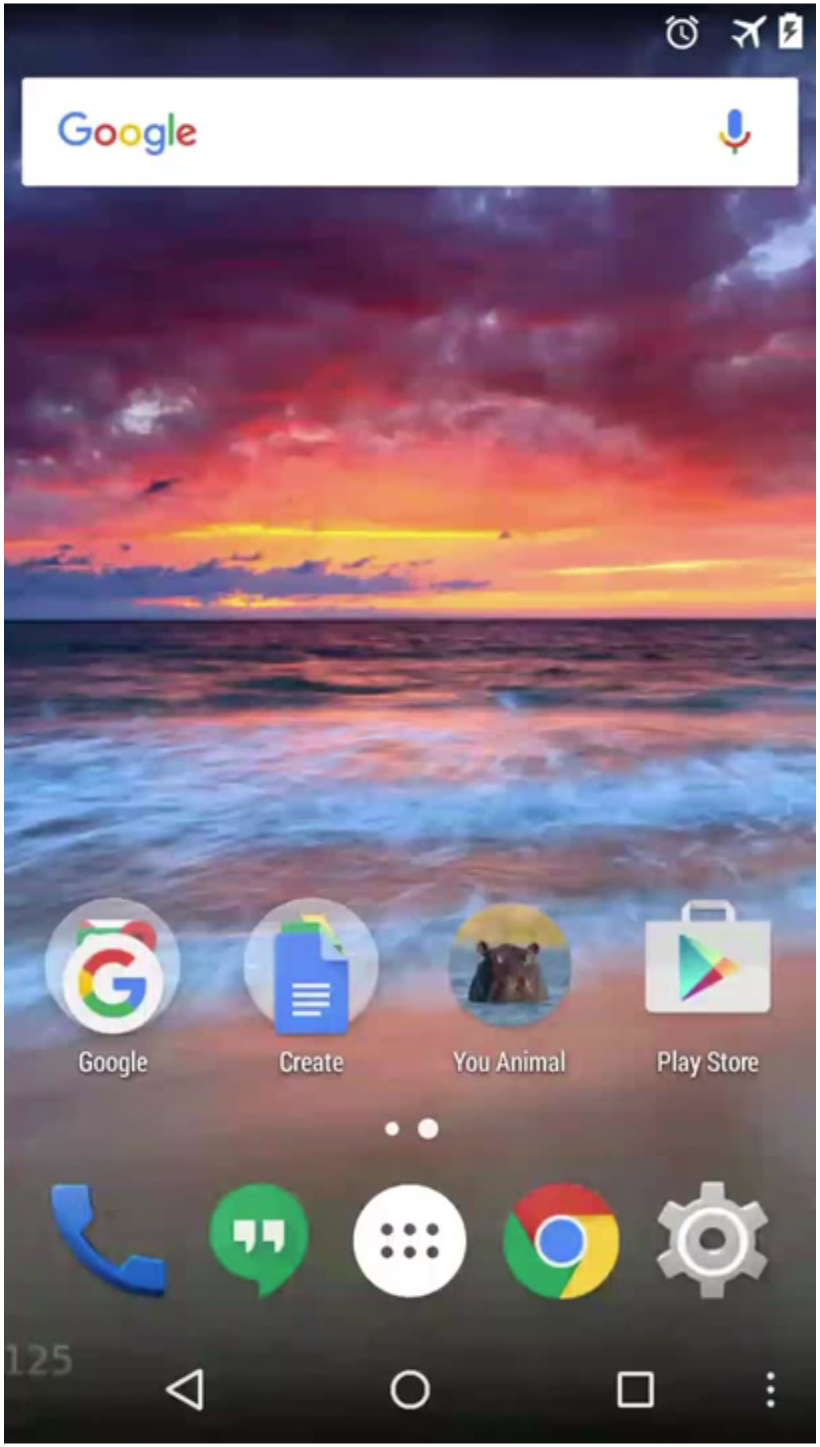
GSI CONTACT FOR EACH GROUP

1-9	Cesar
10-17	Jasper
18-25	Tricia
26-33	Diane
34-38	Jingyi



PROG 01: YOU ANIMAL

Henry Zhang

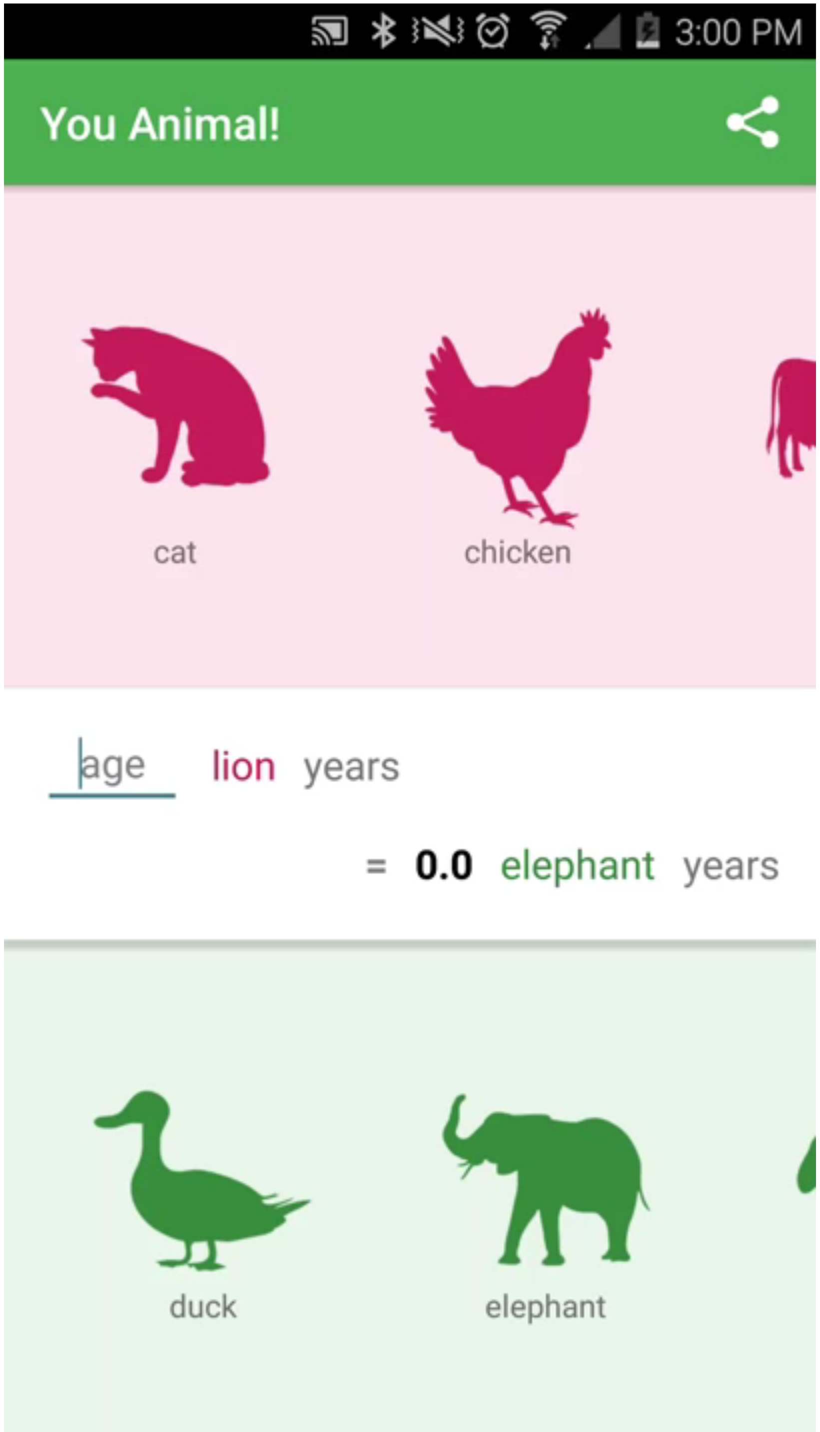


PROG 01: YOU ANIMAL

Sean Zhu

PROG 01:
YOU ANIMAL

Donny Reynolds



PROG 01: YOU ANIMAL

Alex Kang

DESIGN 01: WATCHES IN THE WILD

https://www.hackster.io/larayang/watches-in-the-wild

Lara Yang

DESIGN 01: WATCHES IN THE WILD

https://www.hackster.io/noahkeen/watches-in-the-wild

Noah Keen

DESIGN 01: WATCHES IN THE WILD

https://www.hackster.io/klam/watches-in-the-wild

Kenneth Lam

WHY MODEL HUMAN PERFORMANCE?

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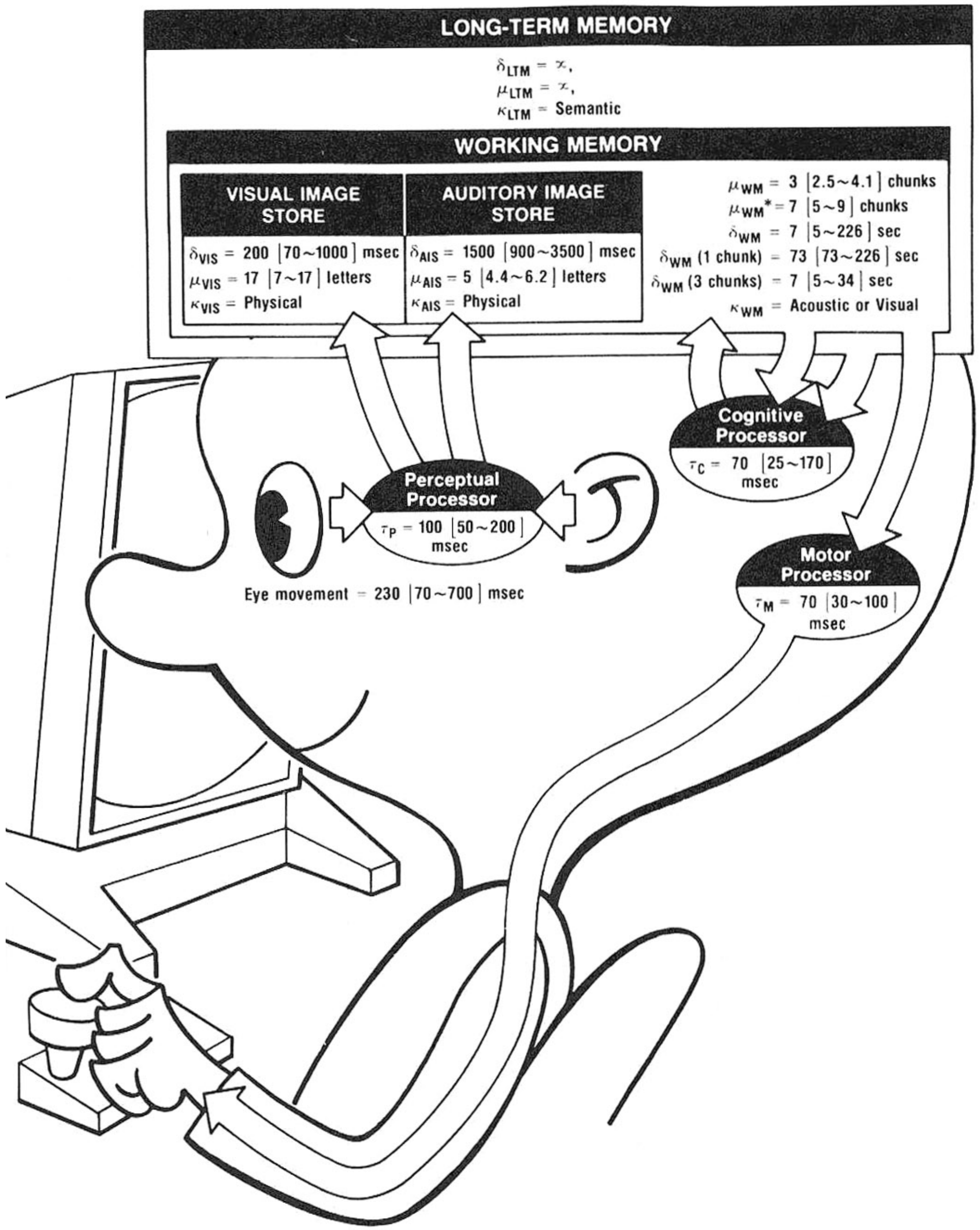
To predict impact of new technology/interface

Apply model to predict effectiveness

We could build a simulator to evaluate user interface designs



Human Info. Processor

Processors:

- Perceptual
- Cognitive
- Motor

Memory:

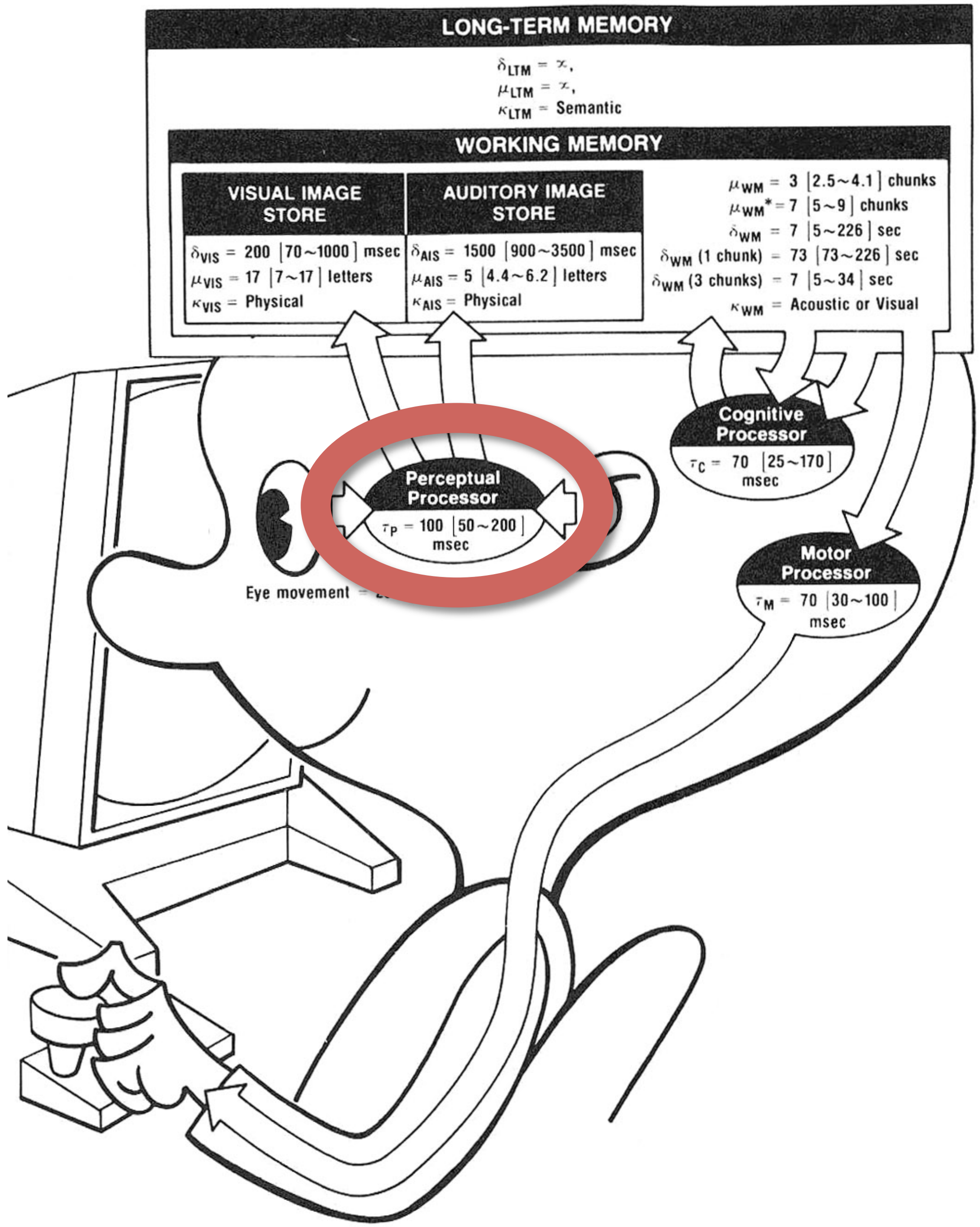
- Working memory
- Long-term memory

Unified model

Probably inaccurate

Predicts performance well

Very influential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$\delta_{LTM} = \infty$,
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Motor Processor
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...

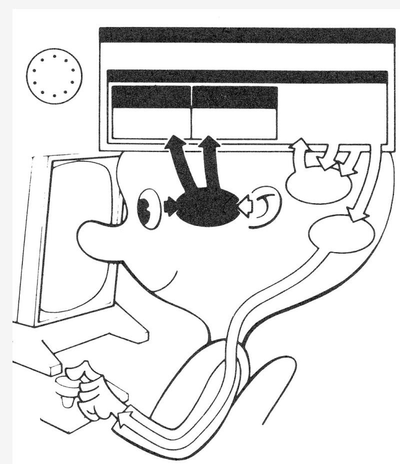
Capacity of visual store

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

12817687561389765469845069856049828267 62
98098584582245098564589450984509809435 85
90910302099059595957725646750506789045 67
88457898098216777654876364908560912949 686

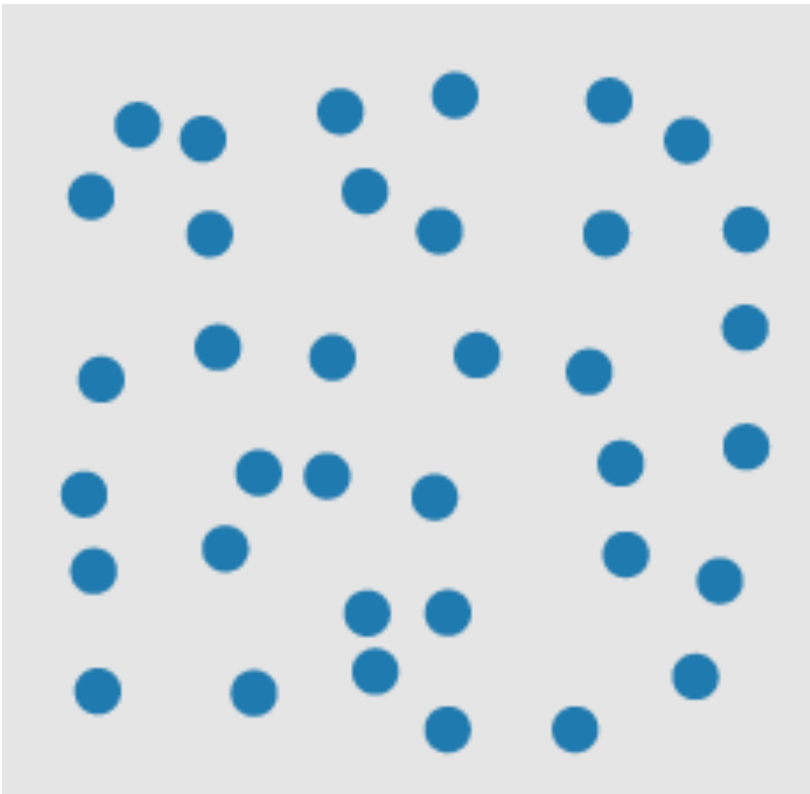
HOW MANY 3'S

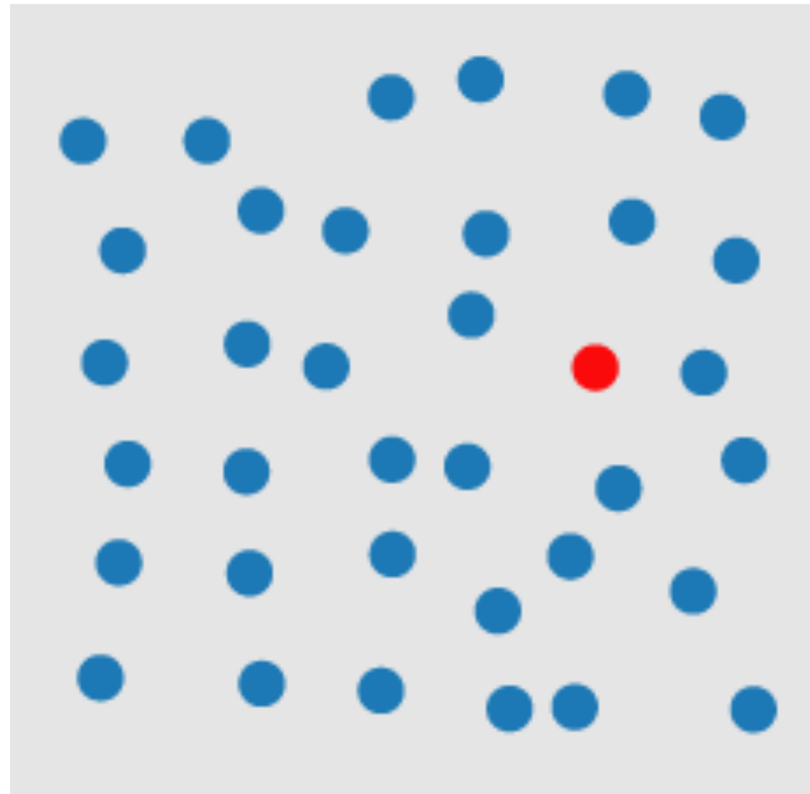
5690859068509681389765469845069856082826
2112091820981209812098465969091030209902
5395959577256445689075469675050678904567
8189457636466950440598681240360912949686

HOW MANY 3'S

12817687561**3**8976546984506985604982826762
9809858458224509856458945098450980943585
9091030209905959595772564675050678904567
8845789809821677654876**3**64908560912949686

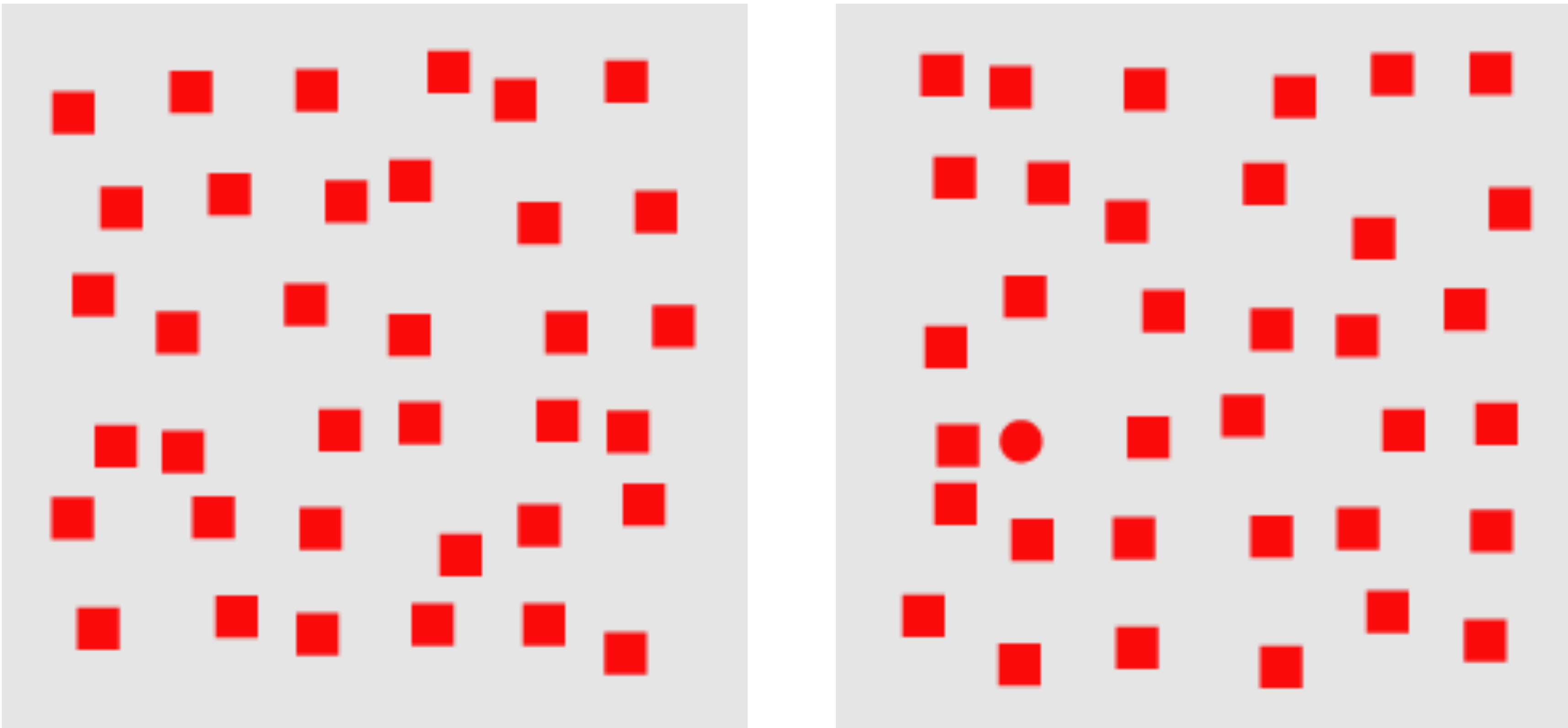
VISUAL POP-OUT: COLOR





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

VISUAL POP-OUT: SHAPE



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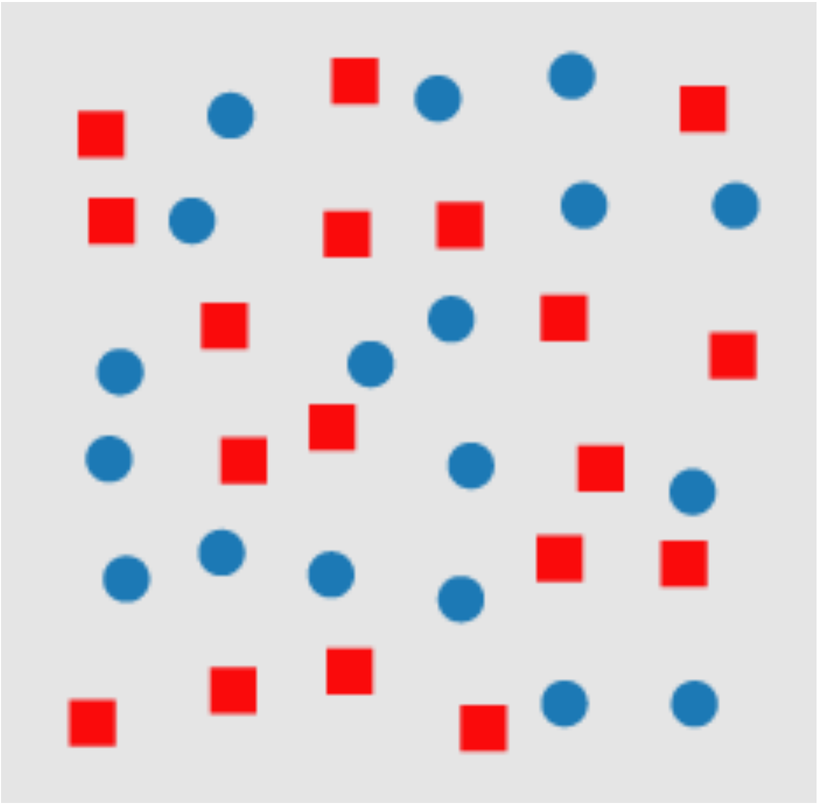
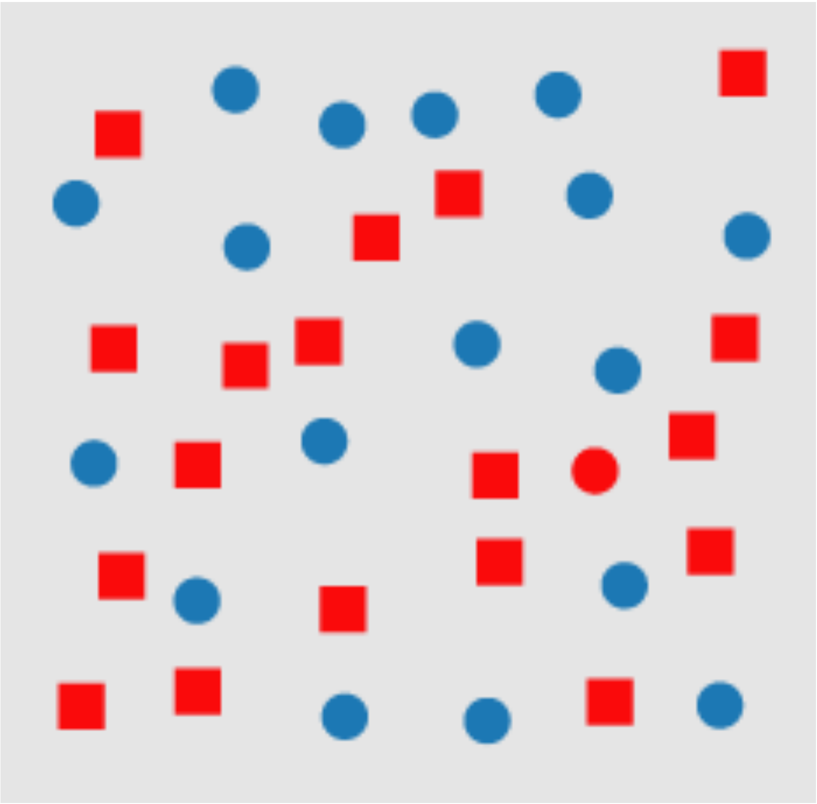
FEATURE CONJUNCTIONS





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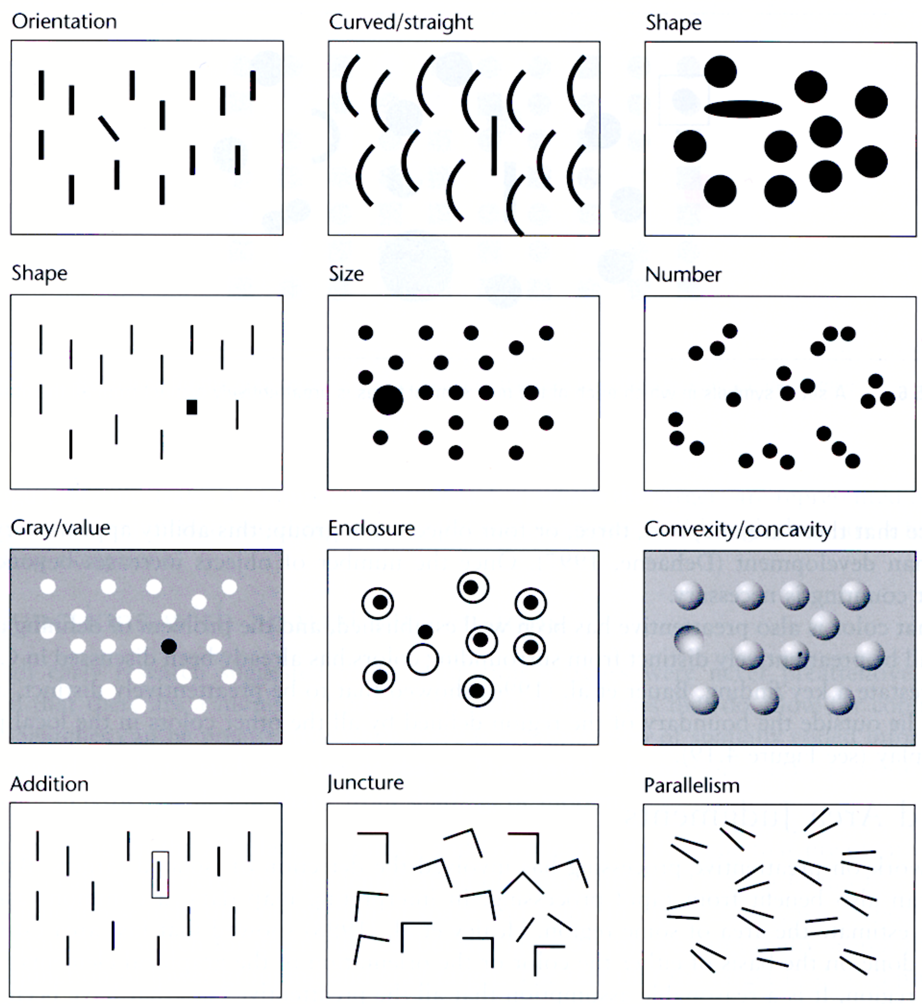
PREATTENTIVE FEATURES



[Information Visualization. Figure 5. 5 Ware 04]

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

PERCEPTION OF CAUSALITY MICHOTTE46

Michotte demonstration 1. 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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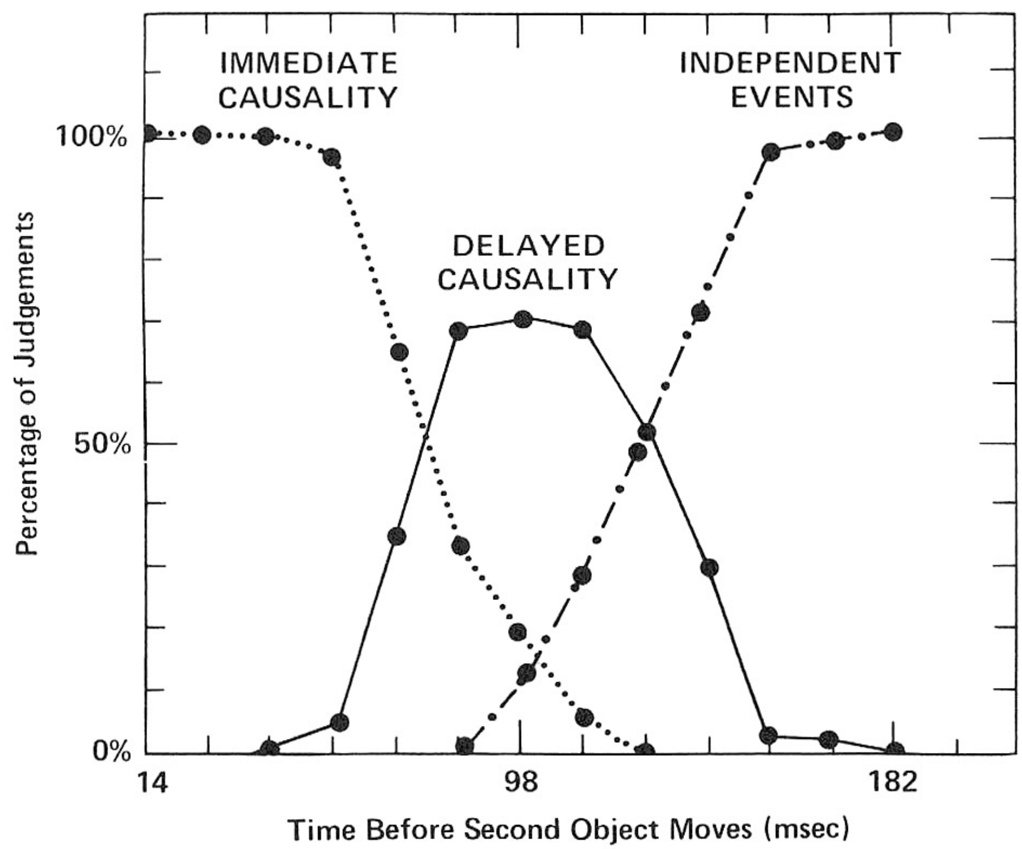


WORKING MEMORY

Access in chunks

Task dependent construct

7 ±2 (Miller)

Decay

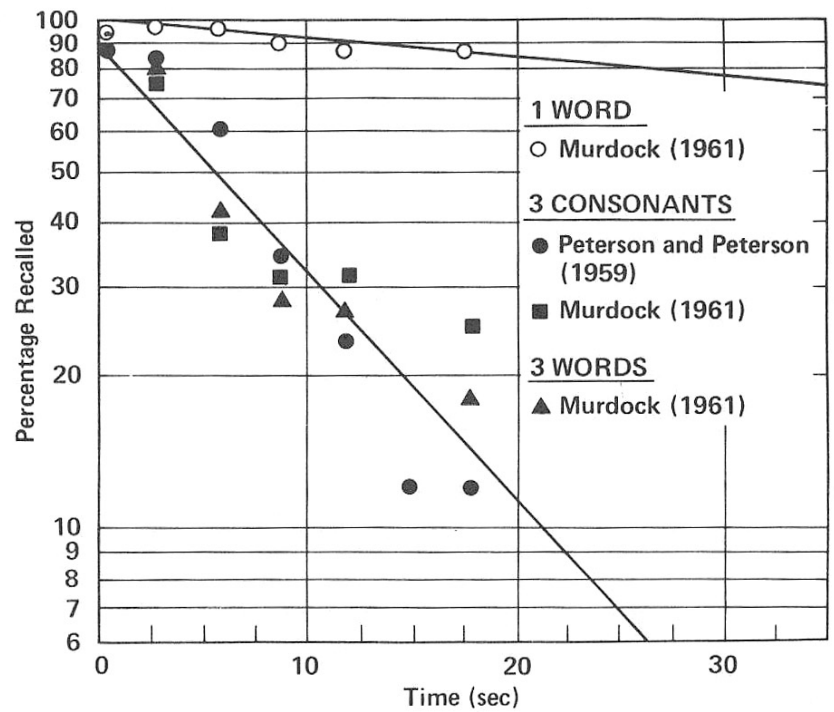
Content dependant

1 chunk 73 sec

3 chunks 7 sec

Attention span

Interruptions > decay time



LONG TERM MEMORY

Very large capacity

Semantic encoding

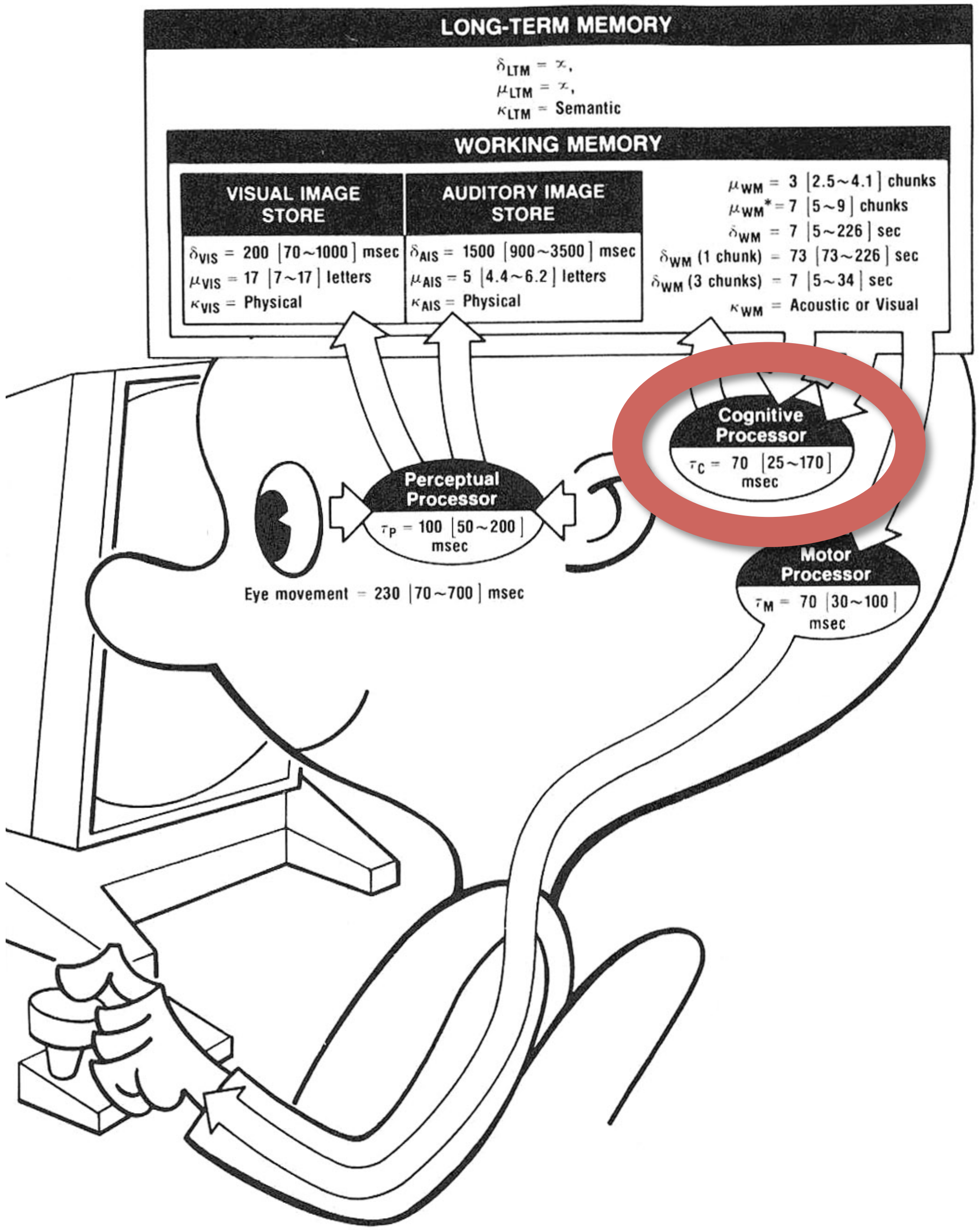
Associative access

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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Eye movement = 230 [70~700] msec
Motor Processor
τ_M = 70 [30~100] 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

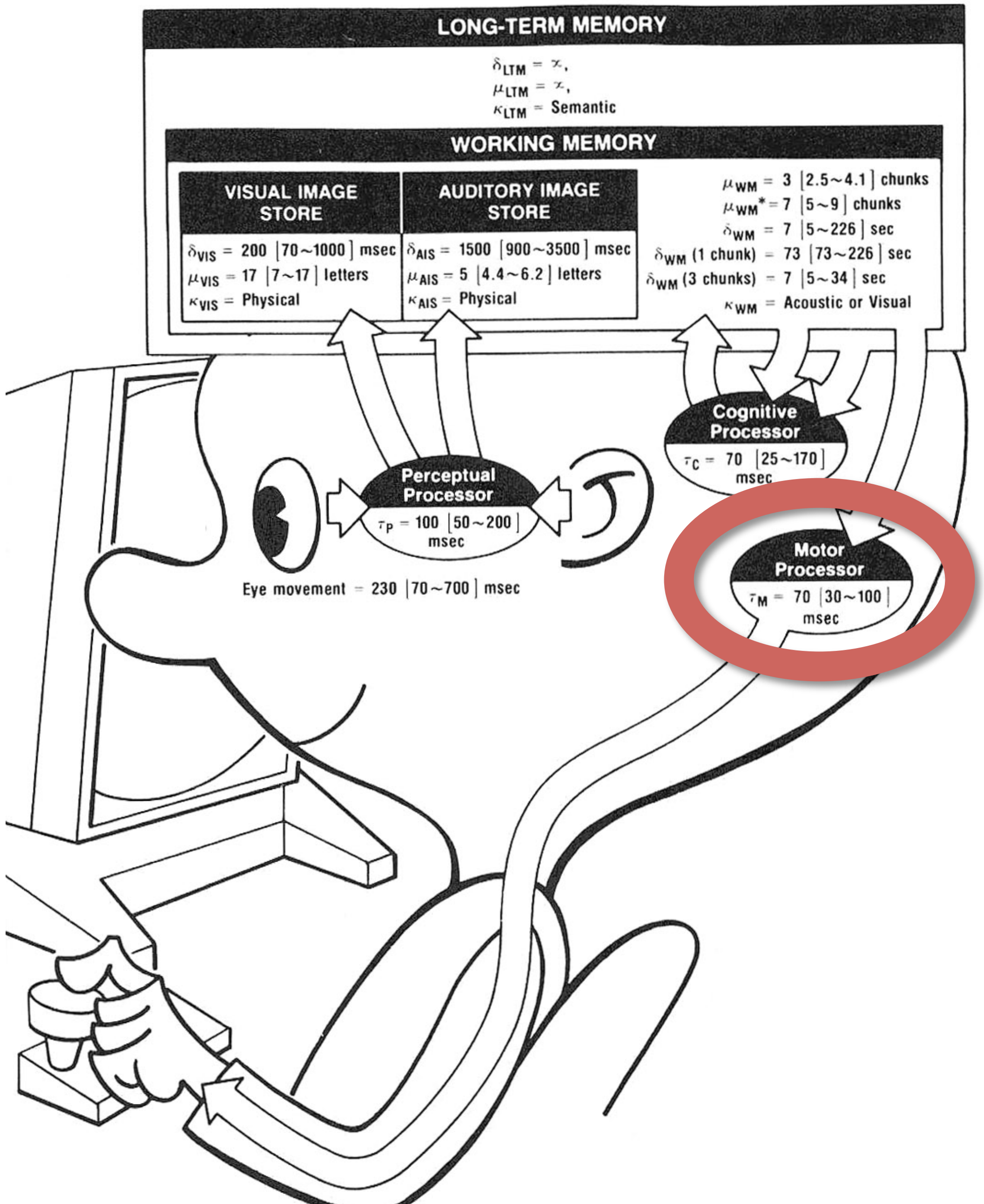
Eastern 401, December 1972

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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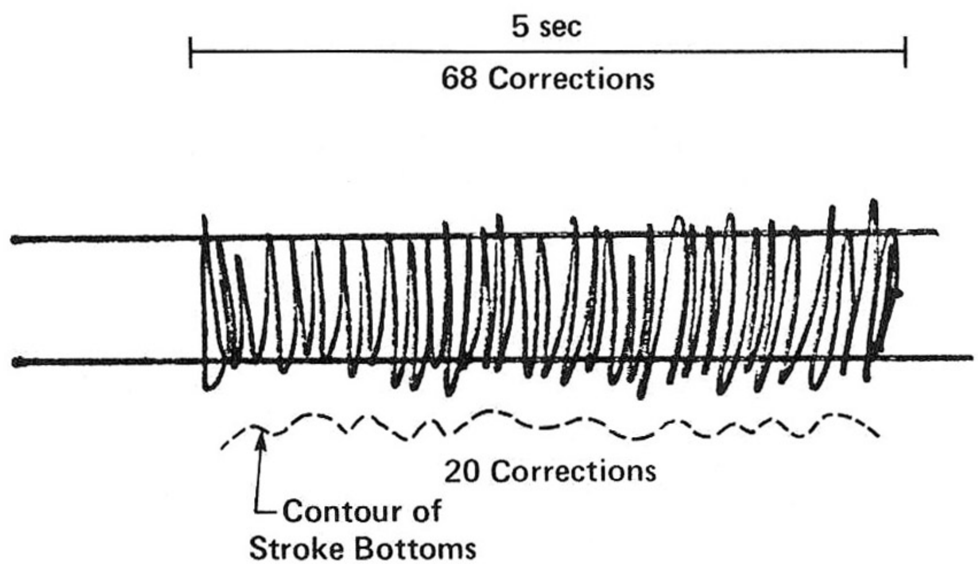
MOTOR PROCESSOR

Receive input from the cognitive processor

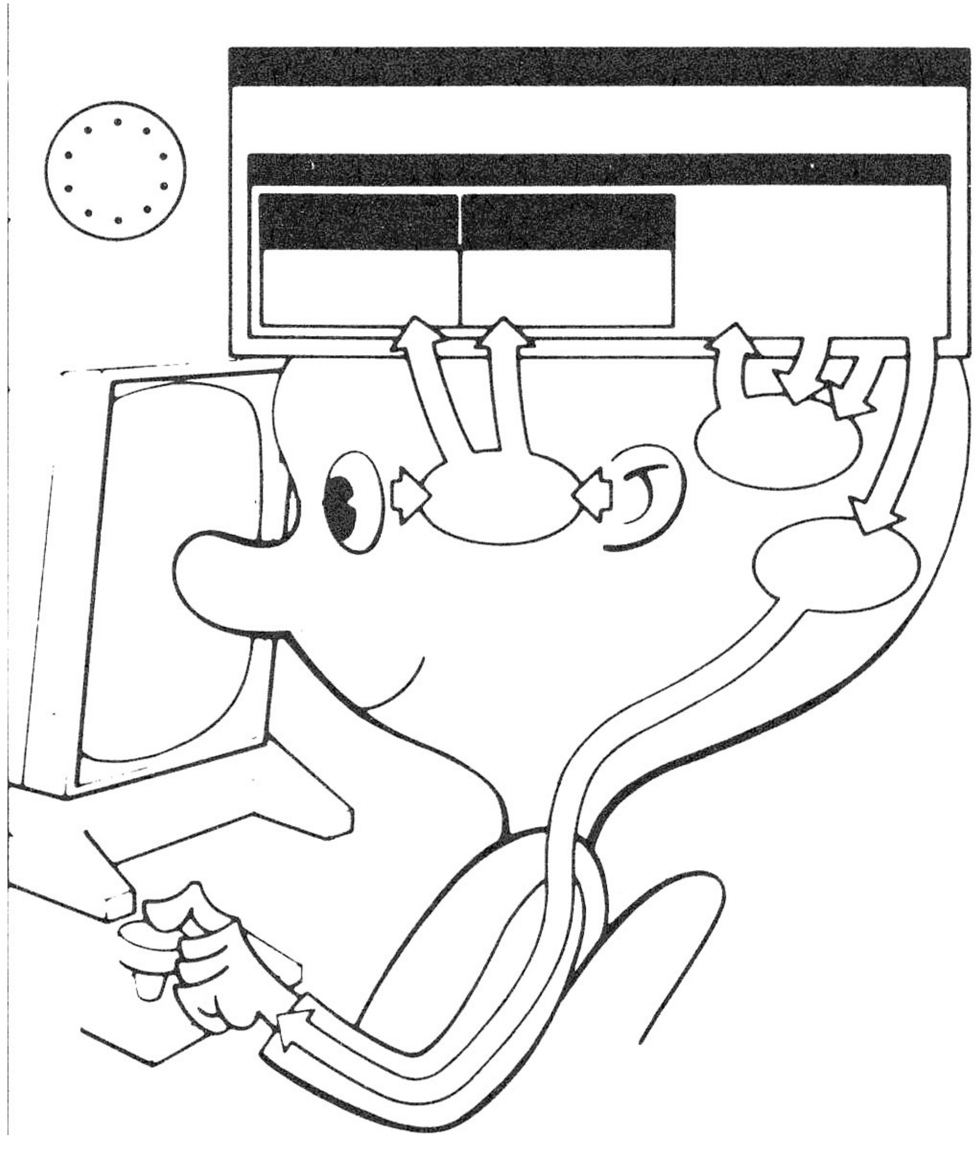
Execute motor programs

Pianist: up to 16 finger movements per second

Point of no-return for muscle action



HIT SPACE WHEN CHARACTER APPEARS



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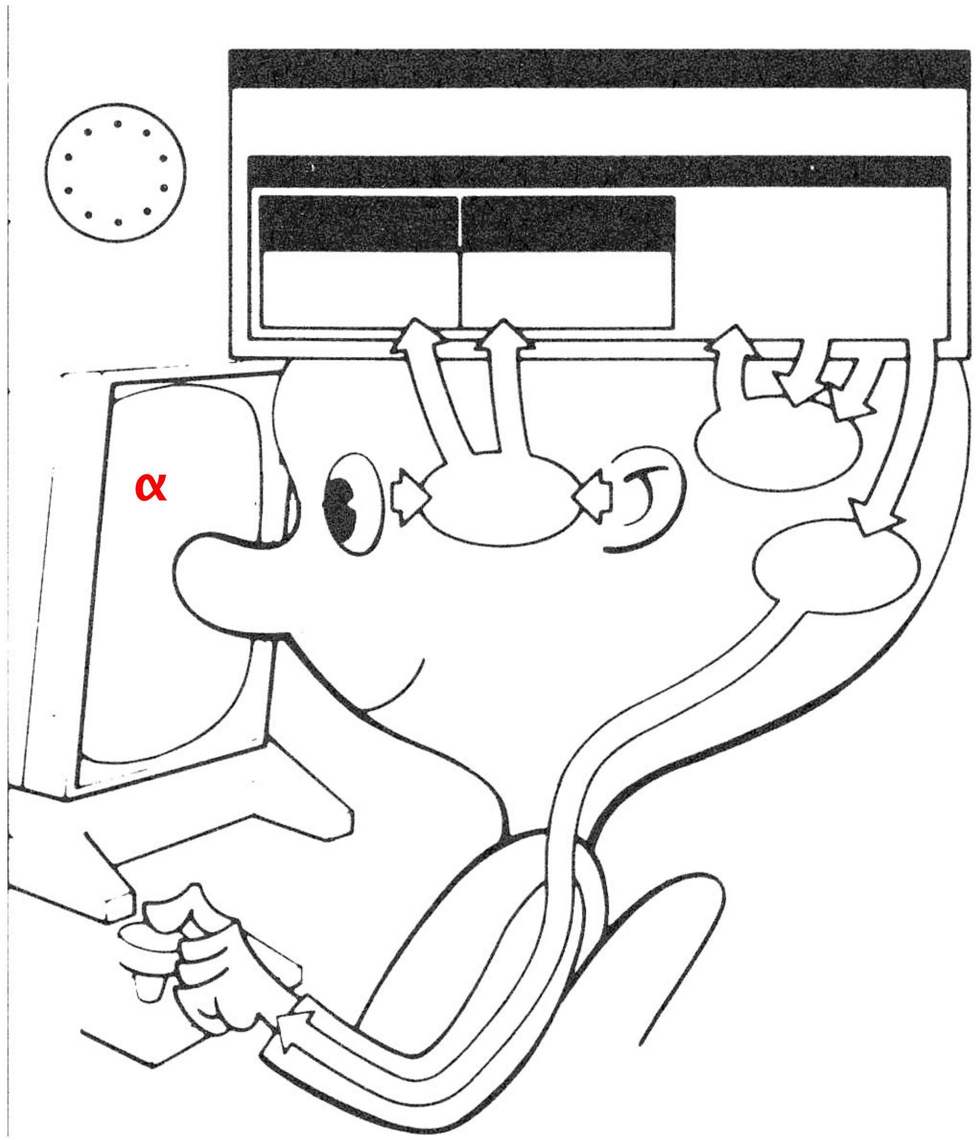

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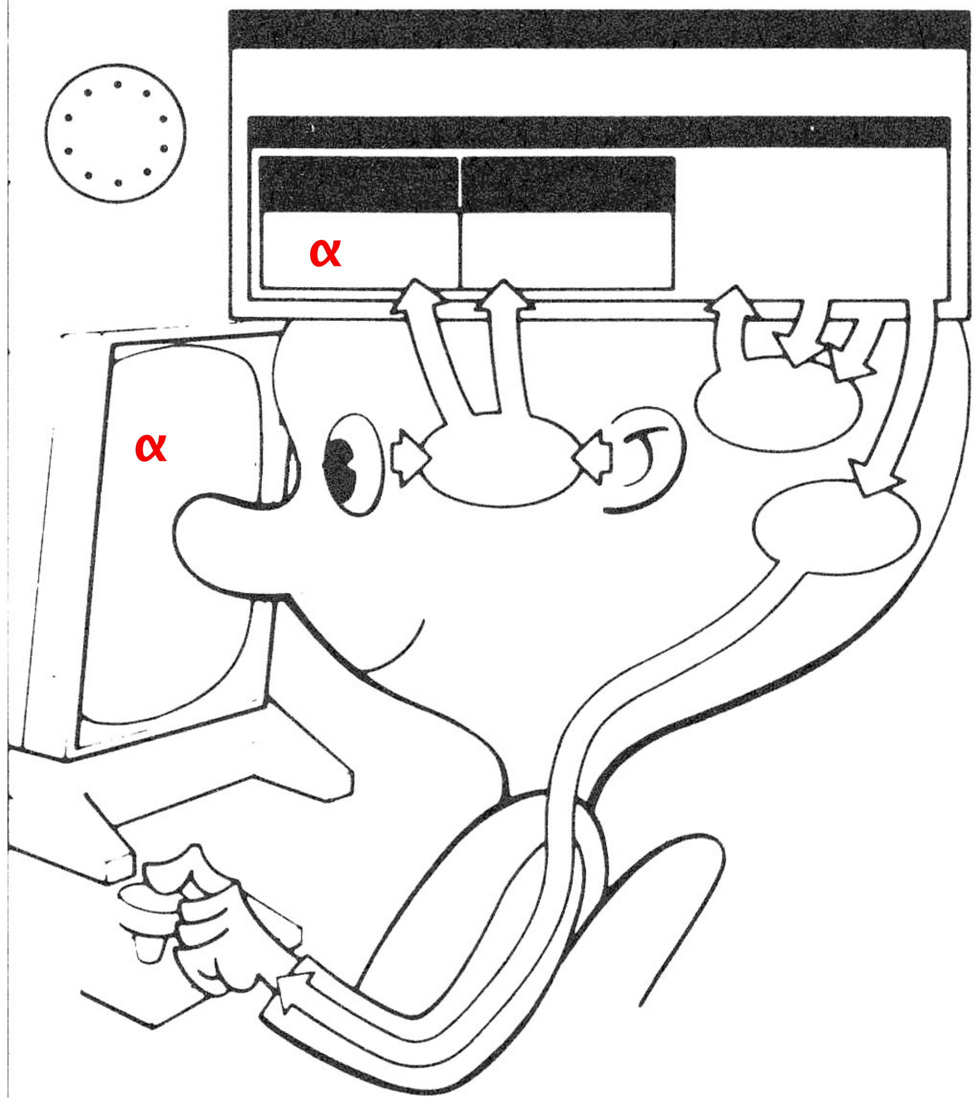

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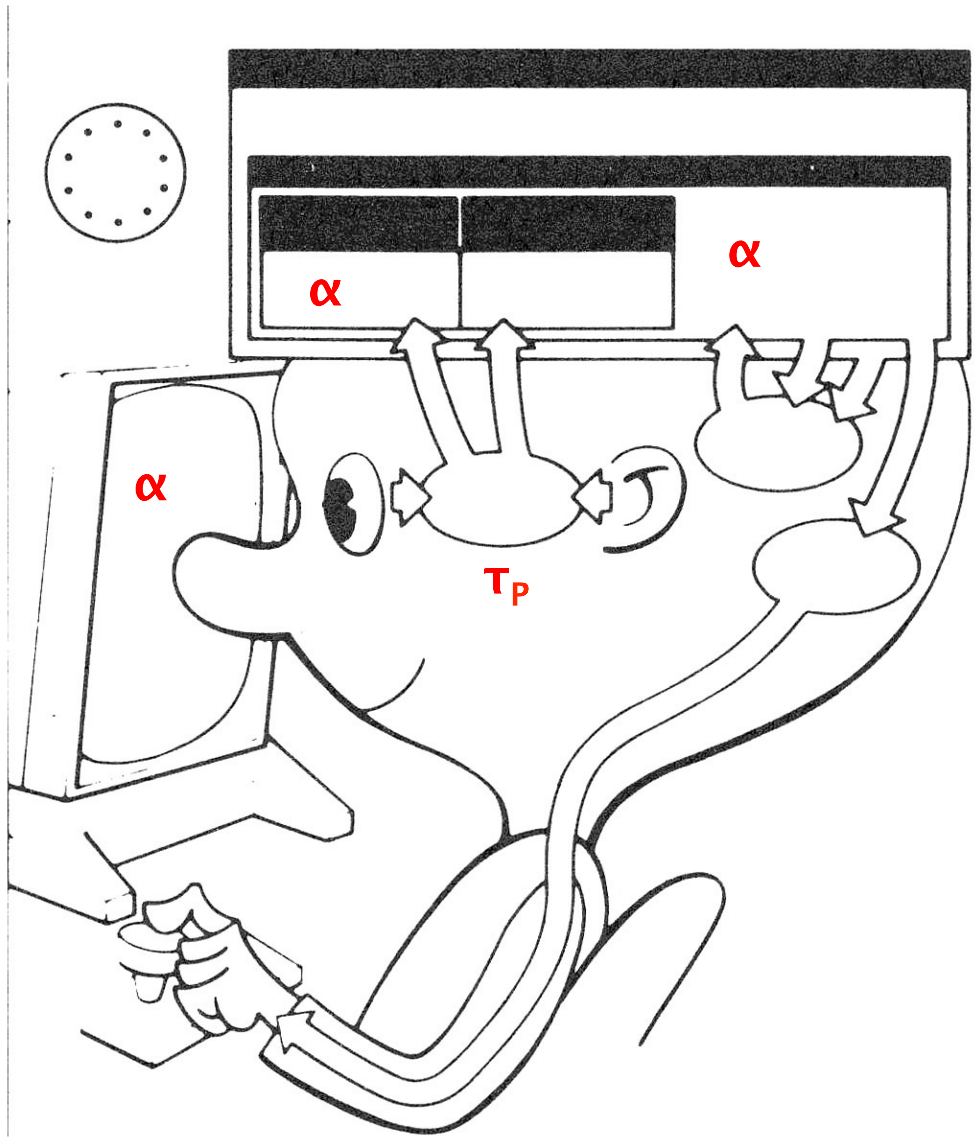

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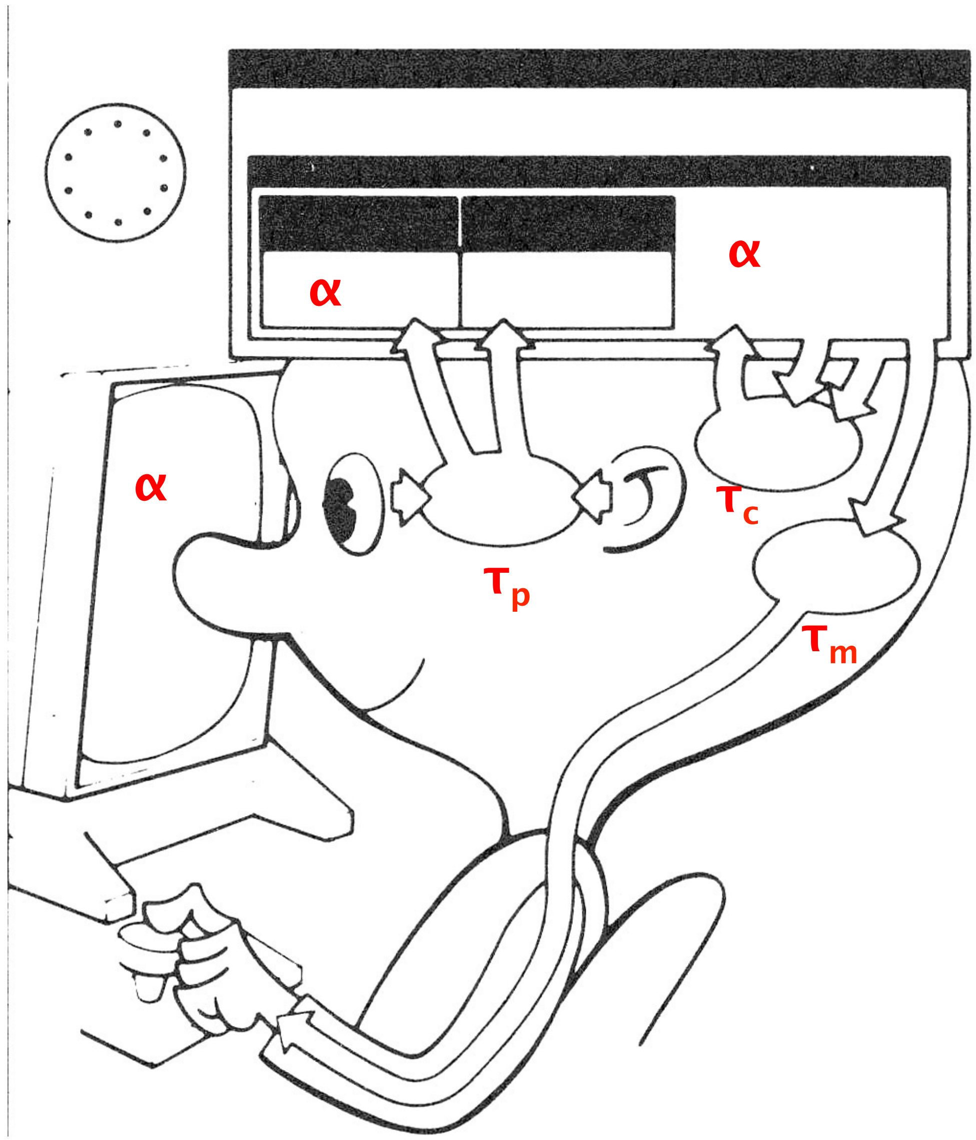

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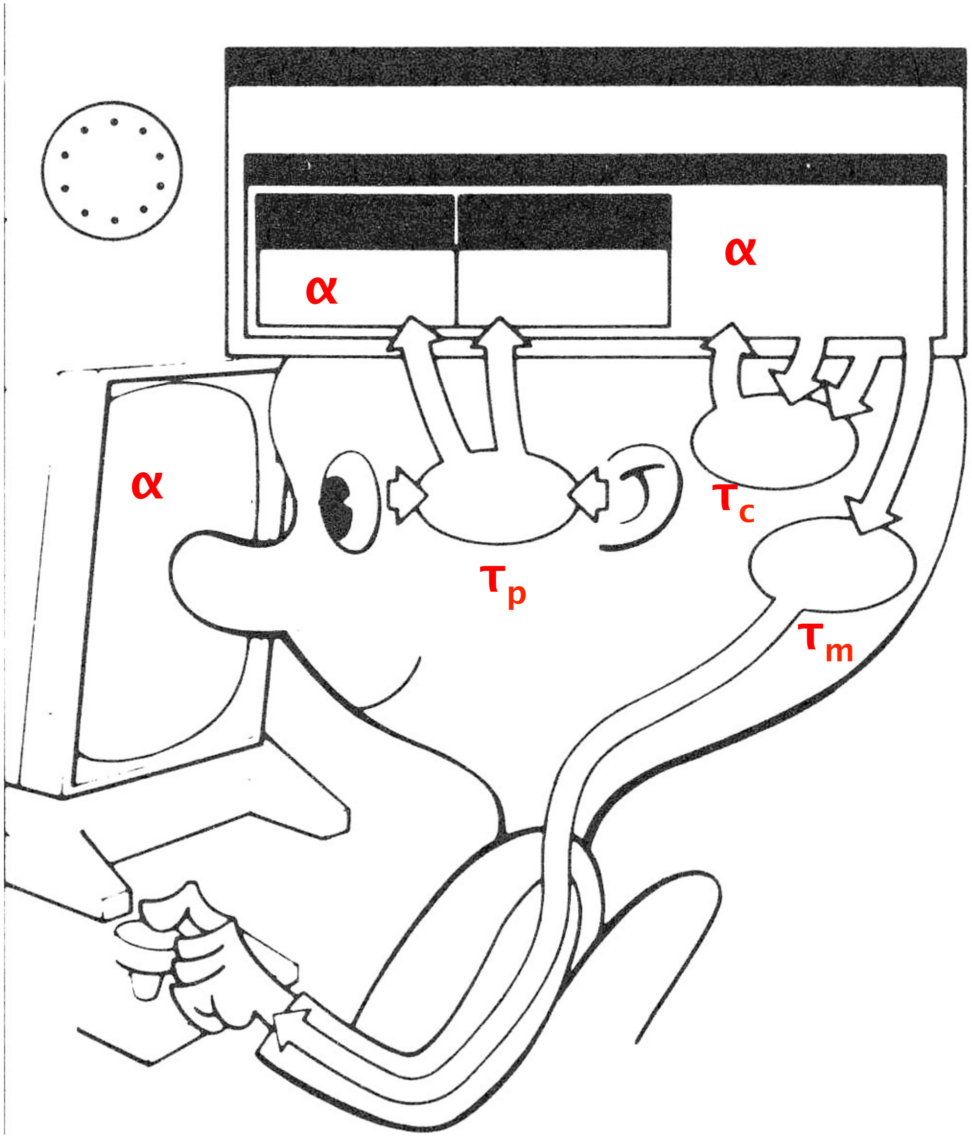
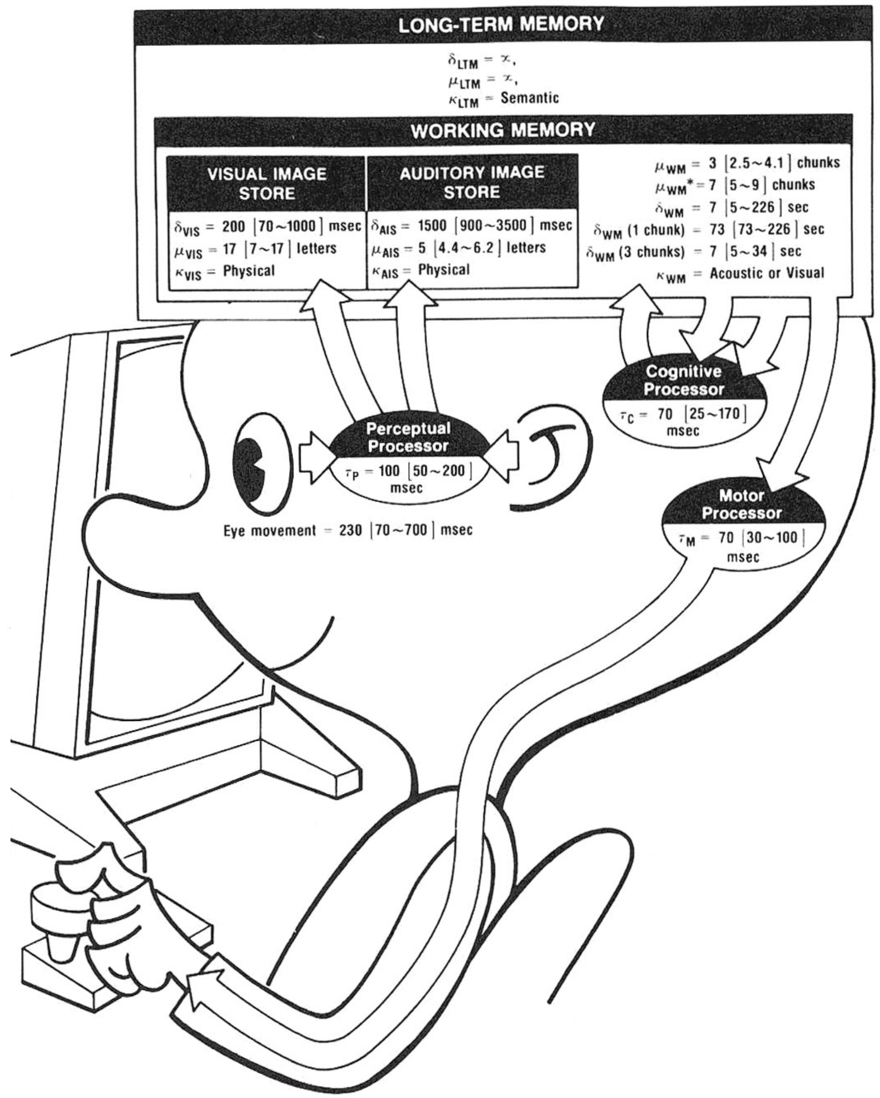
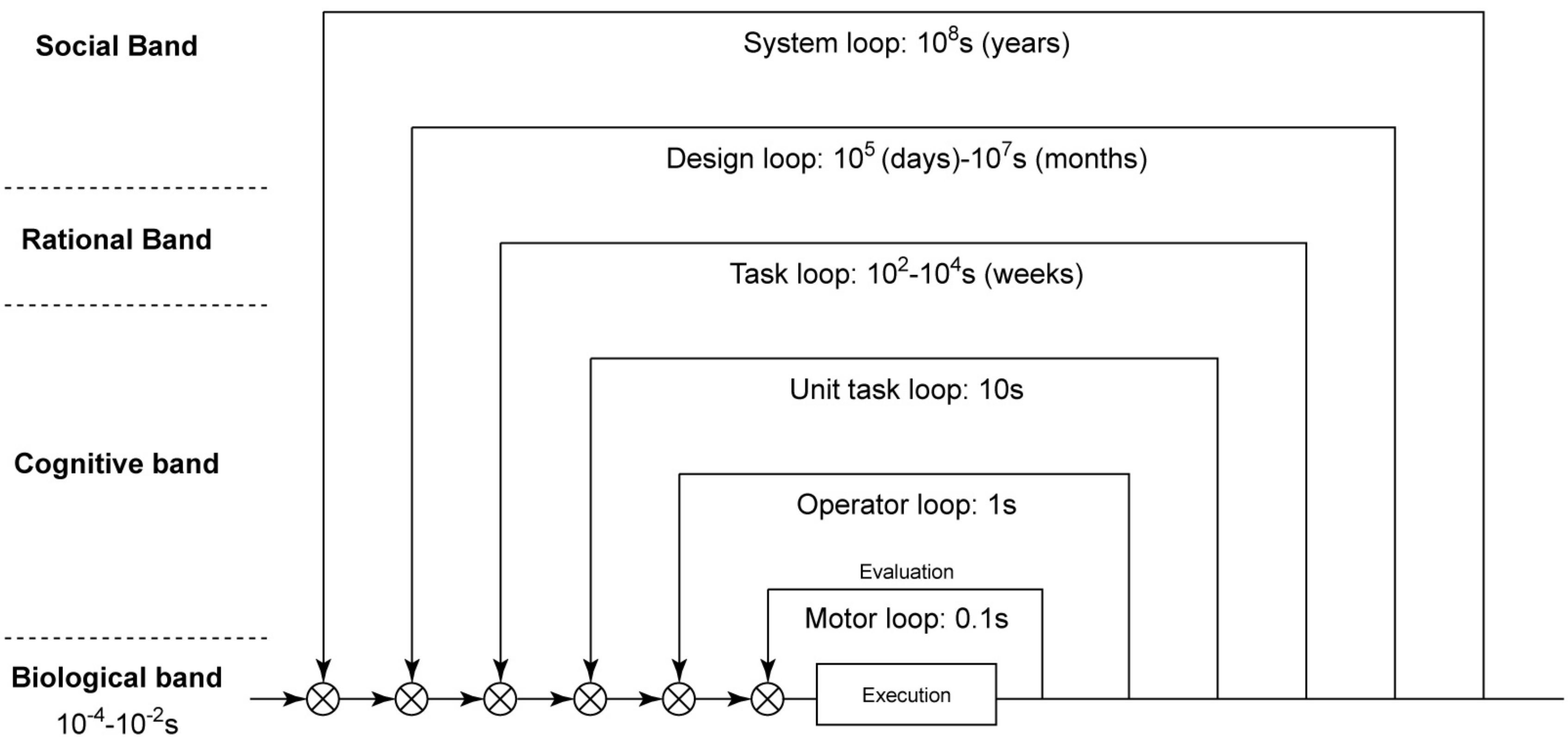




HUMAN INTERACTION LOOPS
(NEWELL)



PRINCIPLES OF OPERATION

Interface should respect limits of human performance

Preattentive 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

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

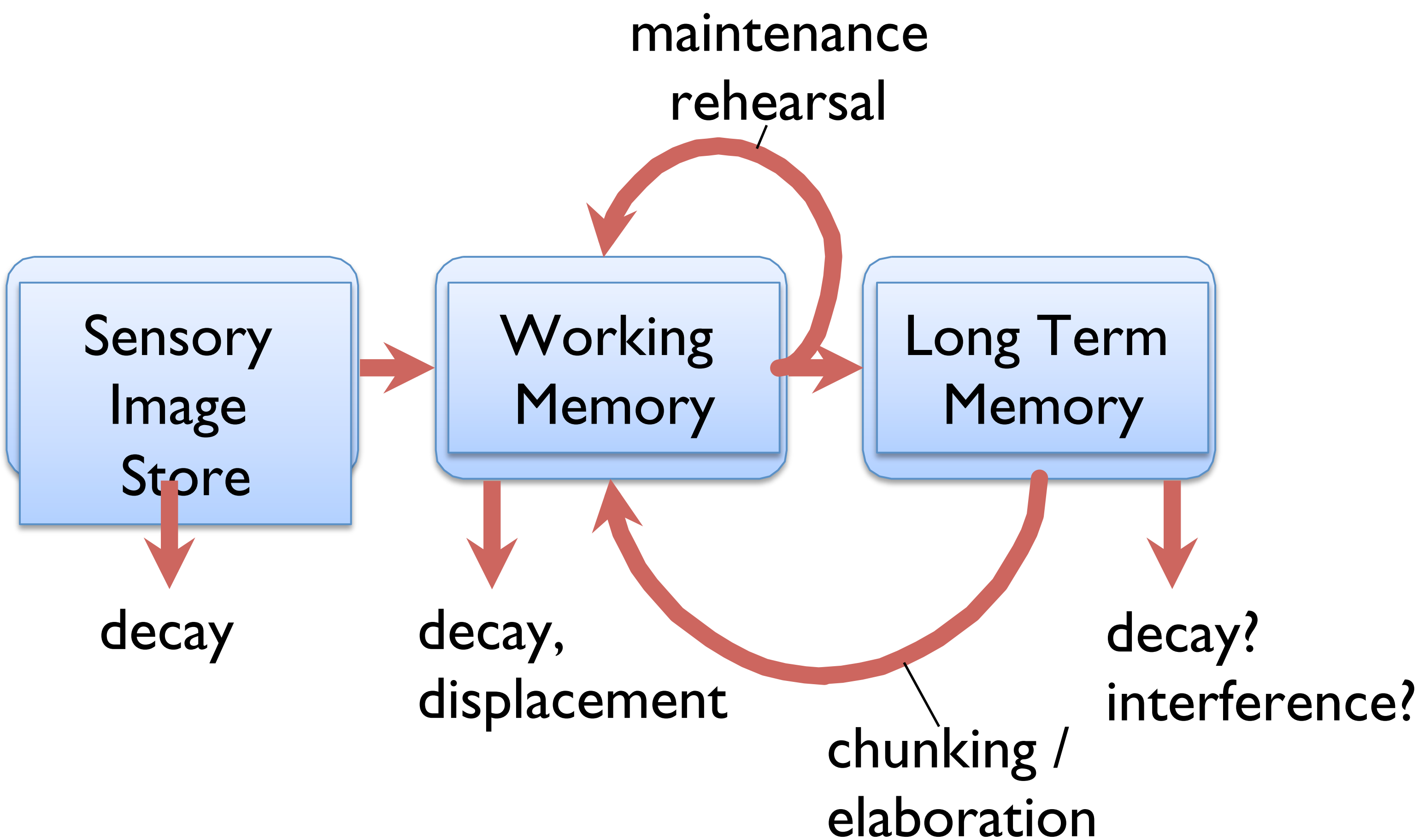
Stroop Effect:

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

LTM 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

DECISION MAKING AND LEARNING


Crest PRO-HEALTH
Colgate Optic White
Colgate Total
Crest Complete
bonus! Save even more on gas.
Colgate Max Fresh
Colgate MaxWhite
Colgate MaxClean Smartfoam
Colgate Cavity Protection
Colgate Tartar Protection
Colgate Triple Action
Colgate White
Colgate Sparkling White
Colgate Luminous
Crest Tartar
Plus White Xtra
AdvanceWhite
PeroxiCare
Close-Up
Ultrabrite
Aim
Aquafresh
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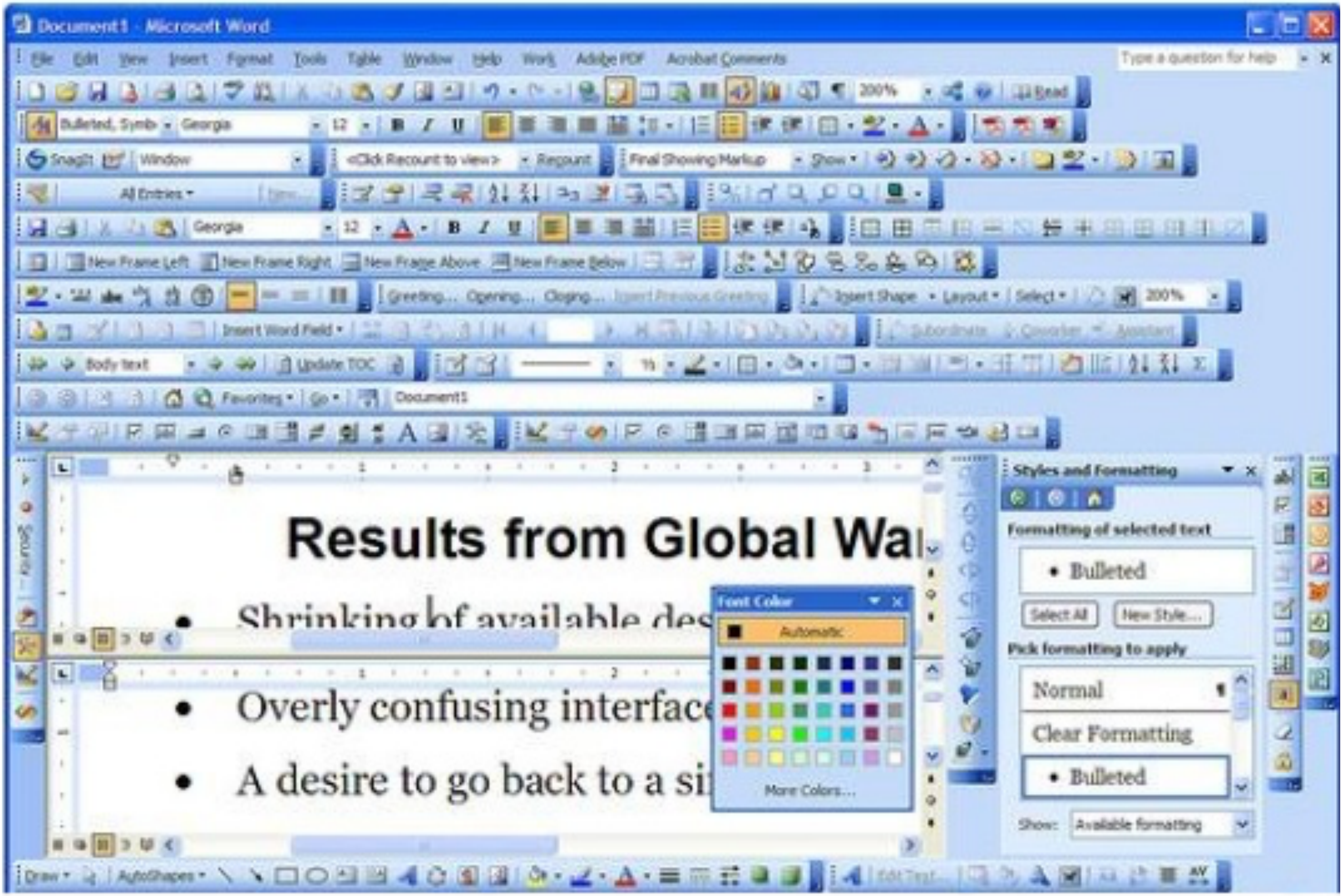
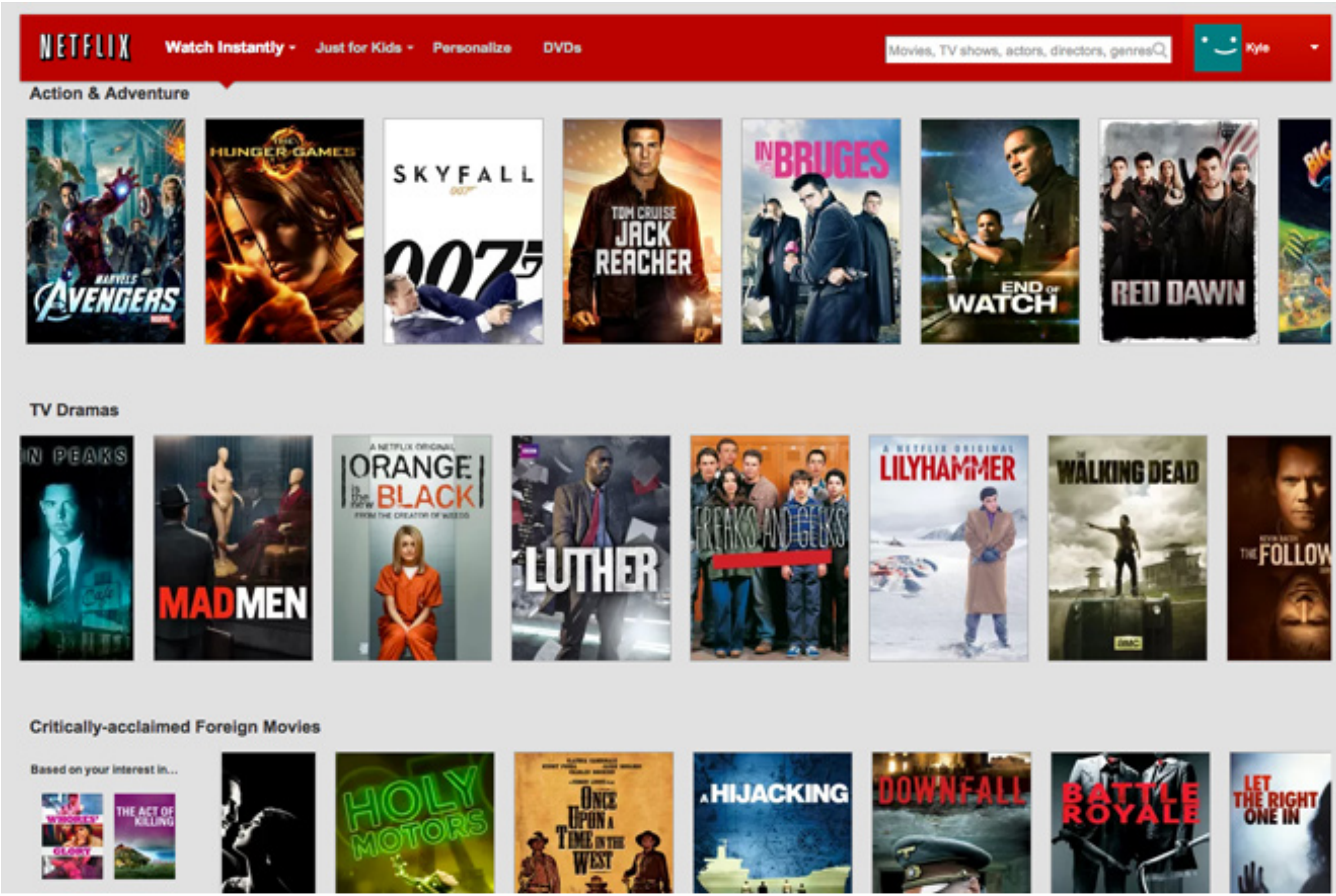
3.69
2.99
3.59
3.49

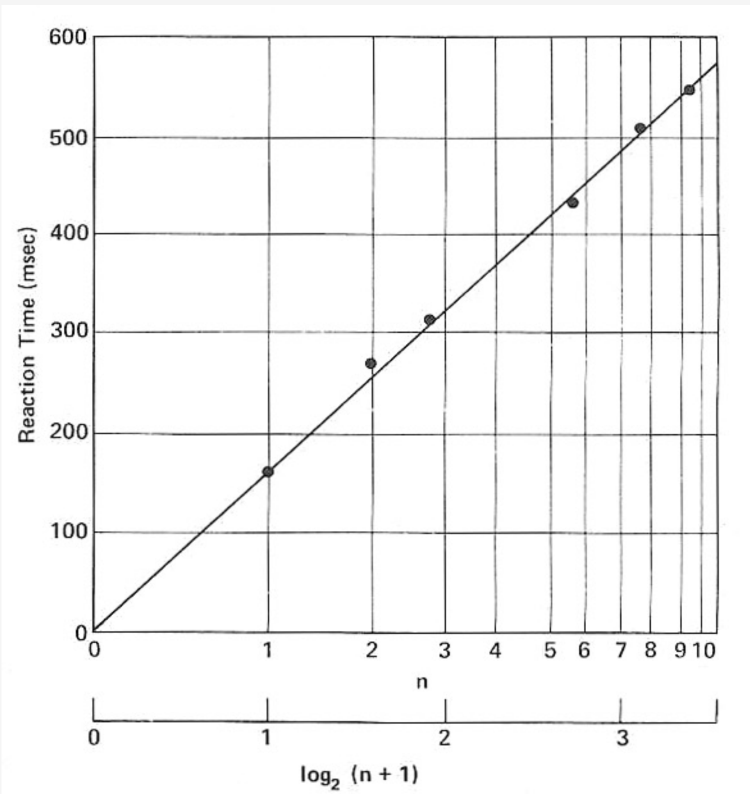

Document1 - Microsoft Word
File Edit View Insert Format Tools Table Window Help Work Adobe PDF Acrobat Comments
Type a question for help
Results from Global Wa
Shrinking of available des
Overly confusing interface
A desire to go back to a si
Font Color
Automatic
More Colors...
Styles and Formatting
Formatting of selected text
• Bulleted
Select All
New Style...
Pick formatting to apply
Normal
Clear Formatting
• Bulleted
Show: Available formatting

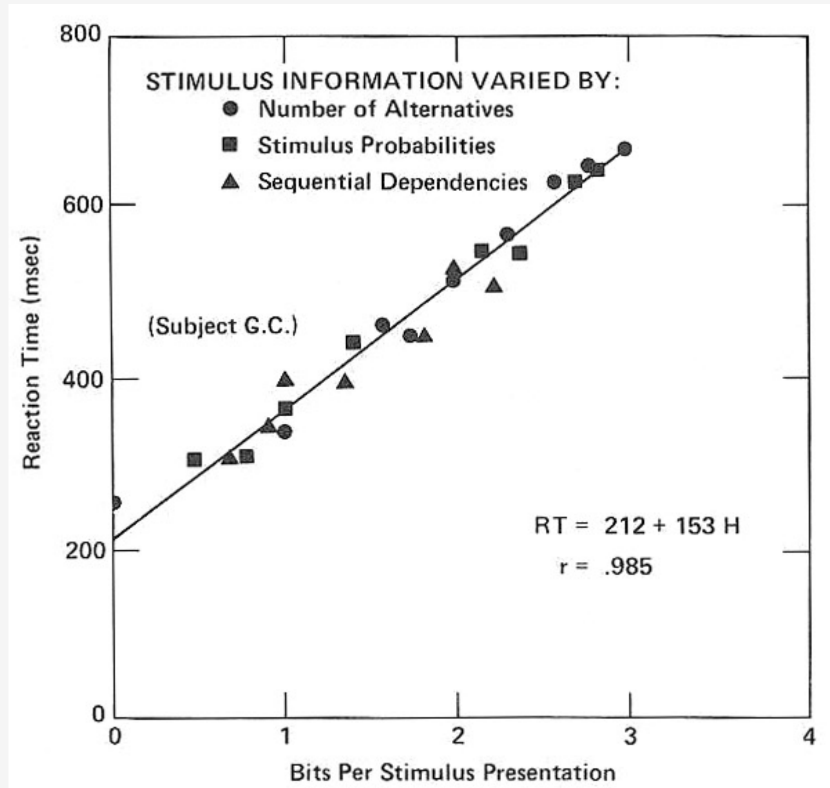

NETFLIX
Watch Instantly
Just for Kids
Personalize
DVDs
Movies, TV shows, actors, directors, genres
Kyle
Action & Adventure
TV Dramas
Critically-acclaimed Foreign Movies
Based on your interest in...

HICK'S LAW

Cost of taking a decision: $T = a + b\log_2(n+1)$

n = number of choices





POWER LAW OF PRACTICE

Task time on the nth trial follows a power law

$$T_n = T_1 n^{-a} + c$$

where a = .4, c = limiting constant

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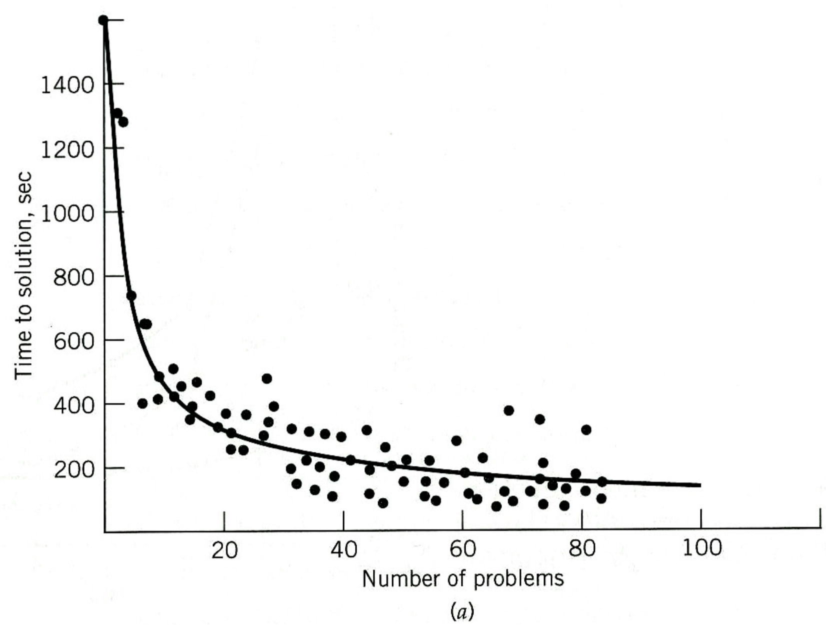
You get faster the more times you do something!



POWER LAW OF PRACTICE

Task time on the nth trial follows a power law

$$T_n = T_1 n^{-a} + c$$

where a = .4, c = limiting constant

You get faster the more times you do something!

Applies to skilled behavior (sensory & motor)

Does not apply to

Knowledge acquisition

Improving quality

SUMMARY

Decision Making and Learning

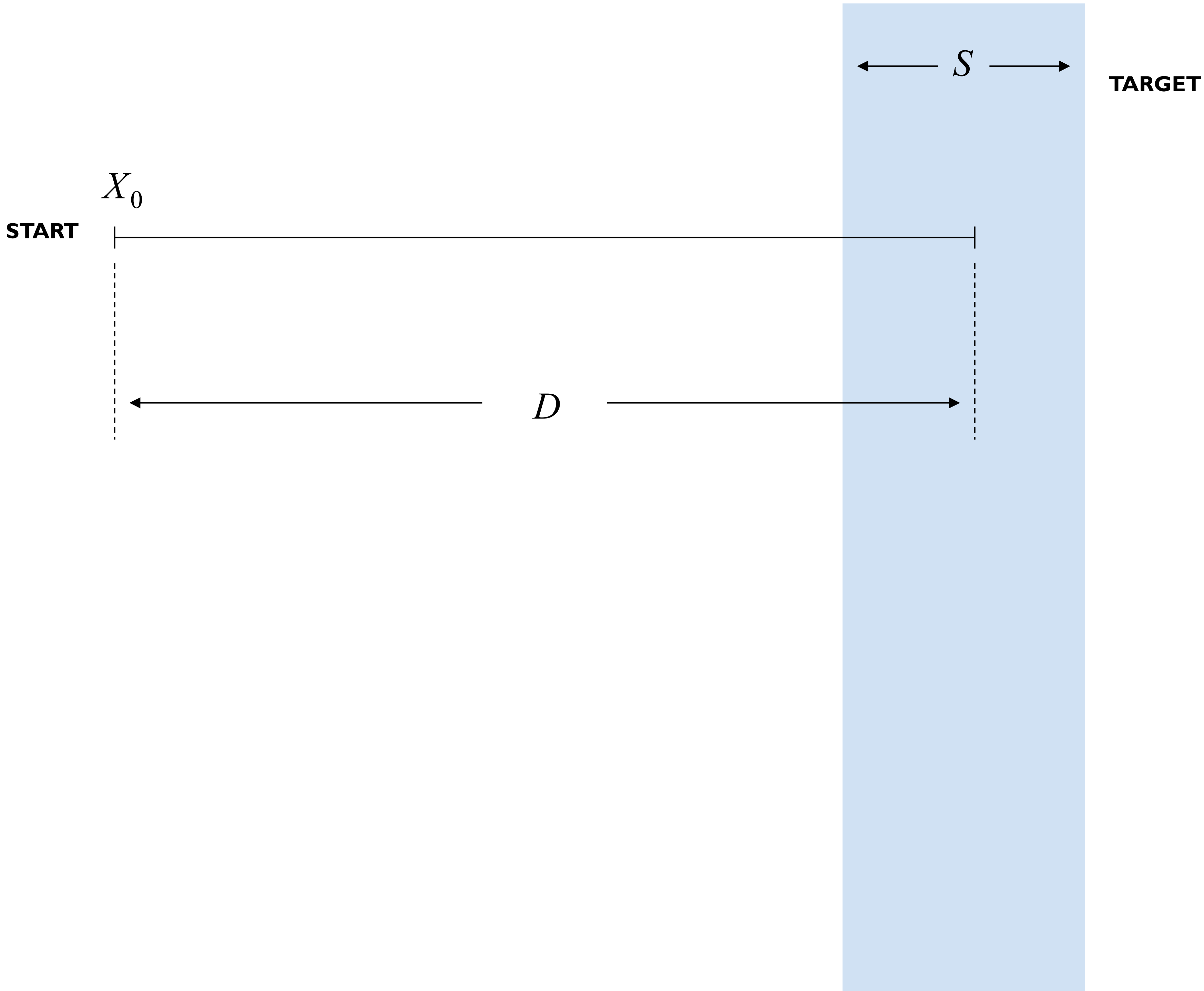
Time to make decisions depends on number of options

Choosing a movie on Netflix

Learning follows a power law

You get faster as you practice

FITTS' LAW


S
TARGET
X0
START
D

FITTS' LAW

$$T = a + b\log_2(D/S + 1)$$

a, b	= constants (empirically derived)
D	= distance
S	= size

ID is Index of Difficulty = $\log_2(D/S+1)$

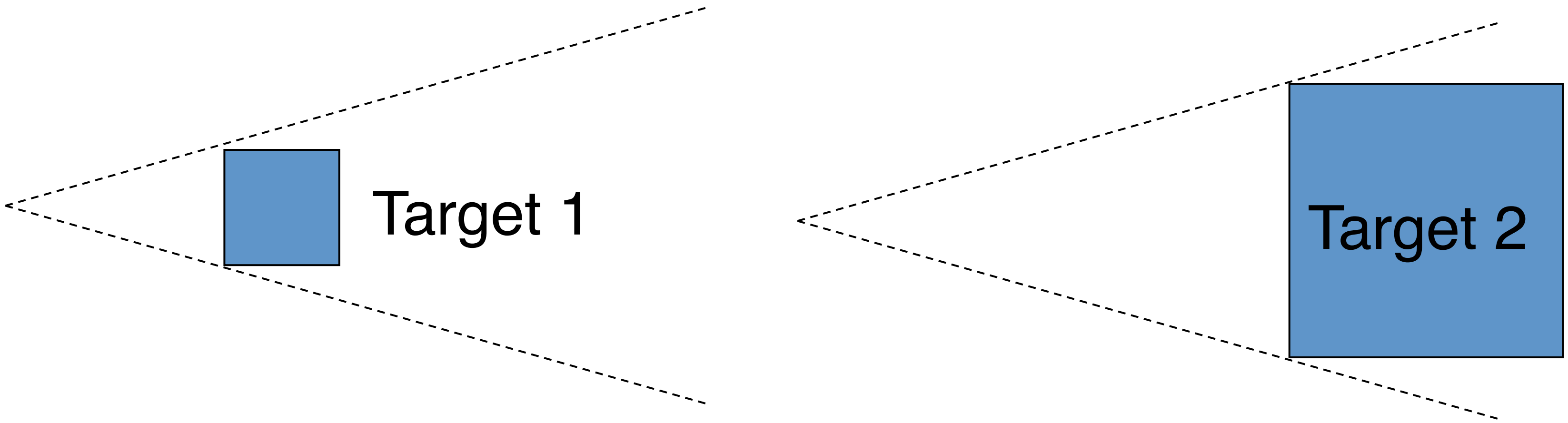
Models well-rehearsed selection task

T increases as the ***distance*** to the target increases

T decreases as the ***size*** of the target increases

CONSIDERS DISTANCE AND TARGET SIZE

$$T = a + b\log_2(D/S + 1)$$



Same ID → Same Difficulty

CONSIDERS DISTANCE AND TARGET SIZE

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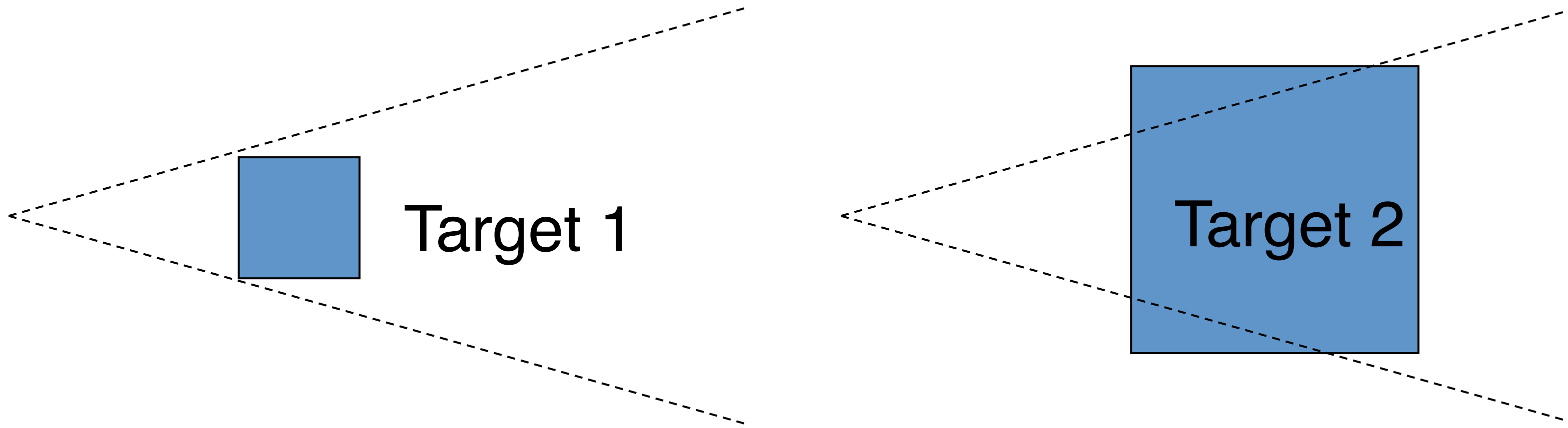

Smaller ID → Easier

CONSIDERS DISTANCE AND TARGET SIZE

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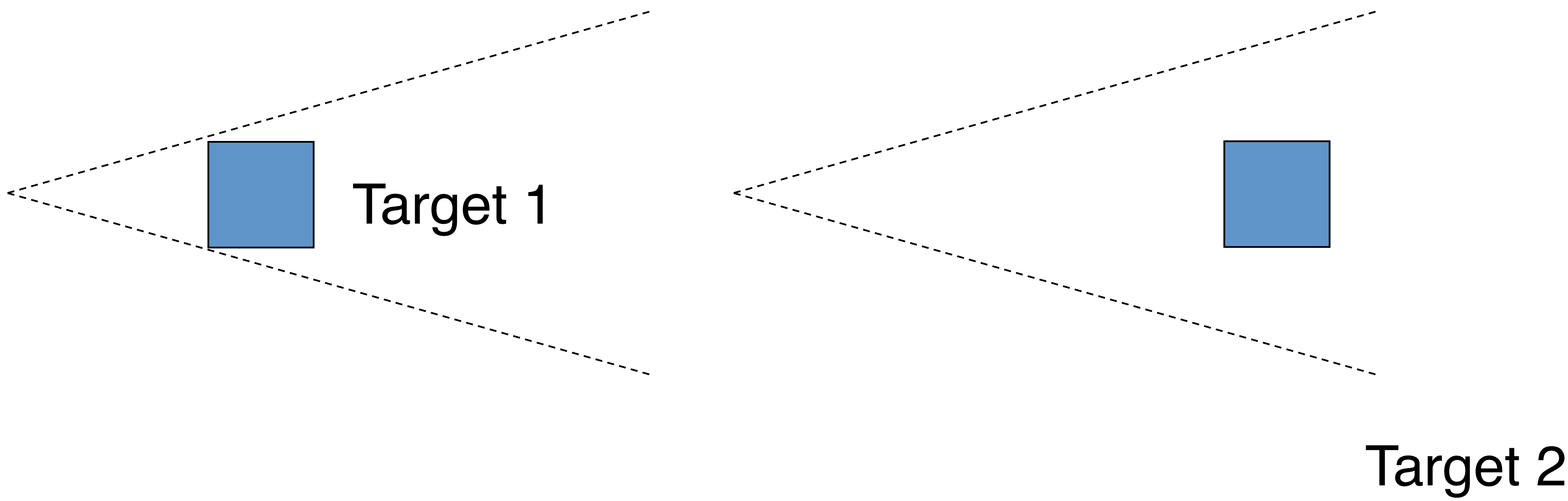
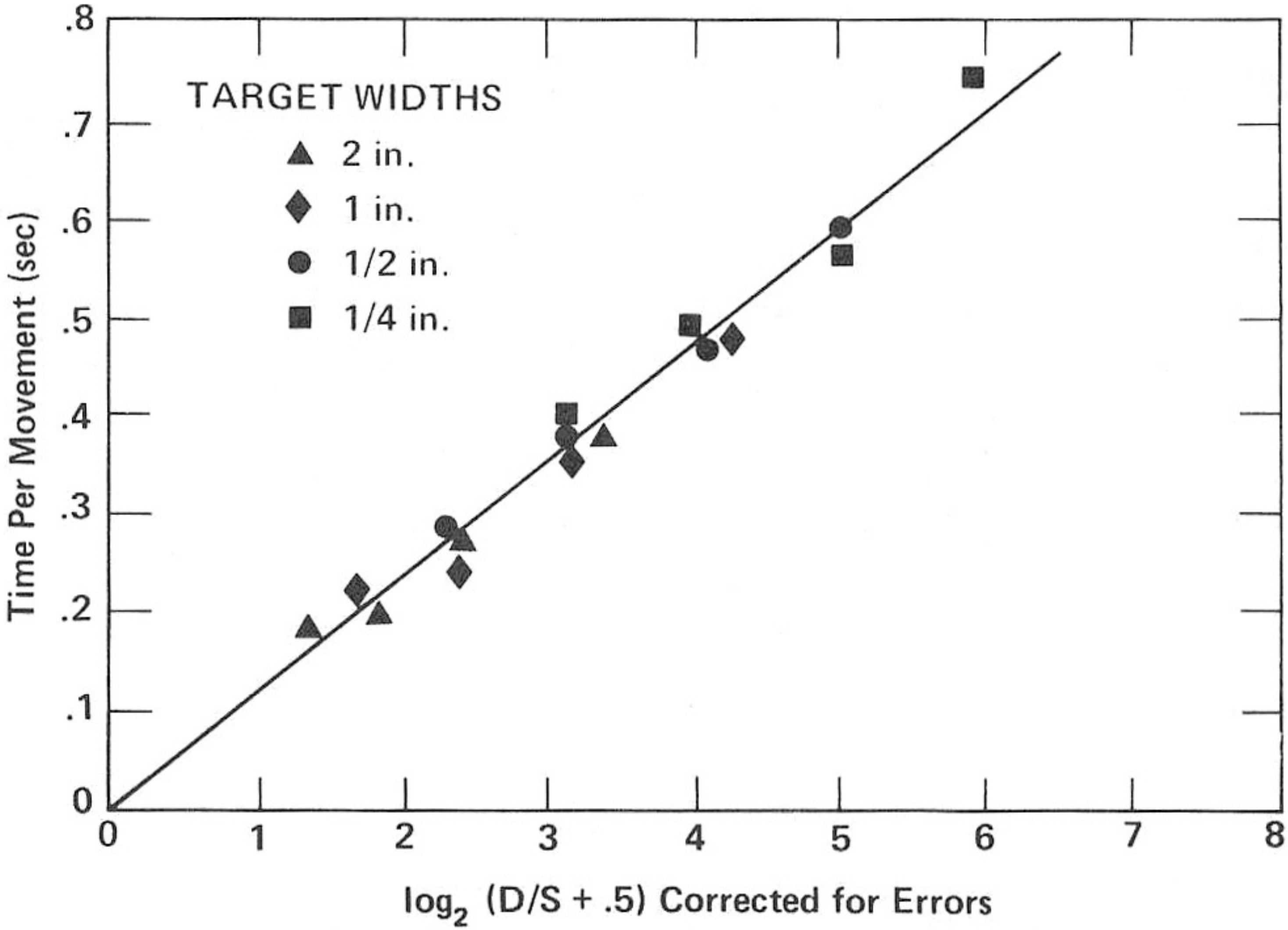


Larger ID → Harder

EXPERIMENTAL DATA

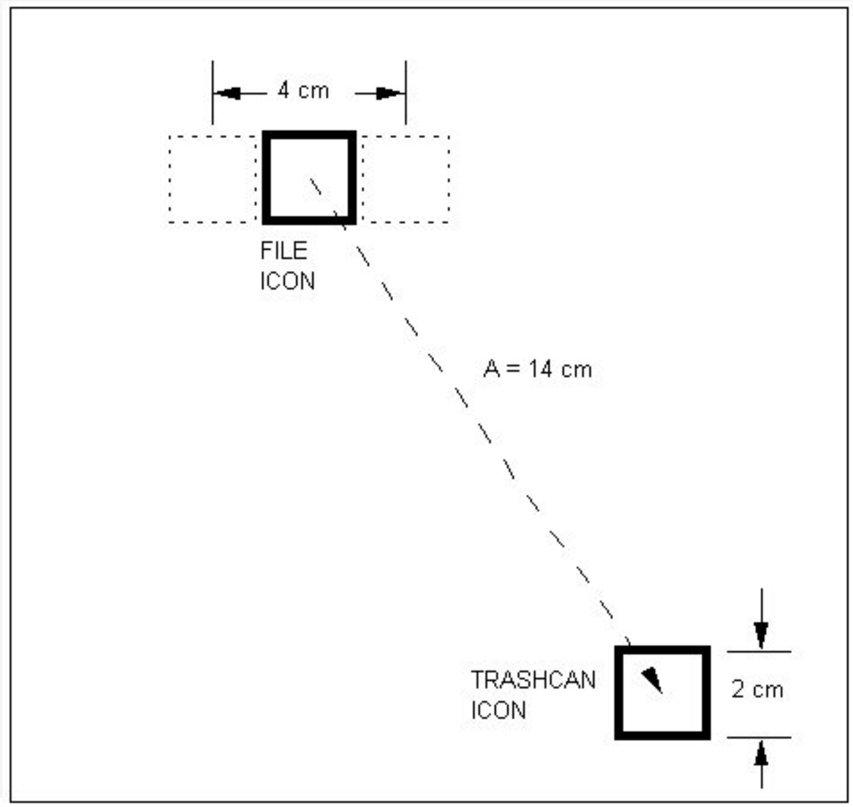


DESIGNING WITH FITTS' LAW

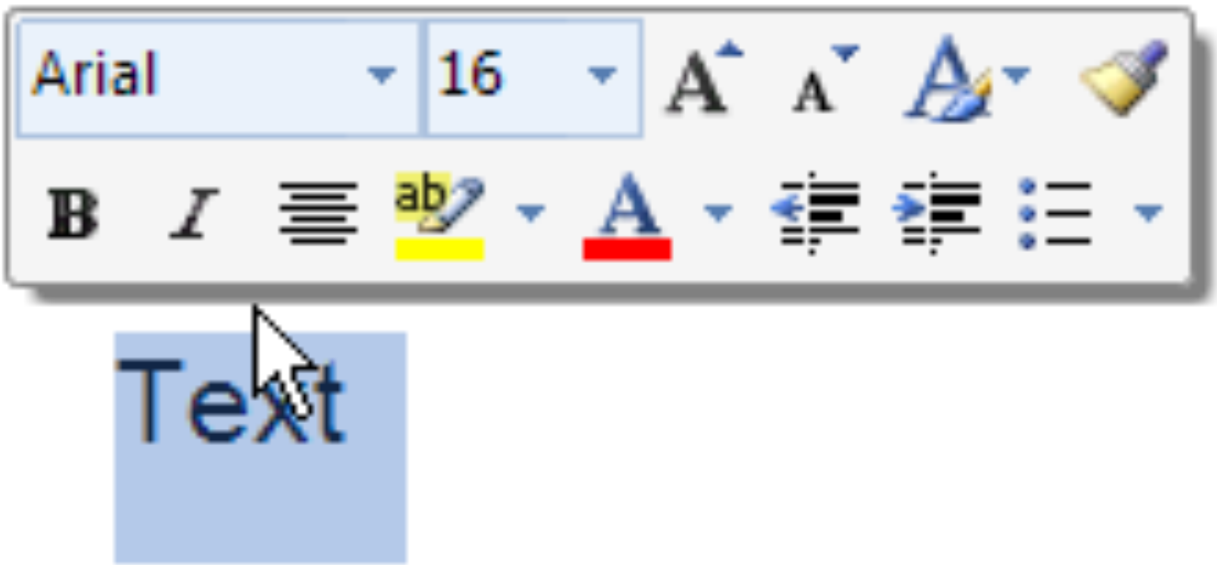
Bring items closer to the cursor

Make them larger

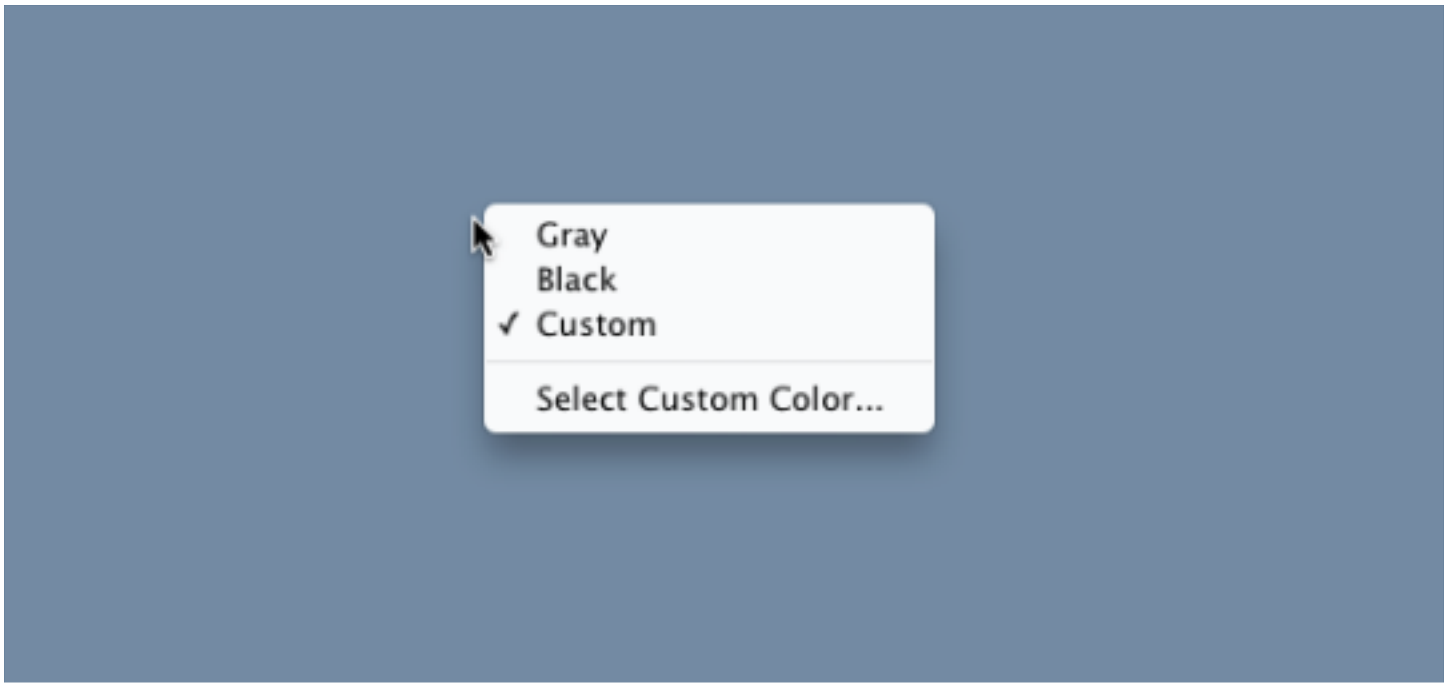
Exploit the edges

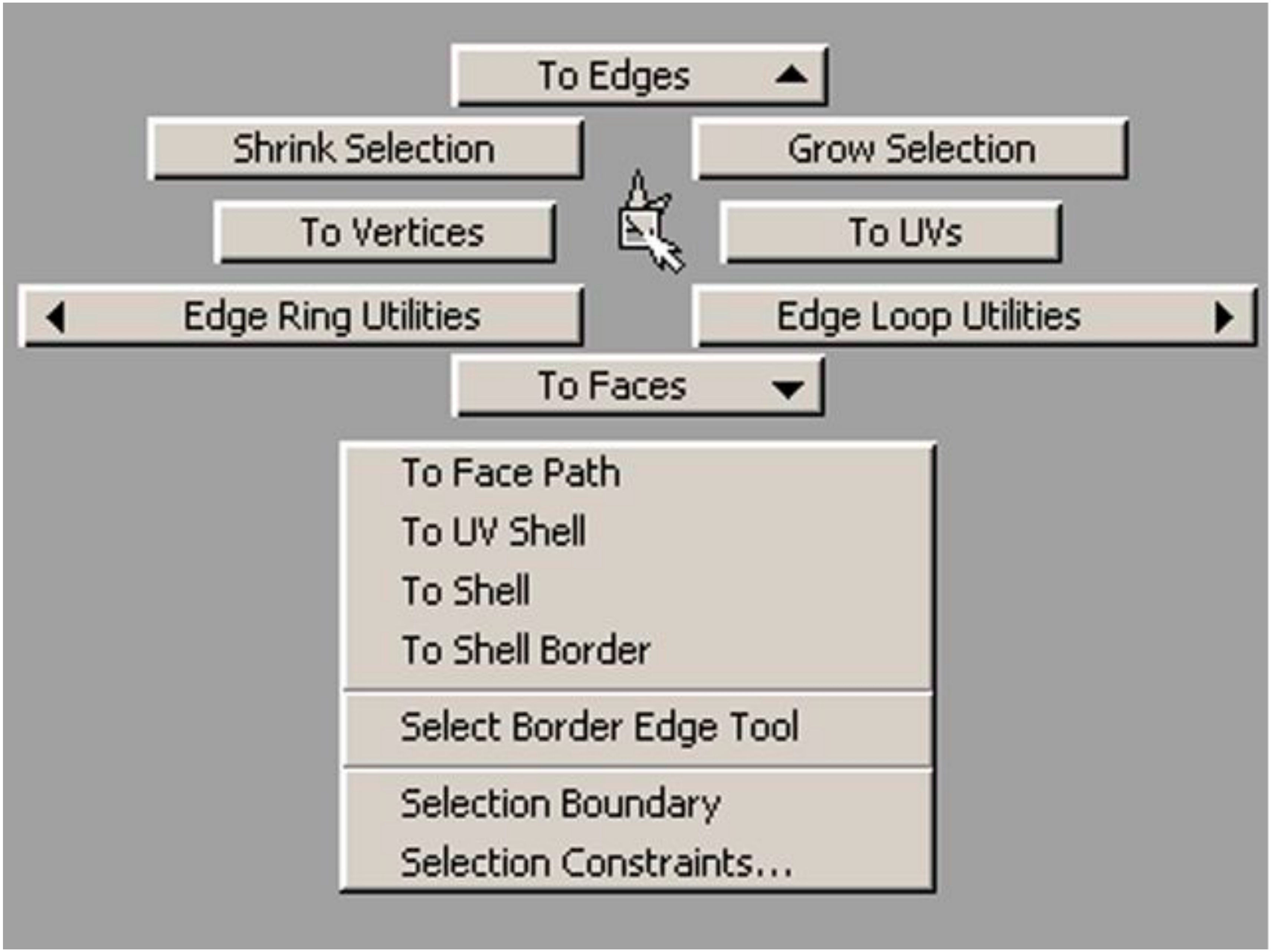


BRING ITEMS CLOSER TO THE CURSOR

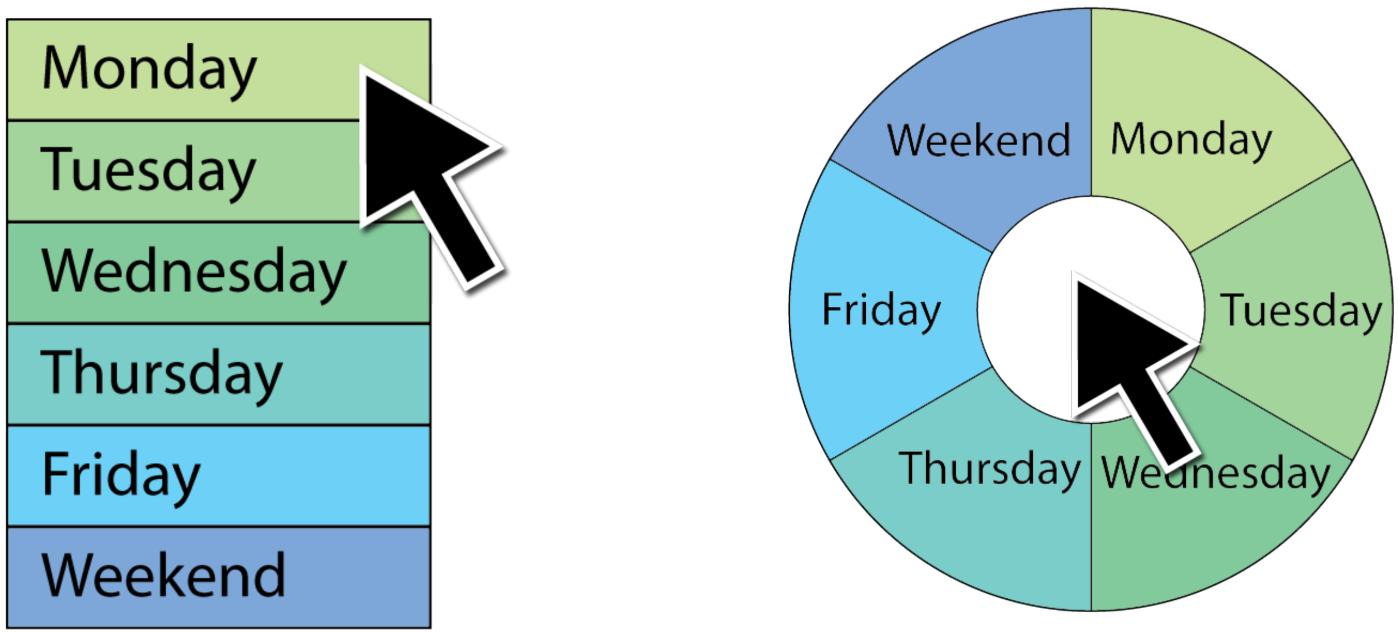


BRING ITEMS CLOSER TO THE CURSOR




To Edges
Shrink Selection
Grow Selection
To Vertices
To UVs
Edge Ring Utilities
Edge Loop Utilities
To Faces
To Face Path
To UV Shell
To Shell
To Shell Border
Select Border Edge Tool
Selection Boundary
Selection Constraints...

FITTS' LAW EXAMPLE

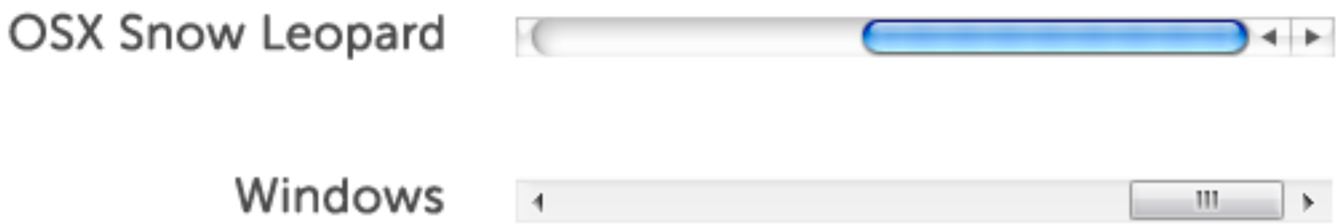


Which will be faster on average?

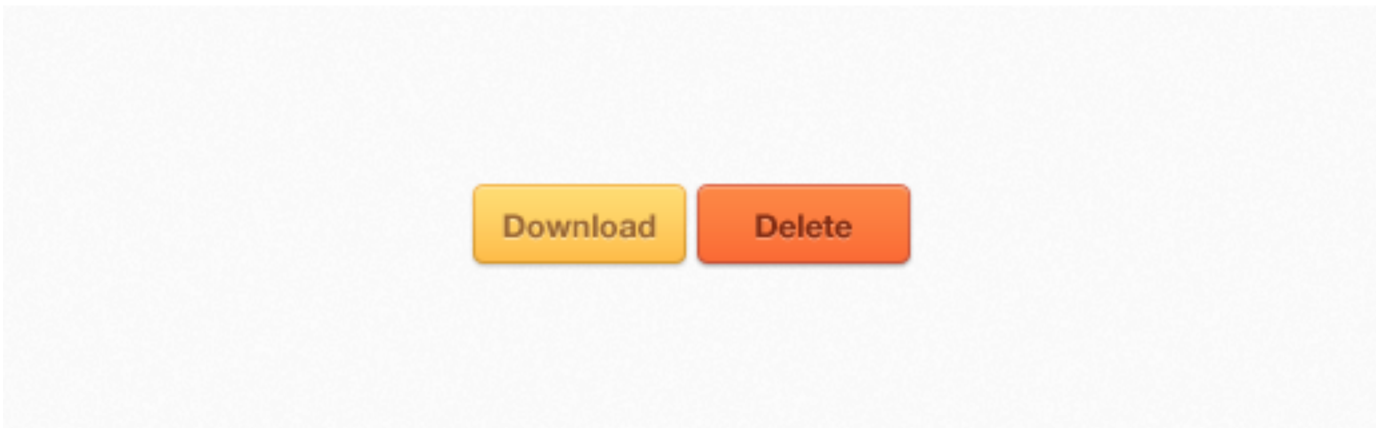
pie menu (bigger targets & less distance)

Source: Landay, James. "Human Abilities". CS160 UC Berkeley.

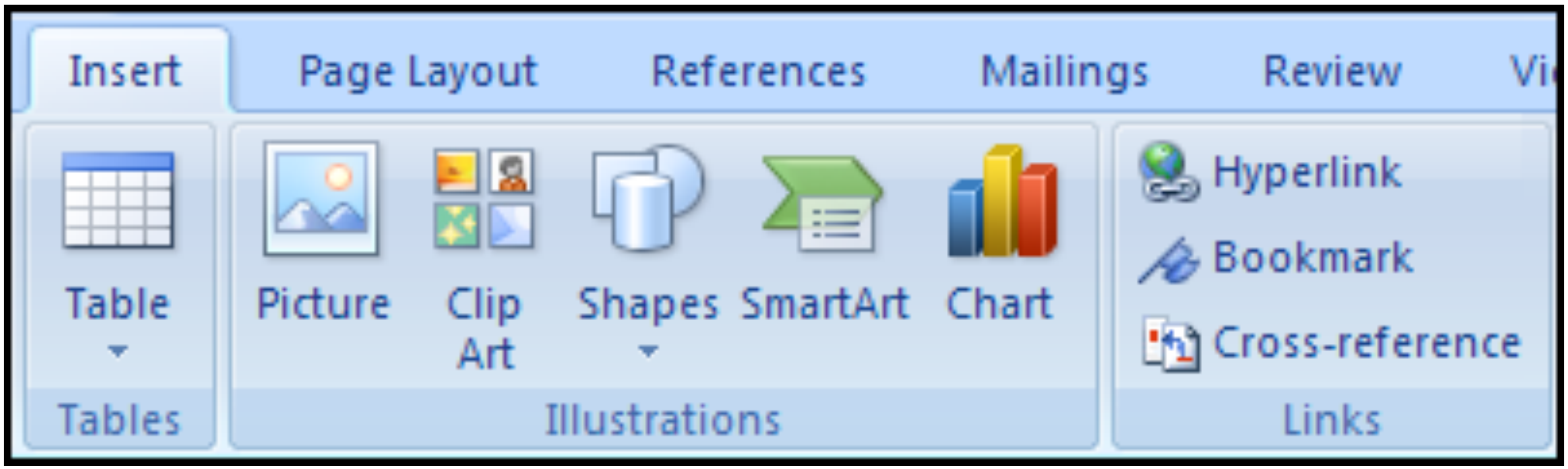
FITTS' LAW EXAMPLE



FITTS’ LAW EXAMPLE



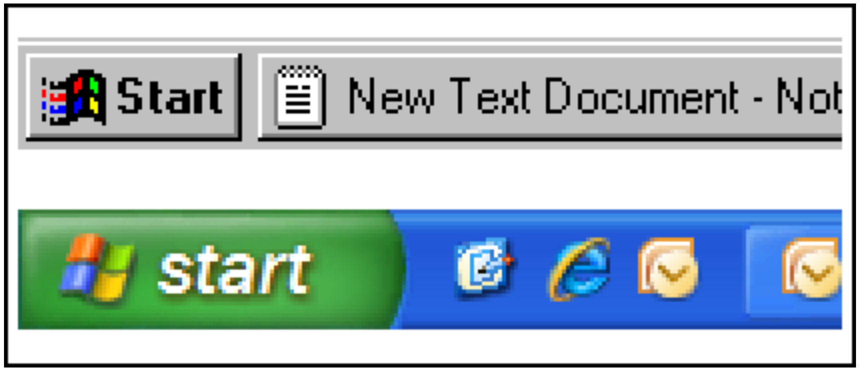
INCREASE TARGET SIZE



Larger, labeled controls can be clicked more quickly

Source: Jensen Harris, An Office User Interface Blog : Giving You Fitts. Microsoft, 2007.

EXPLOIT THE EDGES

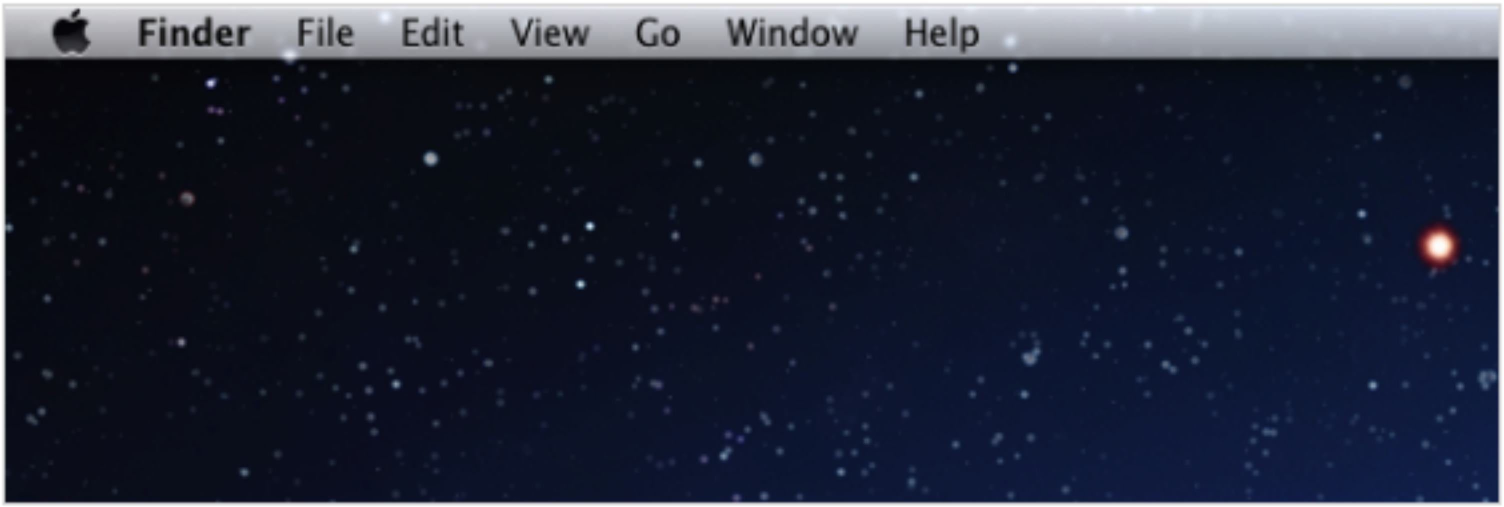


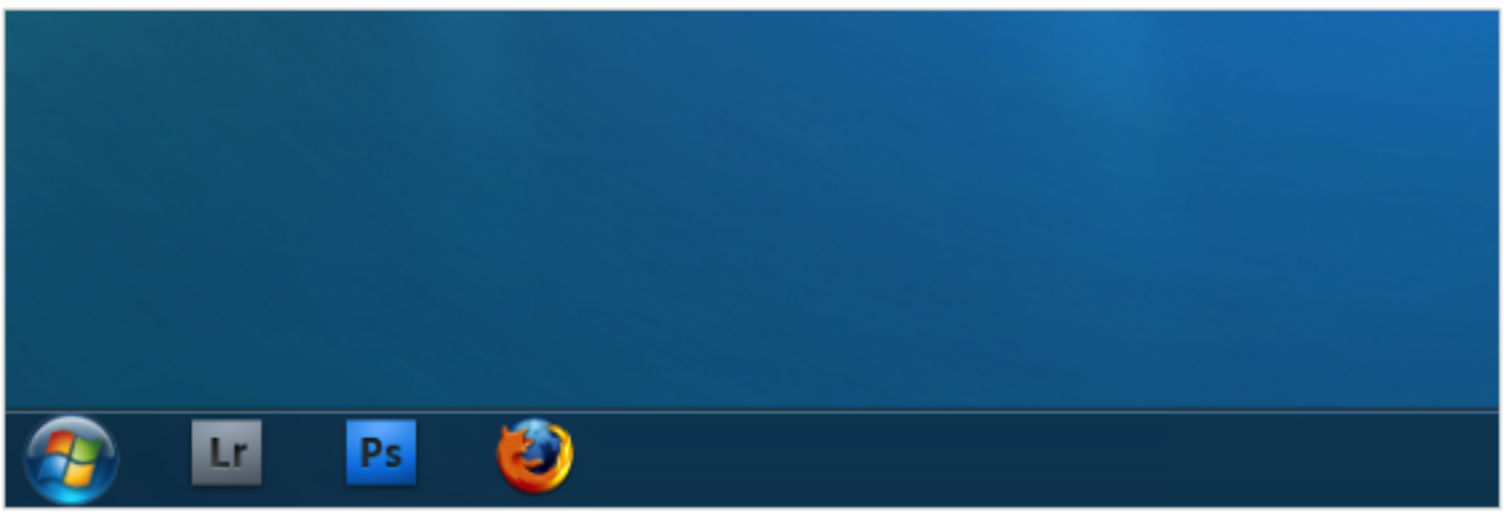
Windows 95: Missed by a pixel
Windows XP: Good to the last drop

The Apple menu in Mac OS

Source: Jensen Harris, An Office User Interface Blog : Giving You Fitts. Microsoft, 2007; Apple

EXPLOIT THE EDGES





DOES FITTS’ LAW APPLY TO MOBILE DEVICES?

DOES FITTS' LAW APPLY TO MOBILE DEVICES?

Yes! Original experiment by Fitts was on human arm movement, not mouse pointing!

Extension to target acquisition with mouse was a big result of Card et al. and not obvious.

Tablet setting is closer to original experimental setting.

No more benefit on device edges

How device is held

MOBILE