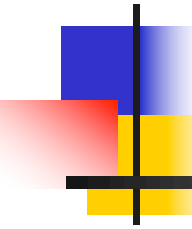
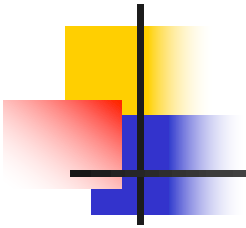


Chapter 2: Human Factor

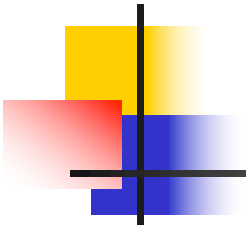
Lecturer: Wei Liang



- Human
- Computer
- Interaction

Humans differ

We're young, old, female, male, experts, novices, left-handed, right-handed, English-speaking, Chinese-speaking, from the north, from the south, tall, short, strong, weak, fast, slow, able-bodied, disabled, sighted, blind, motivated, lazy, creative, bland, tired, alert, and on and on….



Humans differ

So,

Understand Human better.

Newell's Time Scale of Human Action[1]

Scale (sec)	Time Units	System	World (theory)
10^7	Months		SOCIAL BAND
10^7	Weeks		
10^6	Days		
10^5	Hours	Task	RATIONAL BAND
10^3	10 min	Task	
10^2	Minutes	Task	
10^1	10 sec	Unit task	COGNITIVE BAND
10^0	1 sec	Operations	
10^{-1}	100 ms	Deliberate act	
10^{-2}	10 ms	Neural circuit	BIOLOGICAL BAND
10^{-3}	1 ms	Neuron	
10^{-4}	100 μs	Organelle	

[1] Newell, A. (1990). *Unified theories of cognition*. Cambridge, MA: Harvard University Press.

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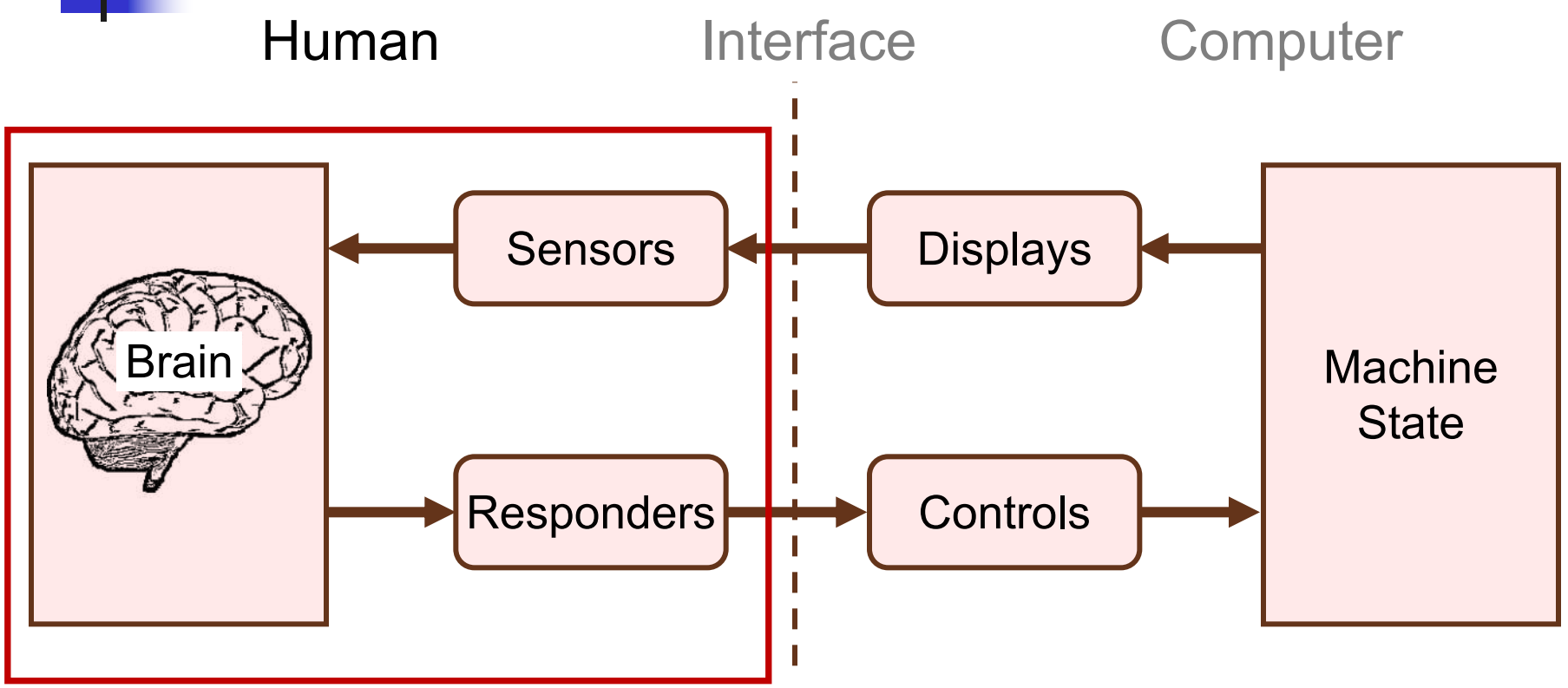
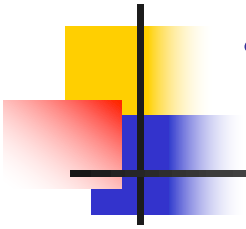
Human Factors Model[1]



[1] Kantowitz, B. H., & Sorkin, R. D. (1983). *Human factors: Understanding people-system relationships*. New York. New York: Wiley.



The human

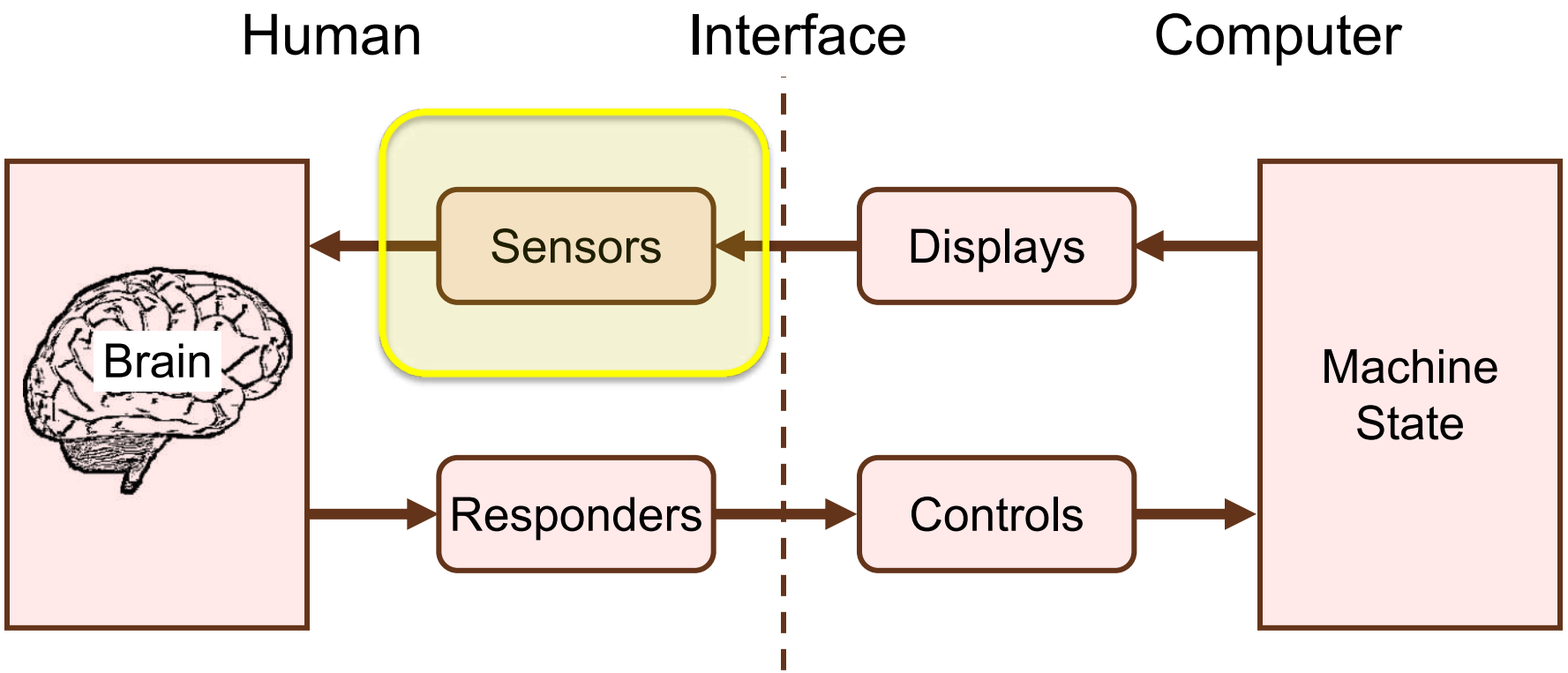
- Information i/o …

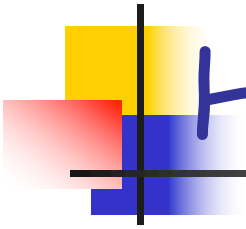
  visual, auditory, haptic, movement
- Information stored in memory

  sensory, short-term, long-term
- Information processed and applied

  reasoning, problem solving, skill, error
- Emotion influences human capabilities
- Each person is different

Human Factors Model[1]

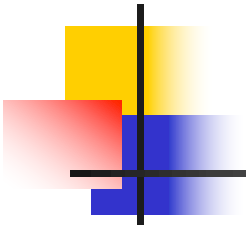




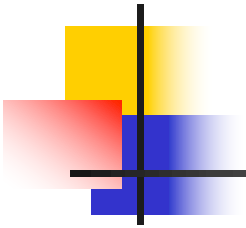
Human Senses

The five senses:

- Vision (sight)
- Hearing (audition)
- Touch (tactition)
- Smell
- Taste



Vision

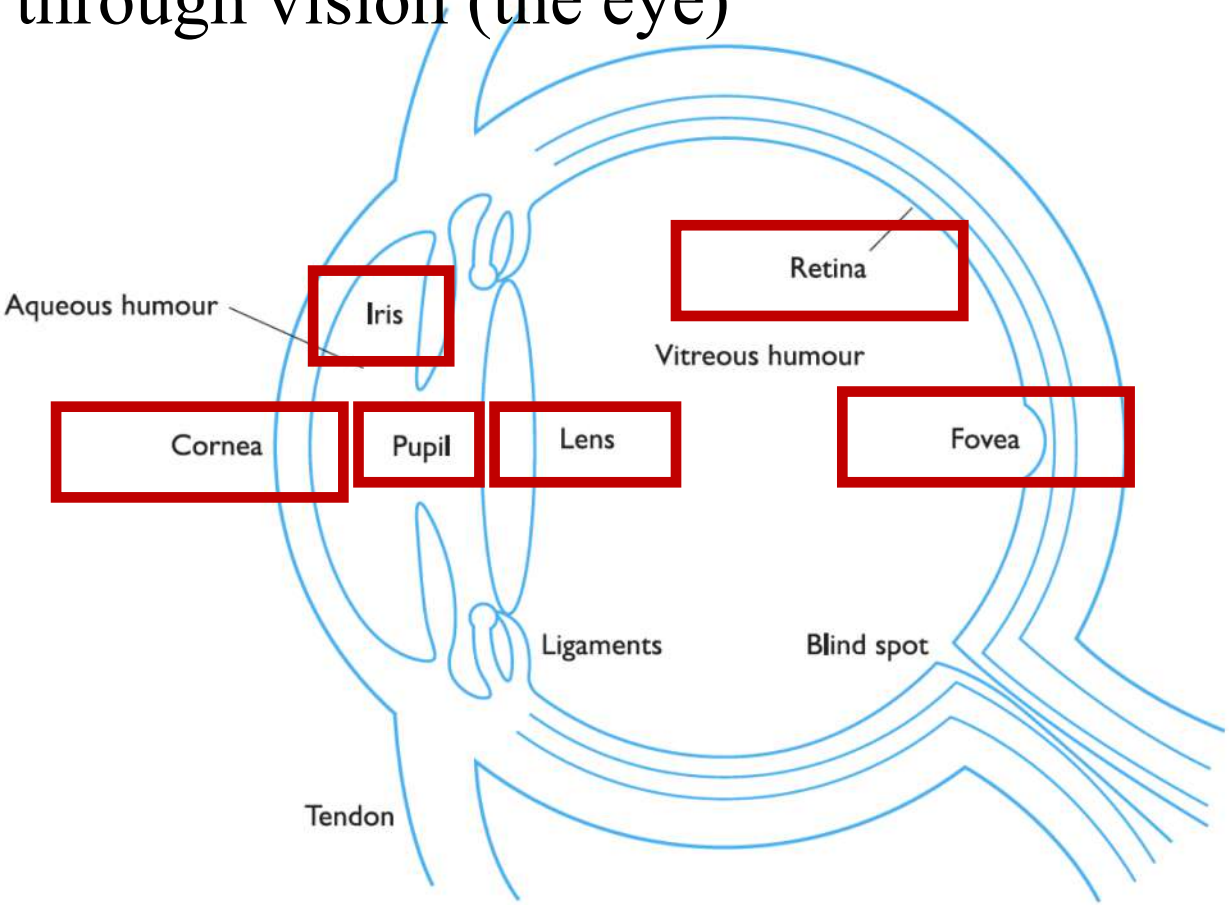


Vision

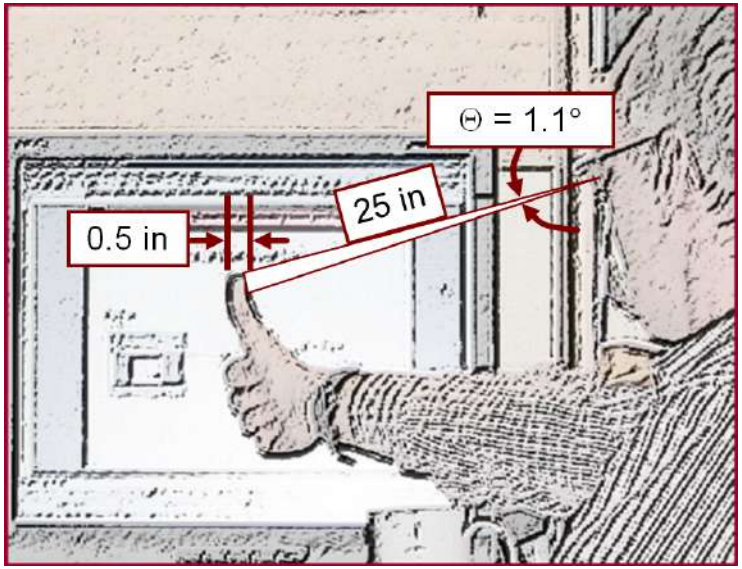
Two stages in vision

- physical reception of stimulus
- processing and interpretation of stimulus

People obtain about 80% of their information through vision (the eye)

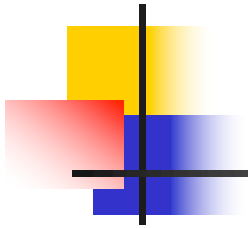


- Sharp central vision
- 1% of retina, 50% of visual cortex
- Fovea image is ≈1° of visual angle:



The Eye - physical reception

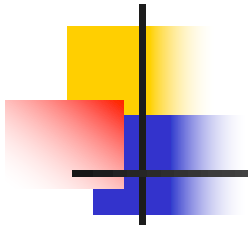
- mechanism for receiving light and transforming it into electrical energy
- light reflects from objects
- images are focused upside-down on retina
- retina contains rods for low light vision and cones for colour vision
- ganglion cells (brain!) detect pattern and movement



Fixate on the dot in the center.
Which side letters are harder to read?

A B C D E F • H I J K

If you want to show a warning message, where should you place it?



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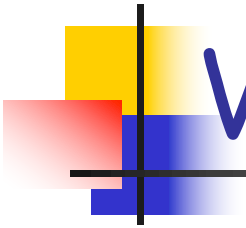


Visual Stimulus

- Physical properties of light…

  -Frequency

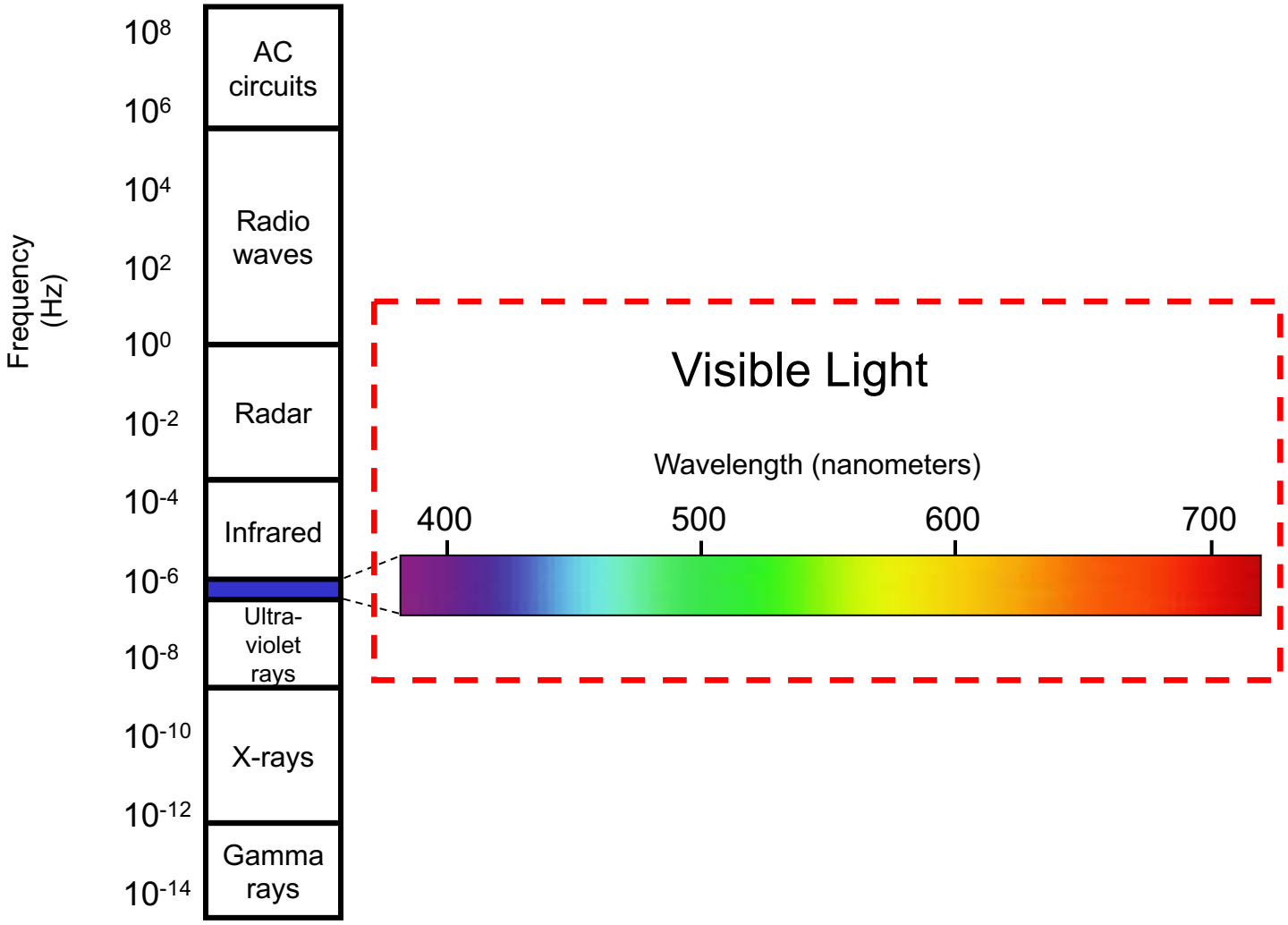
  -Intensity (luminance)

- Create subjective properties of vision perception

  -Colour

  -Brightness

Colour Spectrum



Interpreting the signal

- Brightness
  - subjective reaction to levels of light
  - affected by luminance of object
  - measured by just noticeable difference
  - visual acuity increases with luminance as does flicker

- Colour
  - made up of hue, intensity, saturation
  - cones sensitive to colour wavelengths
  - blue acuity is lowest
  - 8% males and 1% females colour blind

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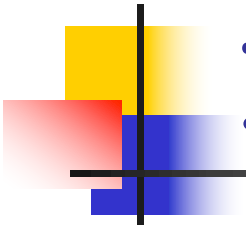
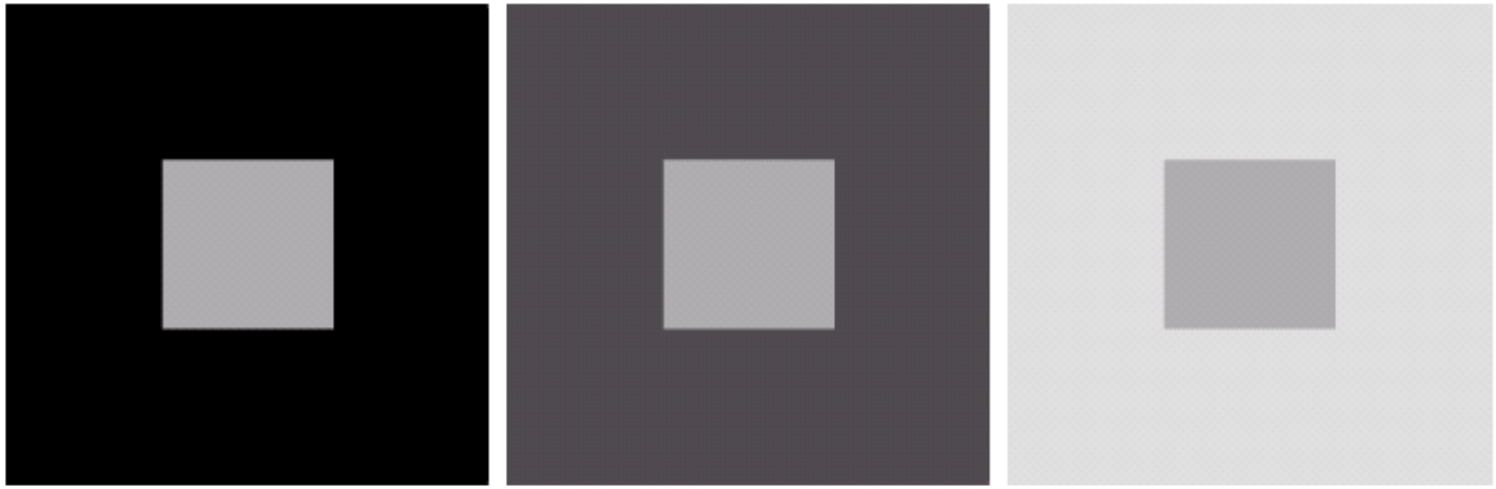


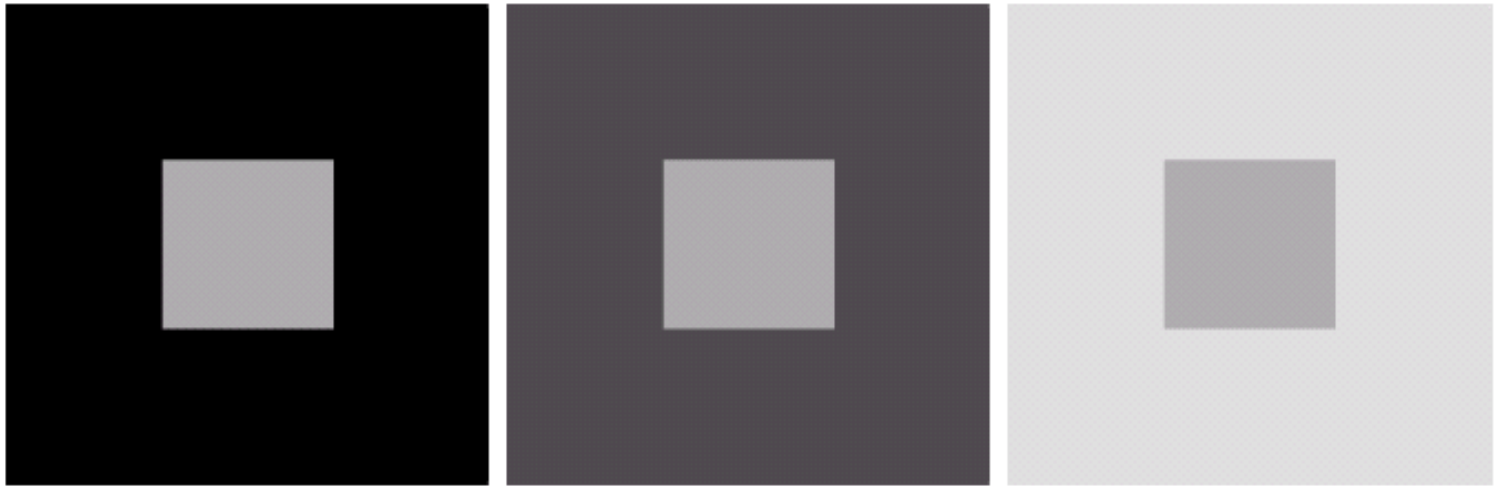
Interpreting the signal

- The visual system compensates for:
  - movement
  - changes in luminance
  - changes in colors
- Context is used to resolve ambiguity
- Optical illusions sometimes occur due to over compensation

Simultaneous contrast

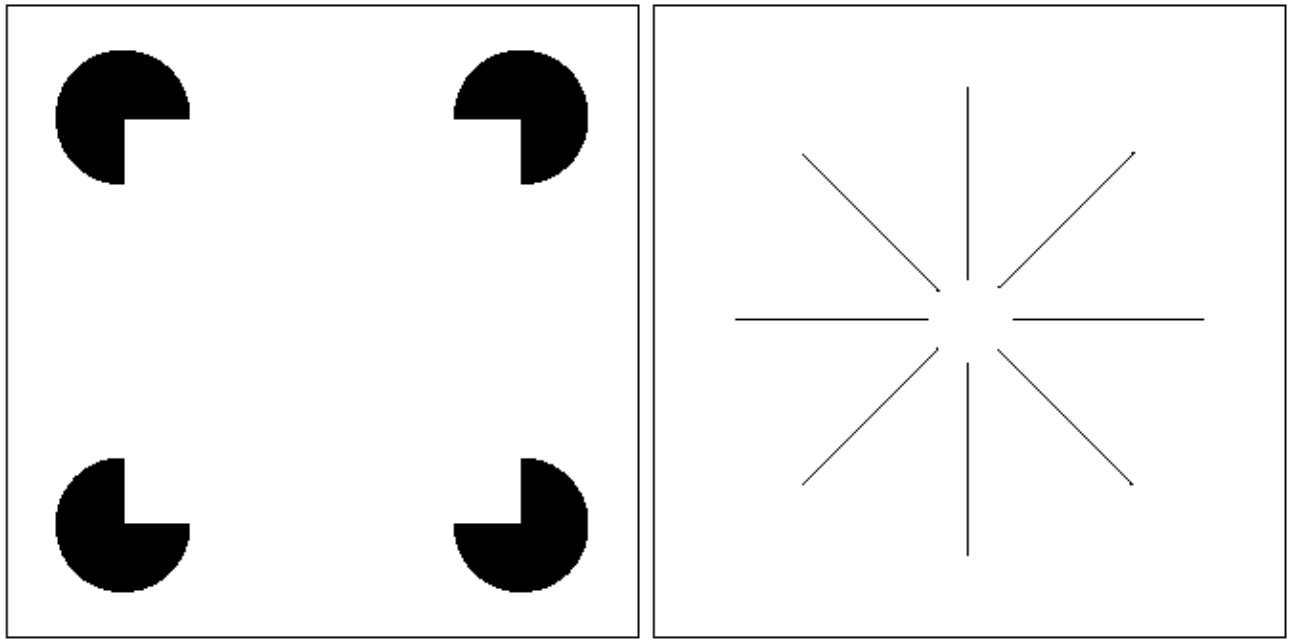


Simultaneous contrast



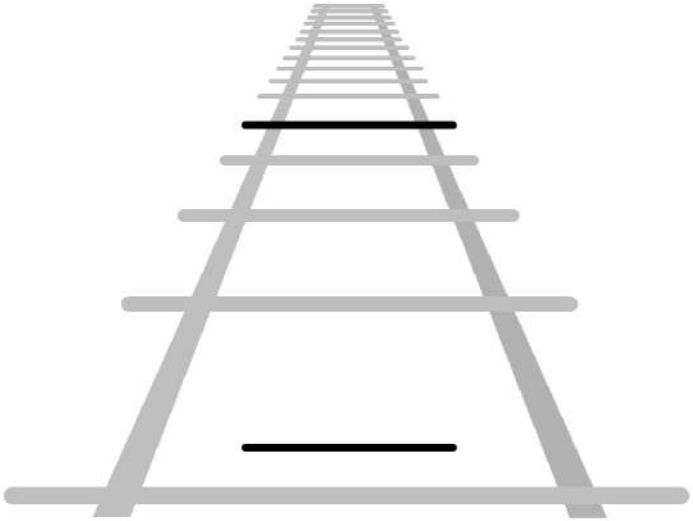
- All the small squares have exactly the same intensity, but they appear to the eye progressively darker as the background becomes brighter.
- Region's perceived brightness does not depend simply on its intensity.

Human Perception Phenomena



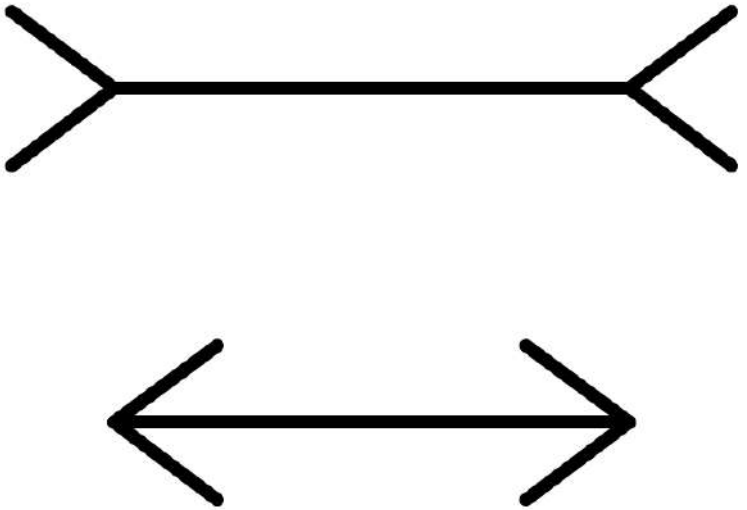
Optical Illusions

Ponzo lines



Which black line is longer?

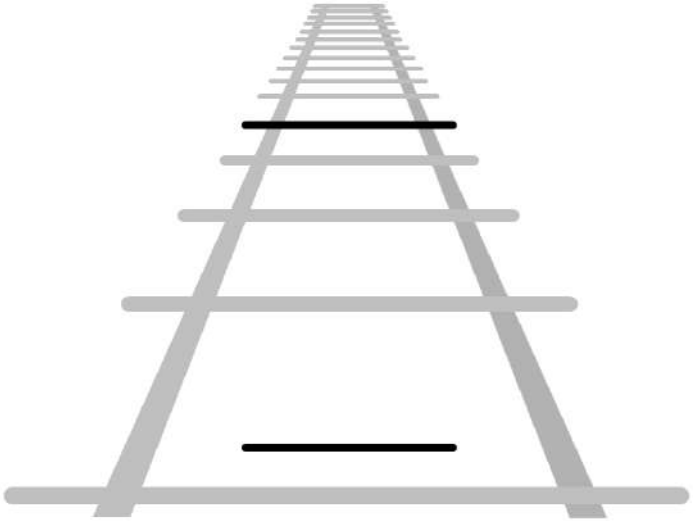
Műller-Lyer arrows



Which horizontal line is longer?

Optical Illusions

Ponzo lines



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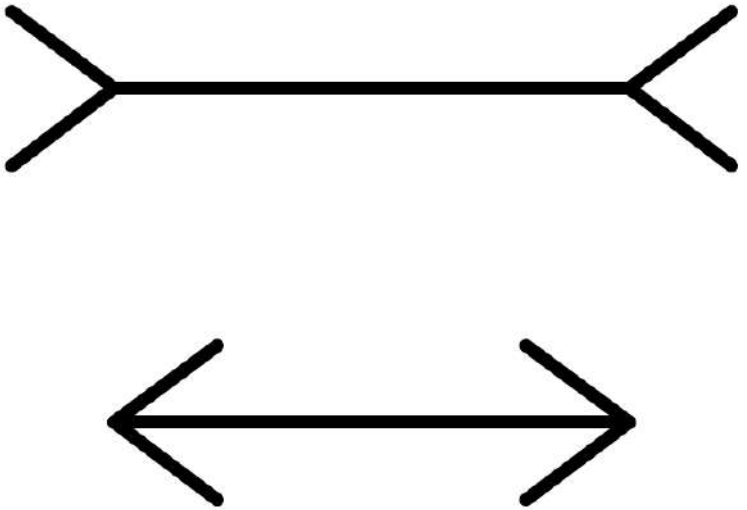
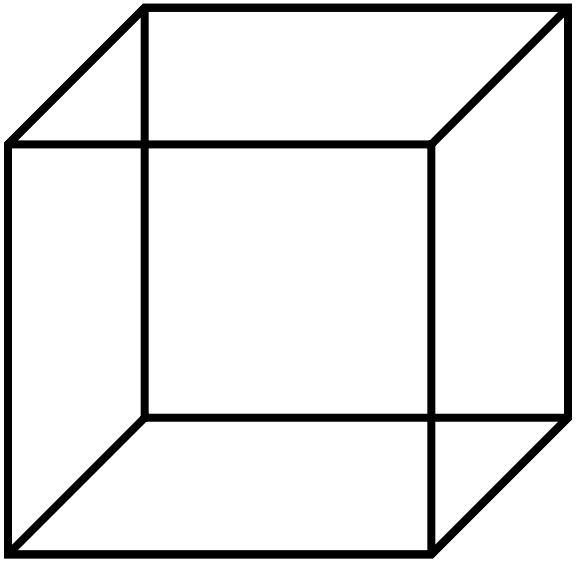


Which horizontal line is longer?

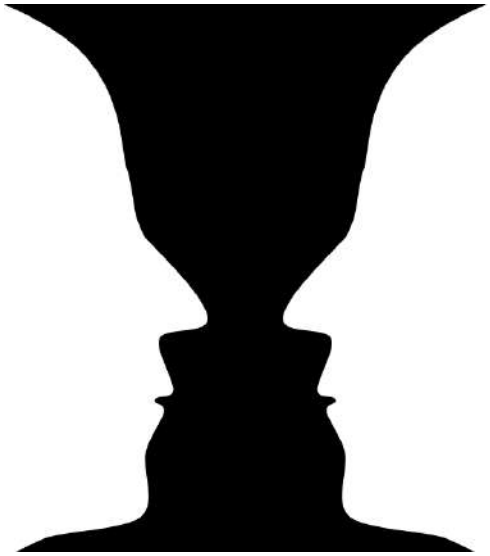
Ambiguity

Necker cube



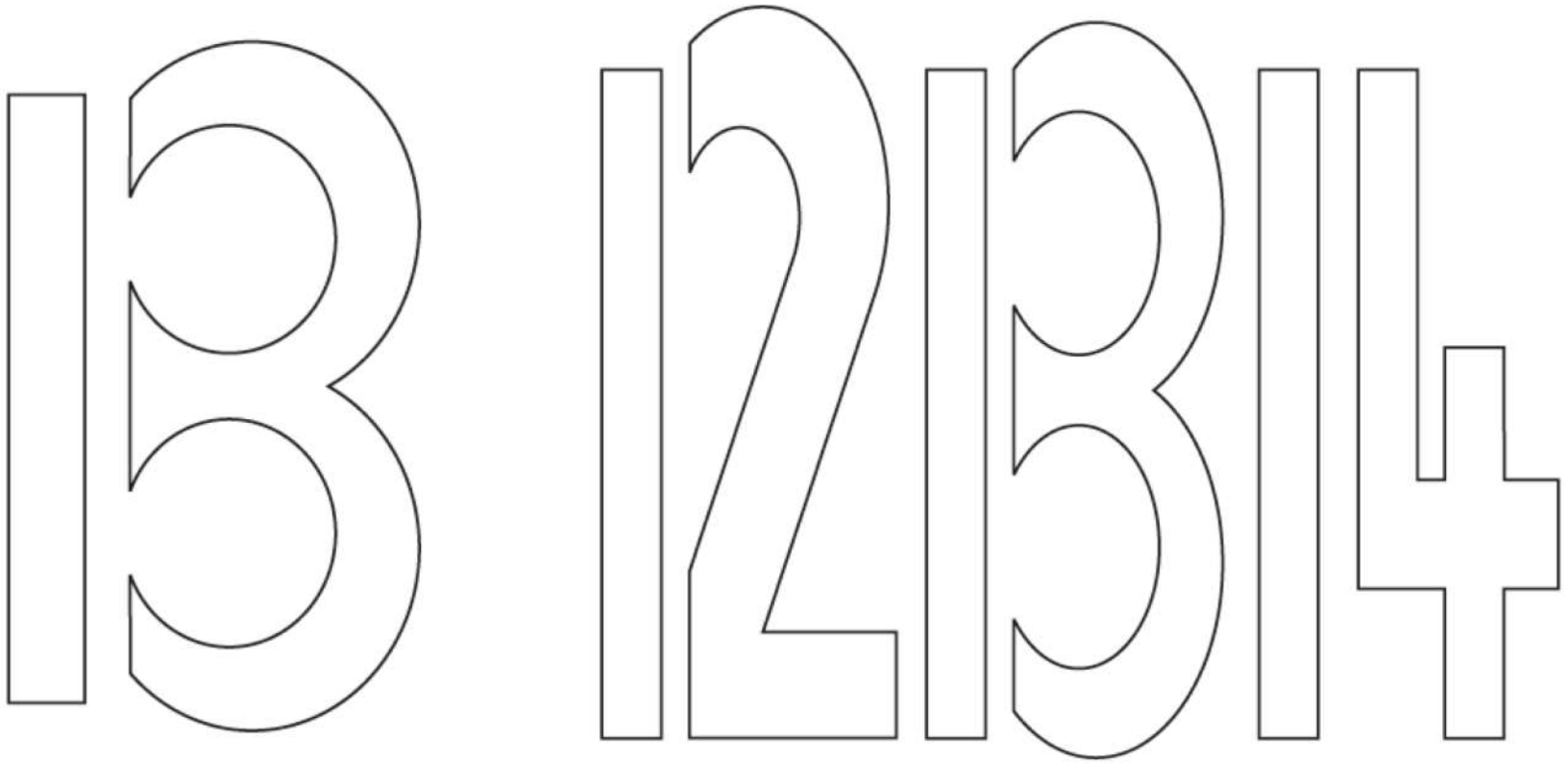
Which surface is at the front?

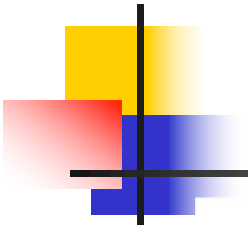
Rubin vase



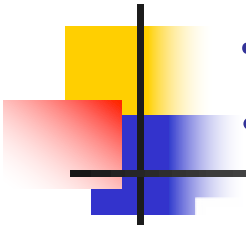
Wine goblet or two faces?

Ambiguity





The quick brown fox jumps over the the lazy dog.



Is this text correct?

The quick brown

fox jumps over the

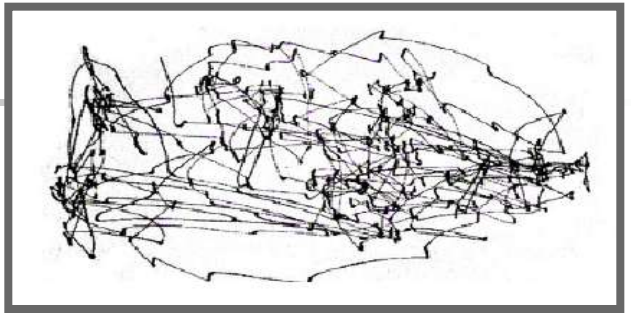
the lazy dog.

Fixations and Saccades

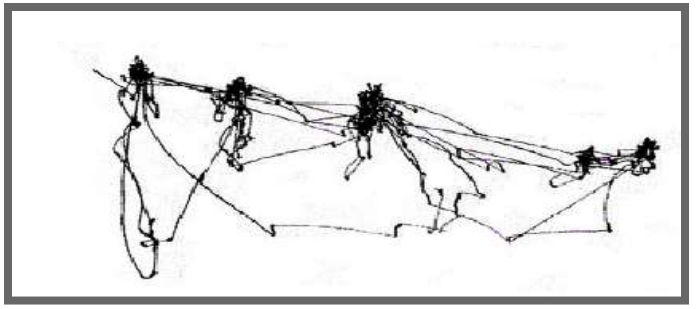
- Fixation
  - Eyes are stationary (dwell)
  - Take in visual detail from the environment
  - Long or short, but typically at least 200 ms
- Saccade
  - Rapid repositioning of the eye to fixate on a new location
  - Quick: ≈120 ms

Yarbus' Eye Tracking Research (1965)[1]

The Unwanted Visitor
by Ilya Repin (1844-1930)



"Remember the position of people and objects in the room"



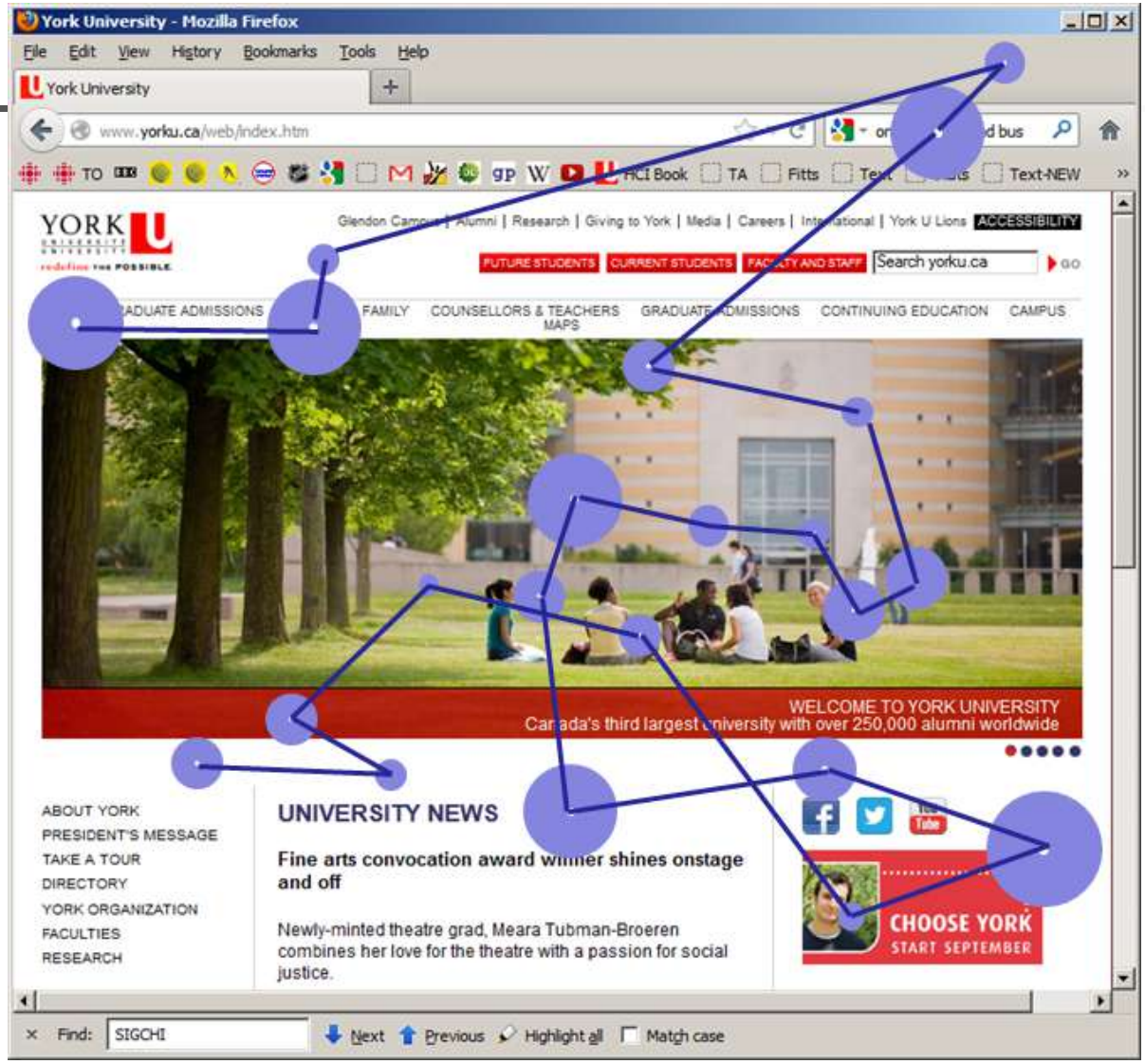
"Estimate the ages of the people"

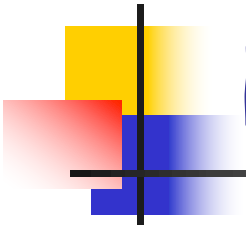
[1] Tatler, B. W., Wade, N. J., Kwan, H., Findlay, J. M., & Velichkovsky, B. M. (2010). Yarbus, eye movements, and vision. *i-Perception, 1*, 7-27..

Scan Paths

- Saccades → straight lines
- Fixations → circles
  - Diameter of circle $\propto$ duration of fixation
- Applications
  - User behaviour research (e.g., reading patterns)
  - Marketing research (e.g., ad placement)

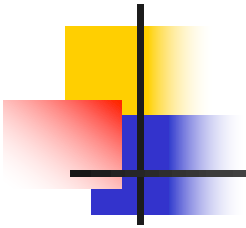
Scan Path Example





Reading

- Several stages:
  - visual pattern perceived
  - decoded using internal representation of language
  - interpreted using knowledge of syntax, semantics, pragmatics
- Reading involves saccades and fixations
- Perception occurs during fixations
- Word shape is important to recognition
- Negative contrast improves reading from computer screen



Hearing

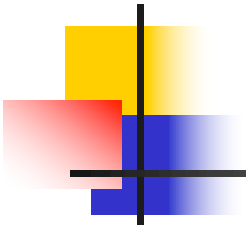
Hearing

- Sound → cyclic fluctuations of pressure in a medium, such as air
- Created when physical objects are moved or vibrated
- Examples
  - Slamming a door, plucking a guitar string, shuffling cards, speaking (via larynx)

Hearing

Hearing

- Provides information about environment:
  distances, directions, objects etc.
- Physical apparatus:
  - outer ear – protects inner and amplifies sound
  - middle ear – transmits sound waves as vibrations to inner ear
  - inner ear – chemical transmitters are released and cause impulses in auditory nerve
- Sound
  - pitch – sound frequency
  - loudness – amplitude
  - timbre – type or quality



Hearing

- Humans can hear frequencies from 20Hz to 15kHz
  - less accurate distinguishing high frequencies than low.

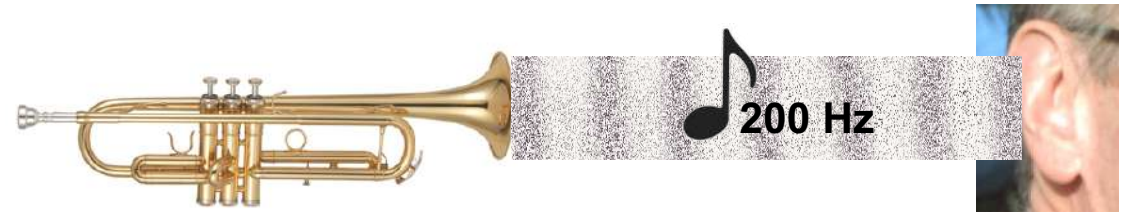
- Auditory system filters sounds
  - can attend to sounds over background noise, for example, the cocktail party phenomenon.

Auditory Stimulus

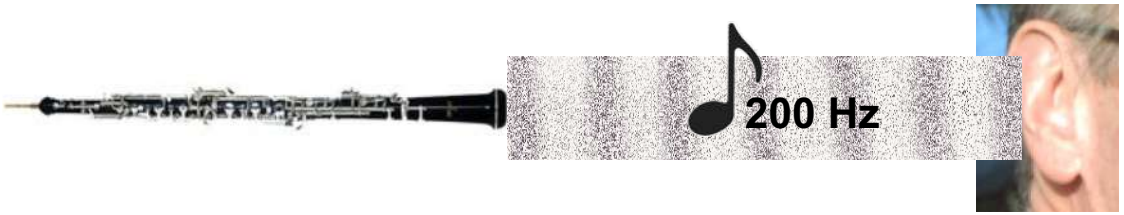
- Physical properties of sound…
  - Frequency
  - Intensity
- Create subjective properties of hearing…
  - Pitch
  - Loudness

Timbre

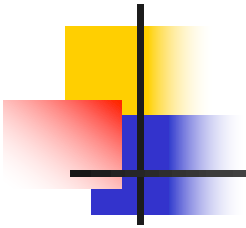
- Results from harmonic structure of sound
- Notes of the same frequency from different instruments are distinguished, in part, due to the unique pattern



“trumpet”



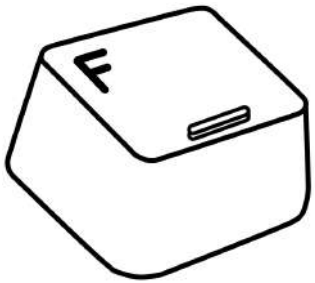
“oboe”

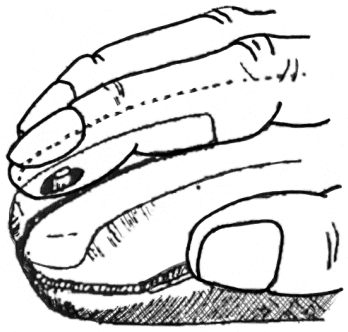


Touch

Touch (Tactition)

- Part of somatosensory system, with…
- Receptors in skin, muscles, joints, bones
  - Sense of touch, pain, temperature, position, shape, texture, resistance, etc.
- Tactile feedback examples:





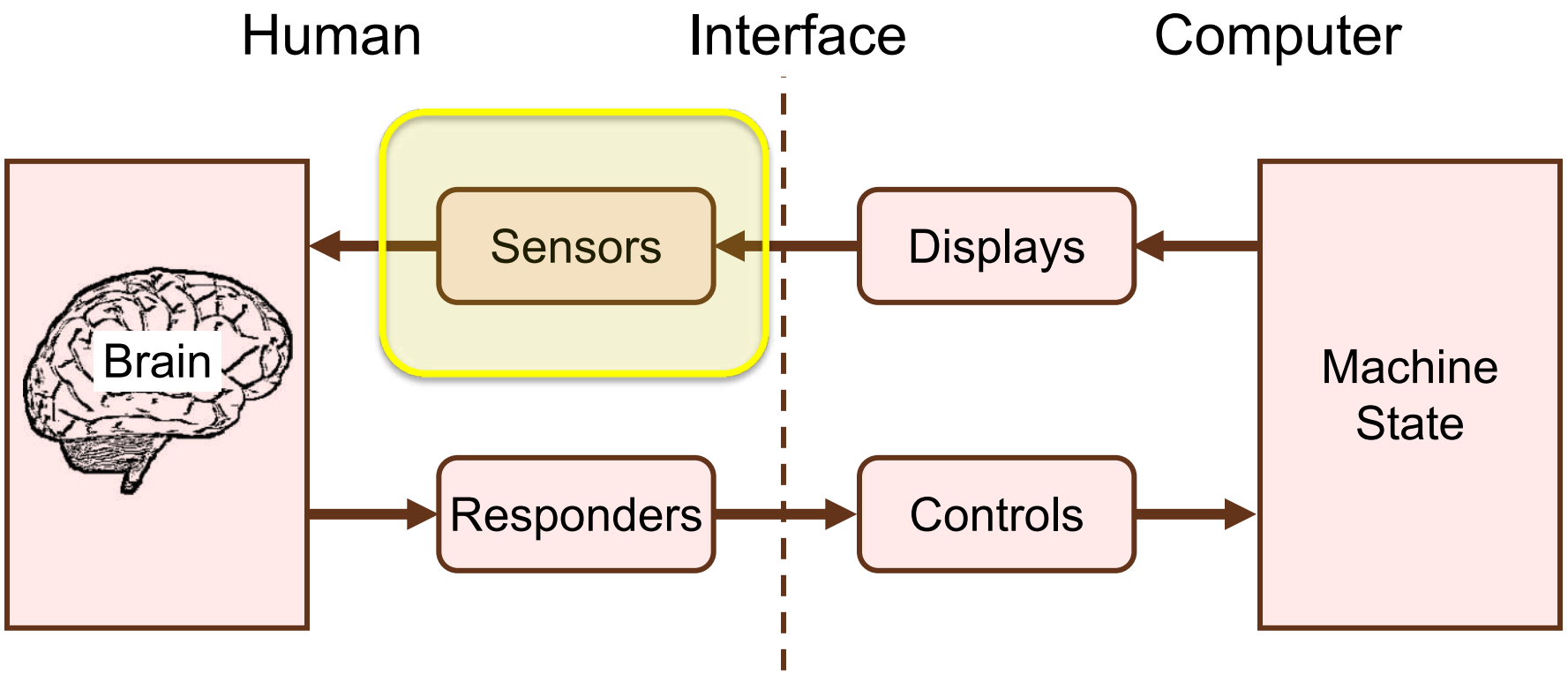
Touch/ haptic perception

- Provides important feedback about environment.
- May be key sense for someone who is visually impaired.
- Stimulus received via receptors in the skin:
  - thermoreceptors – heat and cold
  - nociceptors – pain
  - mechanoreceptors – pressure
    (some instant, some continuous)
- Some areas more sensitive than others e.g. fingers.

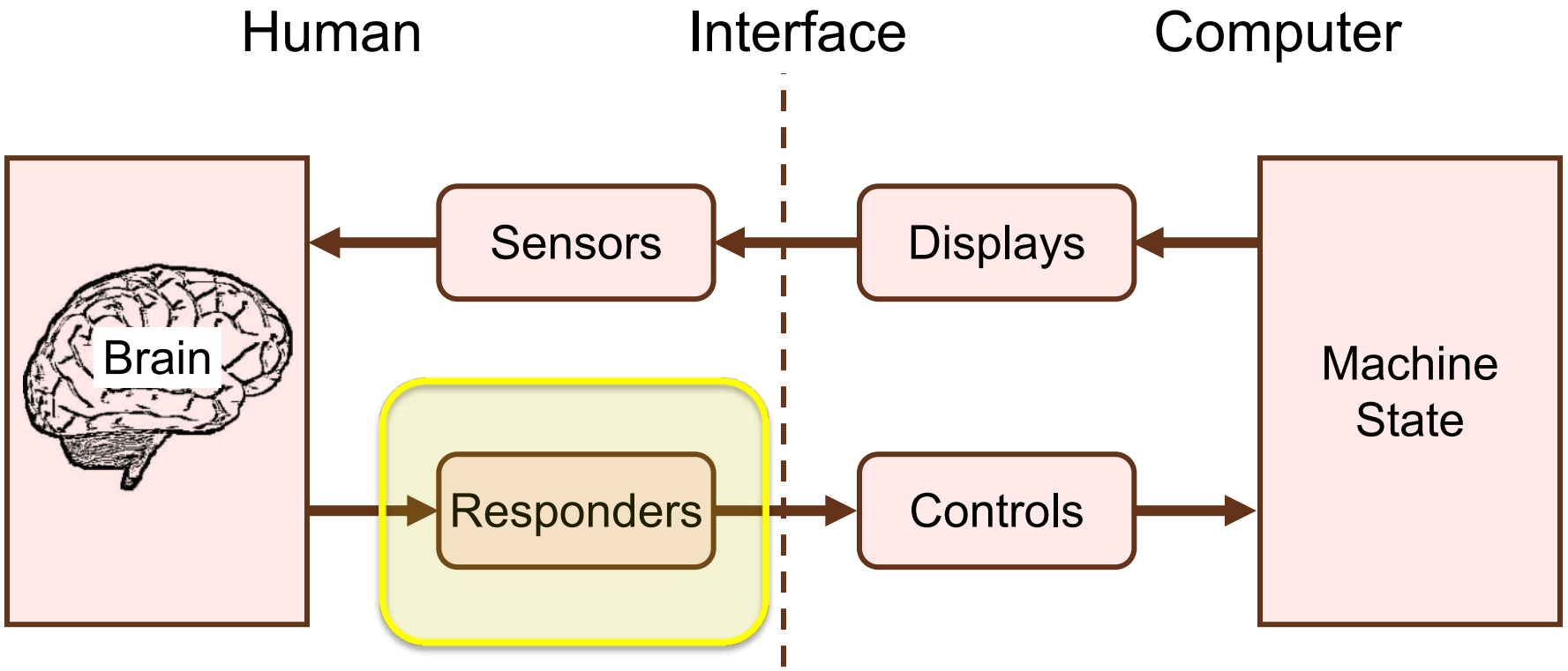
Smell and Taste

- Smell (olfaction)
  - Ability to perceive odours
  - Occurs through sensory cells in nasal cavity
- Taste (gustation)
  - Chemical reception of sweet, salty, bitter, and sour sensations
- Flavour
  - A perceptual process that combines smell and taste
- Only a few examples in HCI (e.g., Brewster et al., 2006; Bodnar et al., 2004)

Human Factors Model



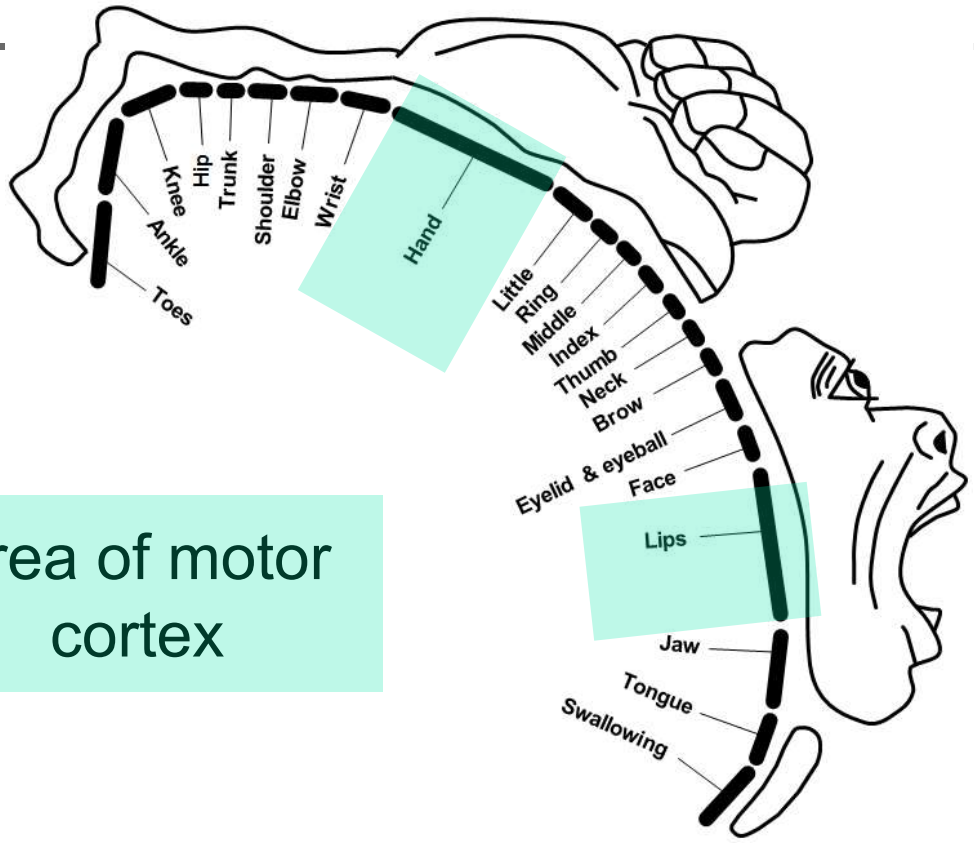
Human Factors Model



Responders

- Humans control their environment through responders, for example…
  - A finger to text or point
  - Feet to walk or run
  - Eyebrow to frown
  - Vocal chords to speak
  - Torso to lean
- Penfield's (1990) motor homunculus
  - Shows human responders and the relative area of motor cortex dedicated to each (next slide)

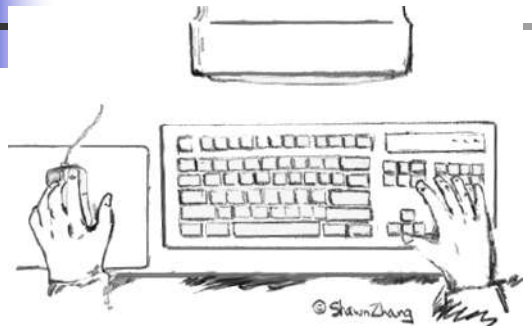
Motor Homunculus[1]

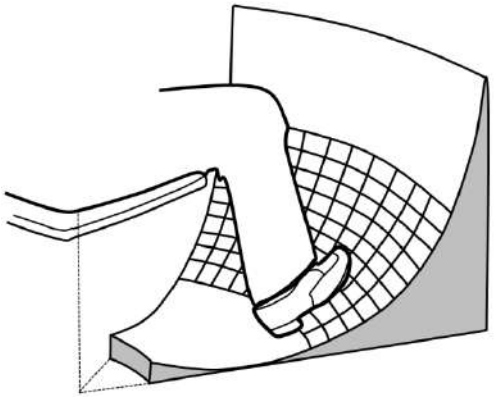


Area of motor cortex

[1] Penfield, W., & Rasmussen, T. (1990). *The cerebral cortex of man: A clinical study of localization of function*. New York: Macmillan.

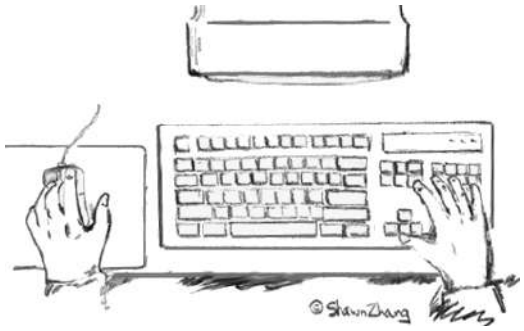
Responder Examples





Handedness

- Some users are left handed, others right handed



- Handedness exists by degree
- Edinburgh Handedness Inventory used to measure handedness (next slide)

Edinburgh Inventory for Handedness[1]

	Left	Right
1. Writing	☐☐	☐☐
2. Drawing	☐☐	☐☐
3. Throwing	☐☐	☐☐
4. Scissors	☐☐	☐☐
5. Toothbrush	☐☐	☐☐
6. Knife (without fork)	☐☐	☐☐
7. Spoon	☐☐	☐☐
8. Broom (upper hand)	☐☐	☐☐
9. Striking a match	☐☐	☐☐
10. Opening box (lid)	☐☐	☐☐
Total (count checks)	☐	☐

Difference	Cumulative Total	**RESULT**
☐	☐	☐

Instructions

Mark boxes as follows:

x	preference
xx	strong preference
blank	no preference

Scoring

Add up the number of checks in the "Left" and "Right" columns and enter in the "Total" row for each column. Add the left total and the right total and enter in the "Cumulative Total" cell. Subtract the left total from the right total and enter in the "Difference" cell. Divide the "Difference" cell by the "Cumulative Total" cell (round to 2 digits if necessary) and multiply by 100. Enter the result in the "RESULT" cell.

Interpretation of RESULT

-100 to -40	left-handed
-40 to +40	ambidextrous
+40 to 100	right-handed

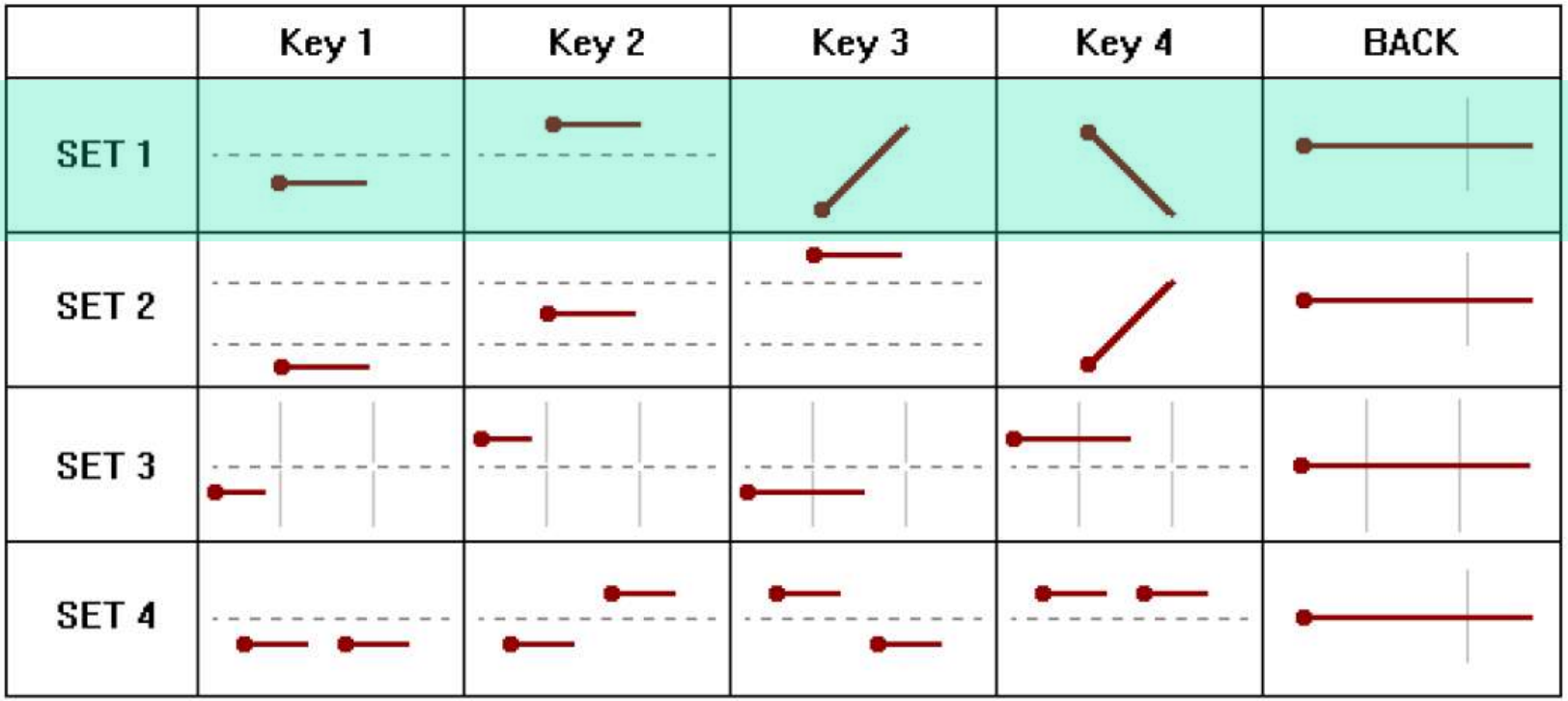
[1] Oldfield, R. C. (1971). The assessment and analysis of handedness: The Edinburgh inventory. *Neuropsycholologia, 9*, 97-113.

Human Voice

- Human vocal chords are responders
- Sounds created through combination of…
  - Movement in the larynx
  - Pulmonary pressure in the lungs
- Two kinds of vocalized sounds:
  - Speech
  - Non-speech
- Both with potential for computer control
  - Speech + speech recognition
  - Non-speech + signal detection (e.g., frequency, loudness, duration, change direction, etc.)

Non-speech Example[1]

NVVI = non-verbal voice interaction

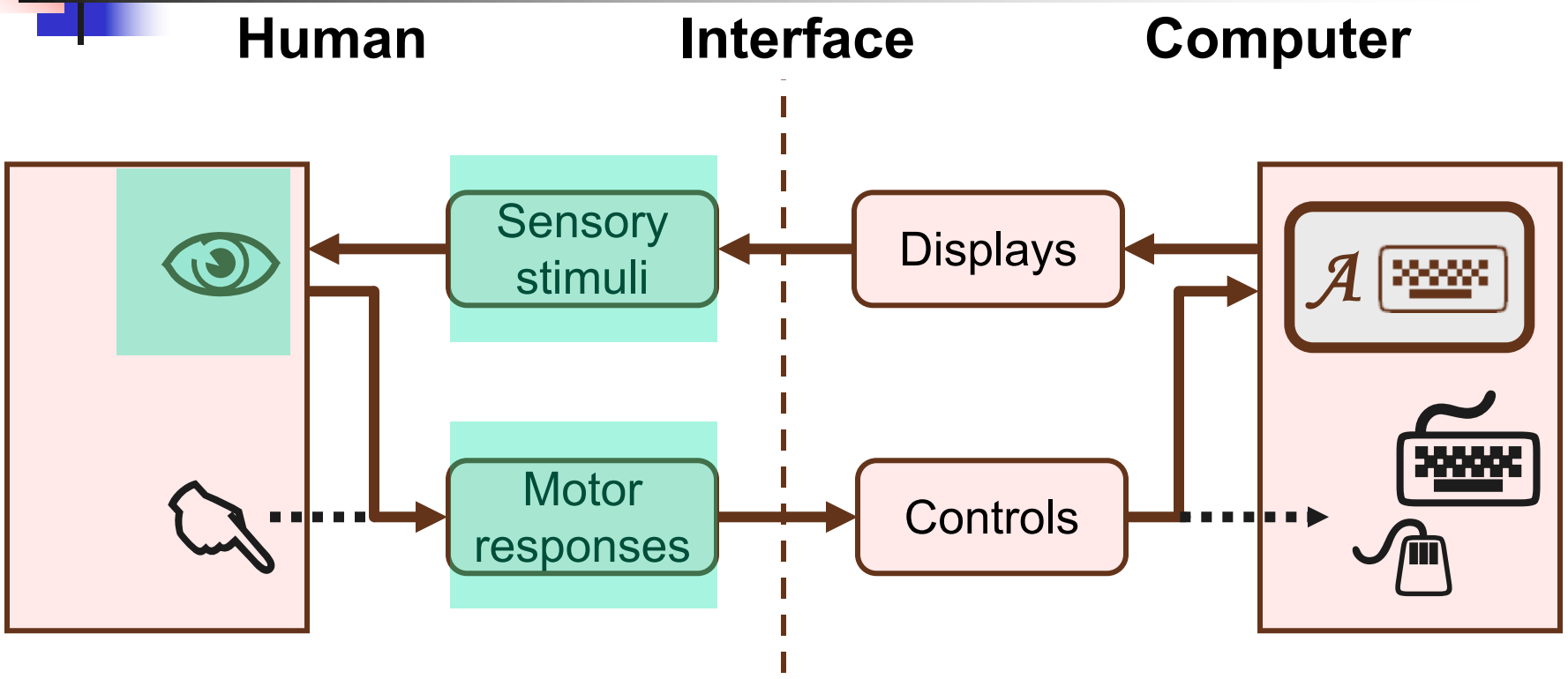


[1] Sporka, A., Felzer, T., Kruniawan, S., Polacek, O., Haiduk, P., & MacKenzie, I. S. (2011). CHANTI: Predictive text entry using non-verbal vocal input. *Proceedings of the ACM Conference on Human Factors in Computing Systems – CHI 2011*, 2463-2472.New York: ACM.

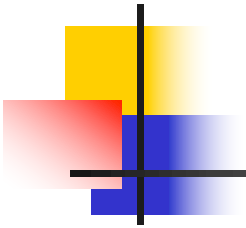
The Eye as a Responder

- As a controller, the eye is called upon to do "double duty"
  1. Sense and perceive the environment/computer
  2. Act as a controller via saccades and fixations
- This suggests a modification to the human factors model presented earlier (next slide)

Modified Human Factors Model[1]

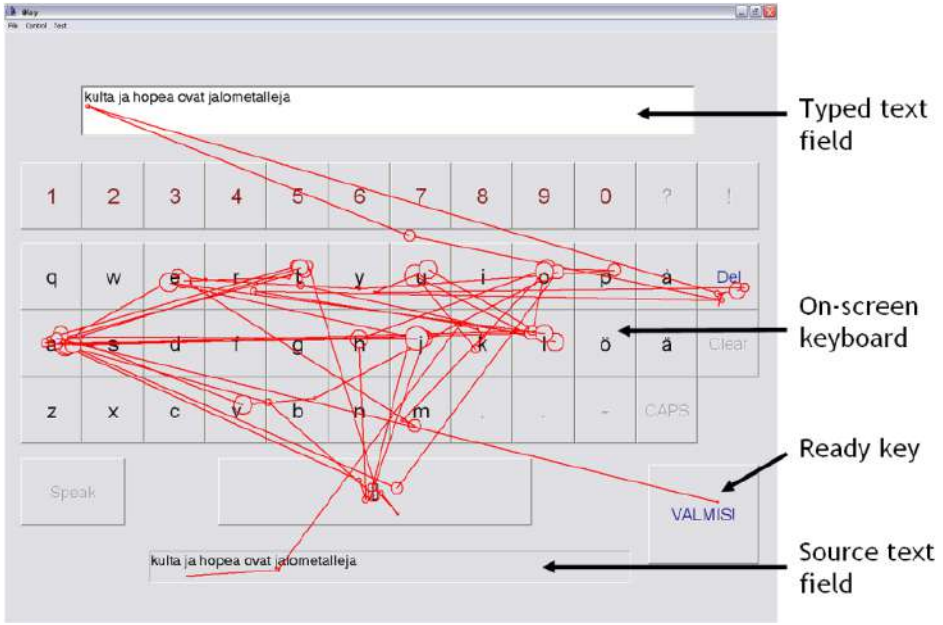


[1] MacKenzie, I. S. (2012). Evaluating eye tracking systems for computer input. In Majaranta, P., Aoki, H., Donegan, M., Hansen, D. W., Hansen, J. P., Hyrskykari, A., & Räihä, K.-J. (Eds.) *Gaze interaction and applications of eye tracking: Advances in assistive technologies*, pp. 205-225. Hershey, PA: IGI Global.



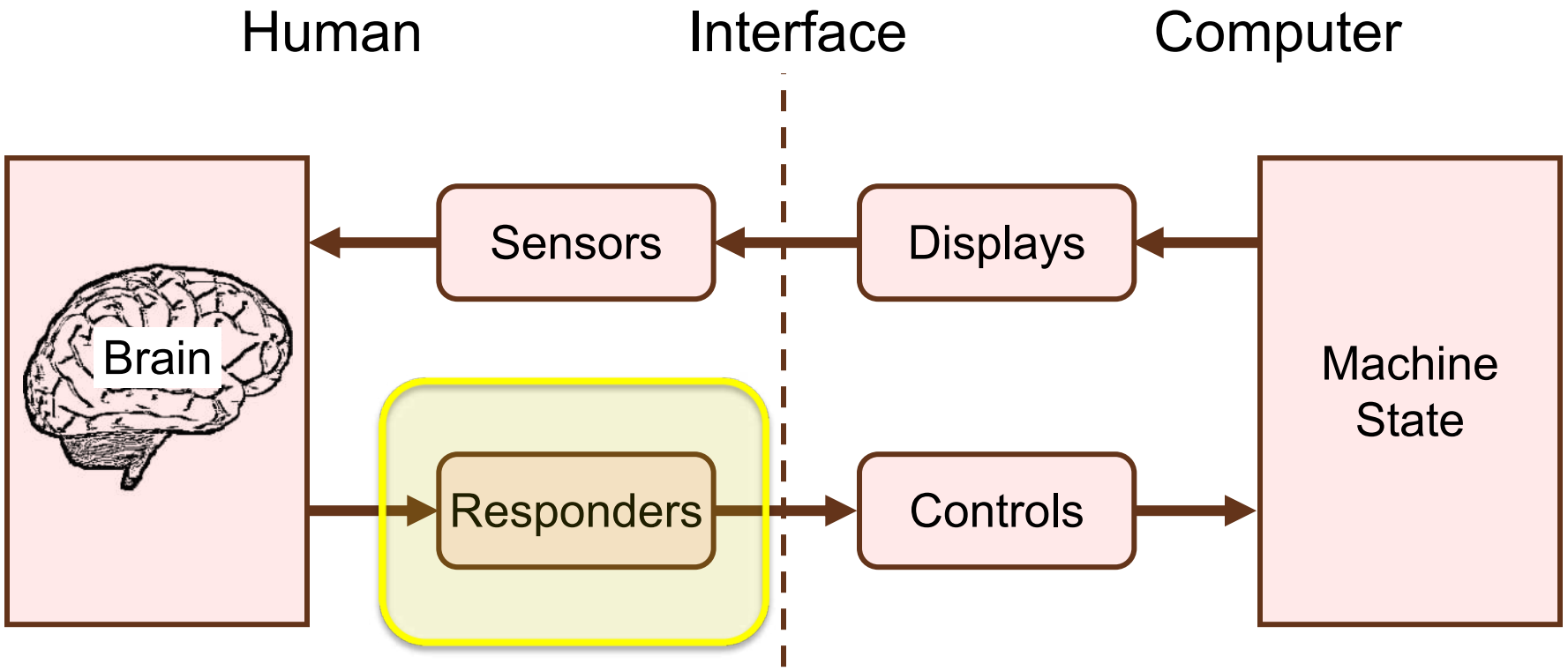
Please watch
the supplemented videos
about two eye tracking devices

Example - Eye Typing[1]

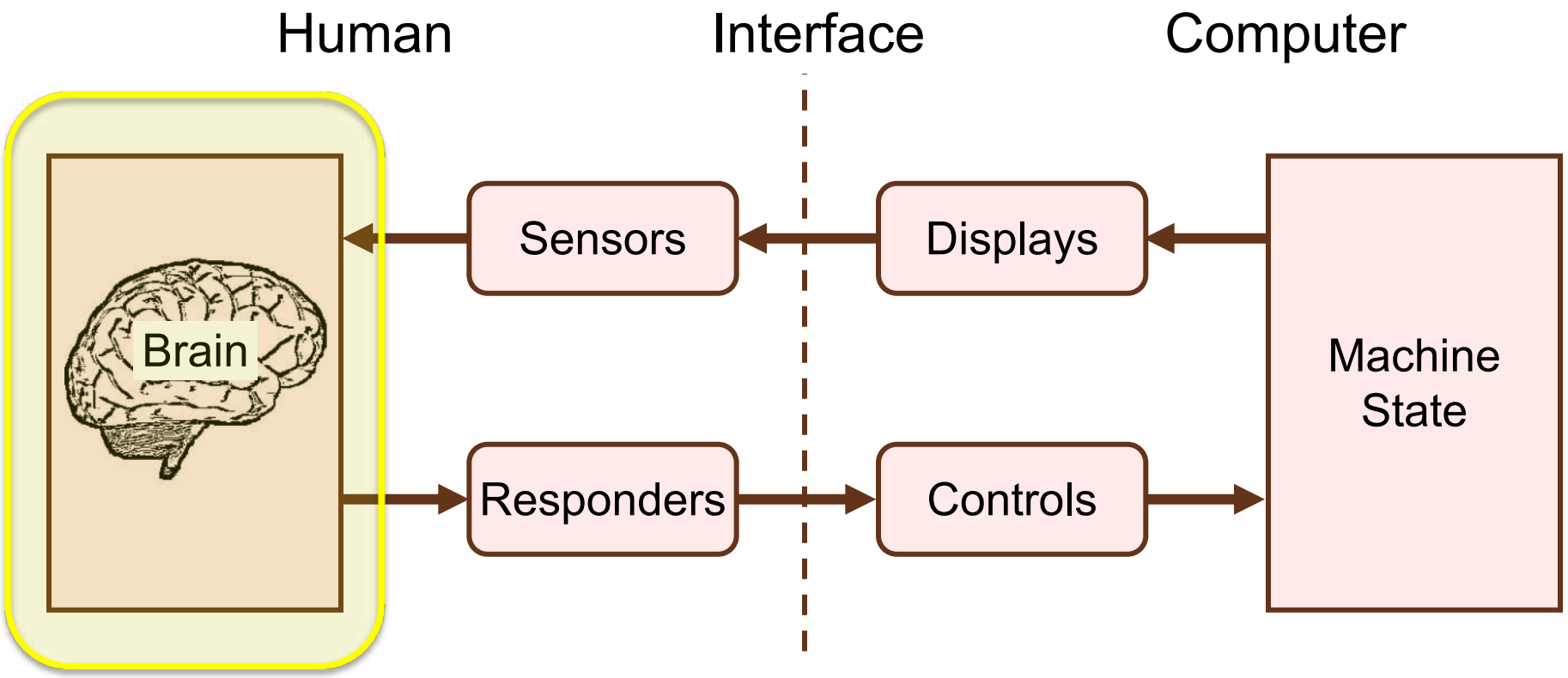


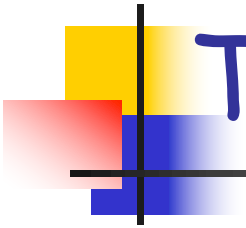
[1] Majaranta, P., MacKenzie, I. S., Aula, A., & Räihä, K.-J. (2006). Effects of feedback and dwell time on eye typing speed and accuracy. *Universal Access in the Information Society (UAIS), 5*, 199-208.

Human Factors Model



Human Factors Model





The Brain

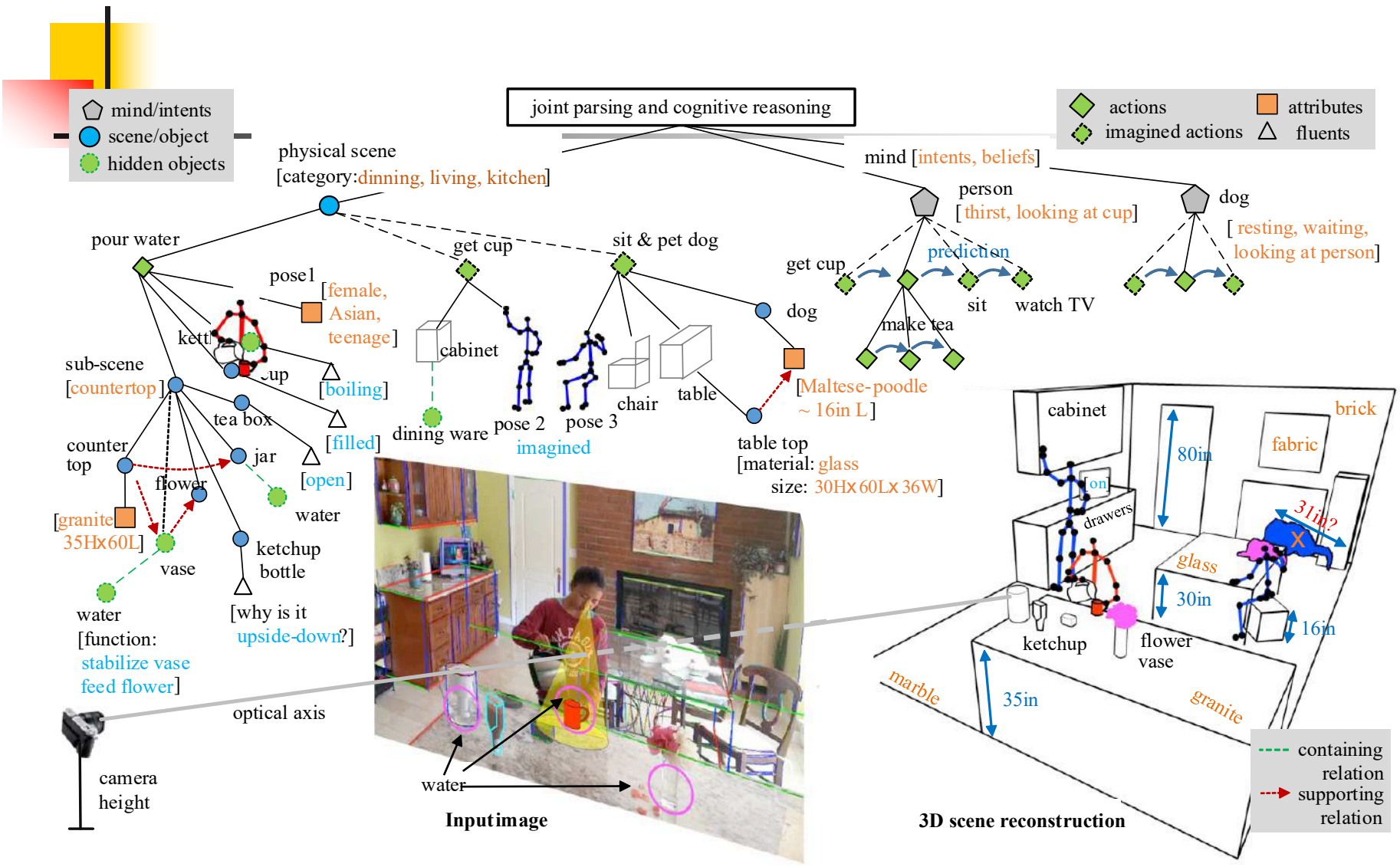
- Most complex biological structure known
- Billions of neurons
- Enables human capacity for…
  - Pondering, remembering, recalling, reasoning, deciding, communicating, etc.
- Sensors (human inputs) and responders (human outputs) are nicely mirrored, but it is the brain that connects them

Human Uniqueness

With associations and meaning attached to sensory input, humans are vastly superior to the machines they interact with:

> People excel at perception, at creativity, at the ability to go beyond the information given, making sense of otherwise chaotic events. We often have to interpret events far beyond the information available, and our ability to do this efficiently and effortlessly, usually without even being aware that we are doing so, greatly adds to our ability to function.[1]

[1] Norman, D. A. (1988). *The design of everyday things*. New York: Basic Books.

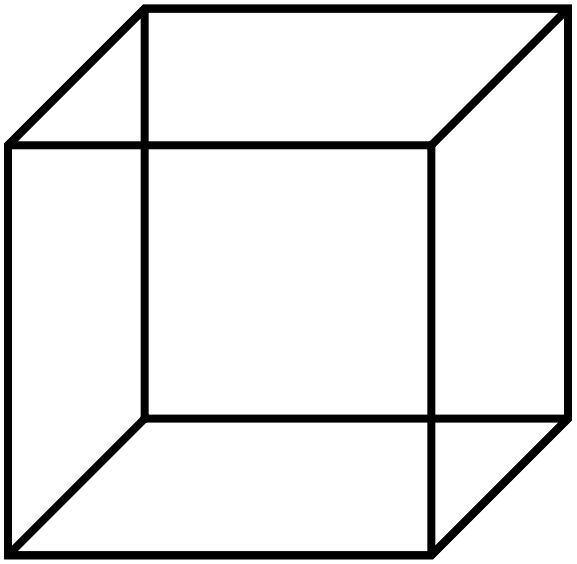

mind/intents
scene/object
hidden objects
joint parsing and cognitive reasoning
actions
imagined actions
attributes
fluents
physical scene
[category:dinning, living, kitchen]
mind [intents, beliefs]
person
[thirst, looking at cup]
dog
[resting, waiting, looking at person]
pour water
get cup
sit & pet dog
prediction
get cup
sit
watch TV
make tea
pose1
[female, Asian, teenage]
kettle
cup
[boiling]
sub-scene
[countertop]
tea box
[filled]
counter top
jar
[open]
flower
water
[granite 35Hx60L]
vase
ketchup bottle
water
[function: stabilize vase feed flower]
[why is it upside-down?]
optical axis
camera height
cabinet
dining ware
pose 2
pose 3
chair
table
dog
[Maltese-poodle ~ 16in L]
imagined
table top
[material: glass
size: 30Hx60Lx36W]
Input image
water
cabinet
brick
fabric
80in
on
drawers
31in?
X
glass
30in
16in
ketchup
flower vase
marble
35in
granite
3D scene reconstruction
containing relation
supporting relation

Perception

- 1st stage of processing for sensory input
- Associations formed…
  - Auditory stimulus → harmonious, discordant
  - Visual stimulus → familiar, strange
  - Tactile stimulus → warm, hot
  - Smell stimulus → pleasurable, abhorrent
  - Taste stimulus → sweet, sour

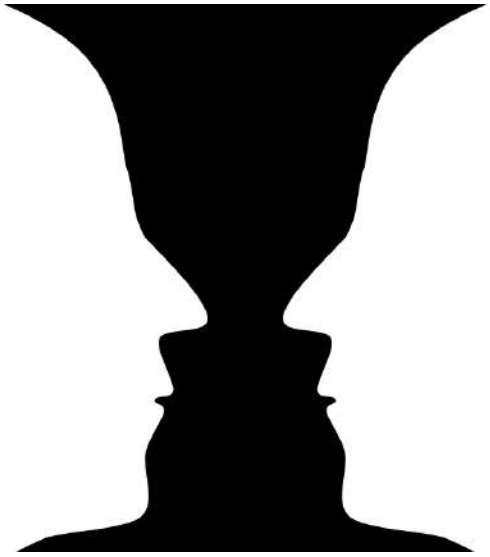
Ambiguity

Necker cube



Which surface is at the front?

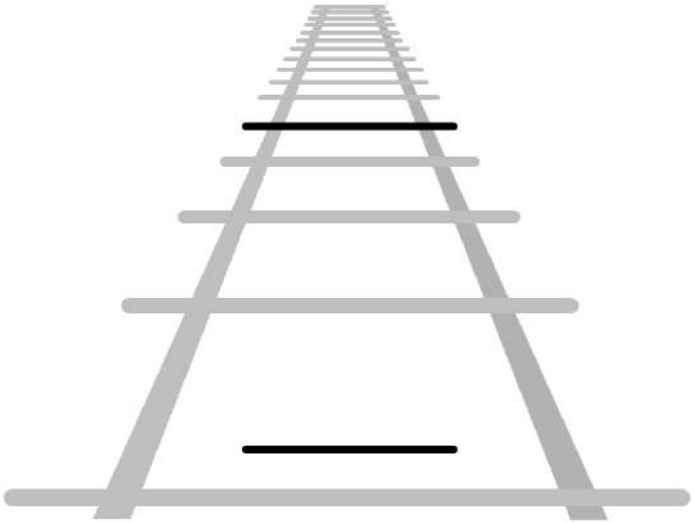
Rubin vase



Wine goblet or two faces?

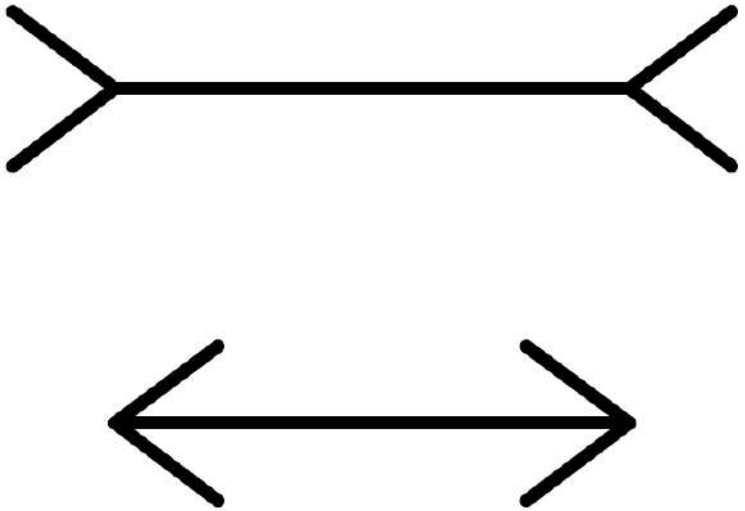
Illusion

Ponzo lines



Which black line is longer?

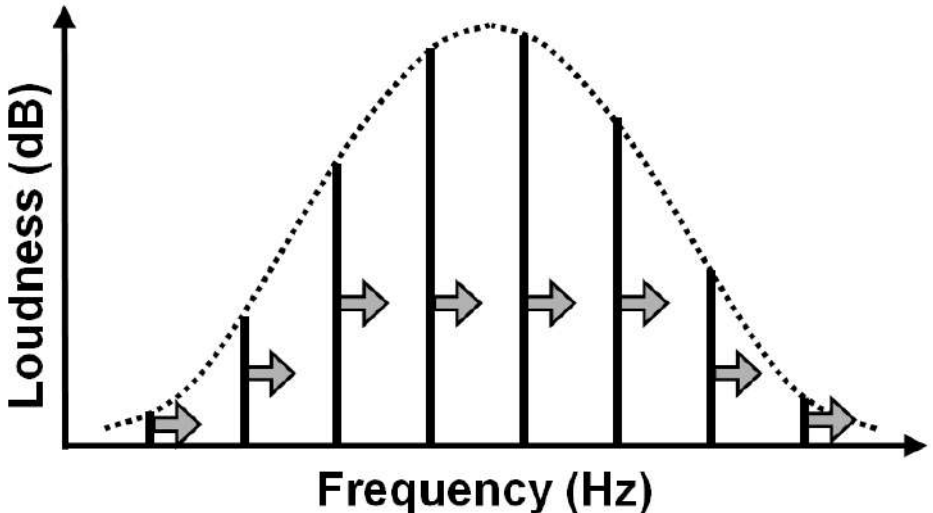
Műller-Lyer arrows



Which horizontal line is longer?

Illusion – Other Senses

- If illusion is possible for the visual sense, the same should be true for the other senses
- Tactile/haptic illusion: phantom limb
- Auditory illusion: Sheppard-Risset glissando



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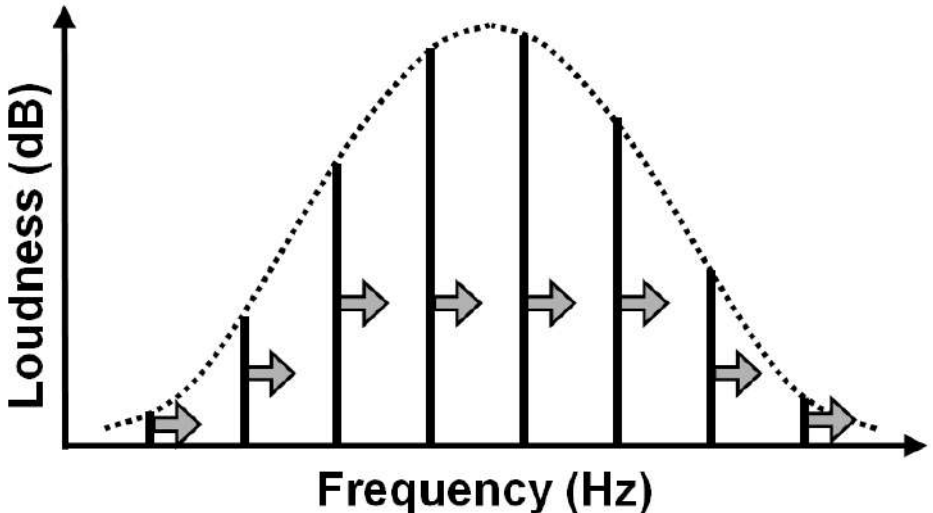


Psychophysics

- Branch of experimental psychology

  Studied since the 19th century
- Relationship between human perception and physical phenomena
- Experimental method:
  - Present subject with two stimuli, one after the other
  - Stimuli differ in a physical property (e.g., frequency)
  - Randomly vary the difference
  - Determine threshold below which the subject deems the two stimuli “the same”
  - This threshold is the *just noticeable different* (JND)

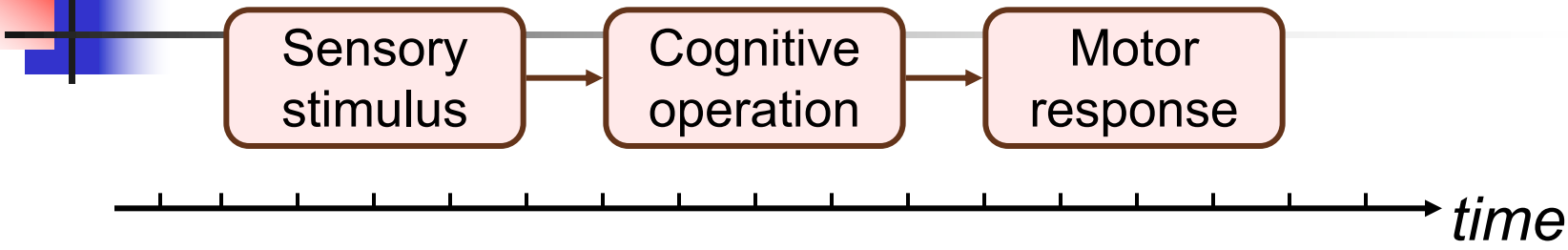
Cognition

- Cognition is the human process of conscious intellectual activity
  - E.g., thinking, reasoning, deciding
- Spans many fields
  - E.g., neurology, linguistics, anthropology
- Sensory phenomena → easy to study because they exist in the physical world
- Cognitive phenomena → hard to study because they exist within the human brain

"Making a Decision"

- Not possible to directly measure the time for a human to "make a decision"
- When does the measurement begin and end?
- Where is it measured?
- On what input is the human deciding?
- Through what output is the decision conveyed?
- There is a sensory stimulus and motor response that bracket the decision (next slide)

Making a Decision – in Parts



Operation	Typical time (ms)
Sensory reception	1 – 38
Neural transmission to brain	2 – 100
Cognitive processing	70 – 300
Neural transmission to muscle	10 – 20
Muscle latency and activation	30 –70
Total:	113 - 528

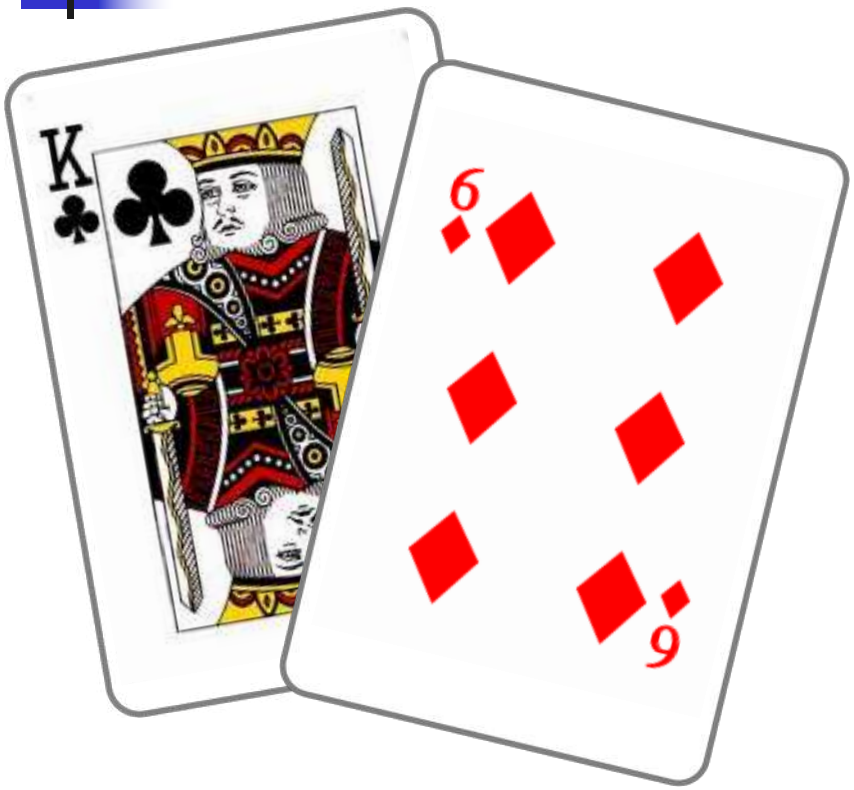
Large variation!

Examples of Simple Decisions

- Driving a car → decision to depress the brake pedal in response to a changing signal light
- Using a mobile phone → decision to press REJECT-CALL in response to an incoming call
- Reading news online → decision to click the CLOSE button on a popup ad

These are *reaction time* tasks

A More Involved Decision



Another card?
(dealer has 17)

Memory

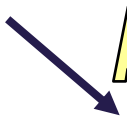
- Vast repository
- Long-term memory
  - Declarative/explicit area → information about events in time and objects in the external world
  - Implicit/procedural area → information about how to use objects and how to do things
- Short-term memory
  - Aka *working memory*
  - Information is active and readily available for access
  - Amount of working memory is small, about 7 (±2) units or chunks[1]

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

Memory

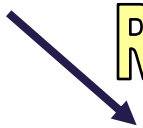
There are three types of memory function:

Sensory memories



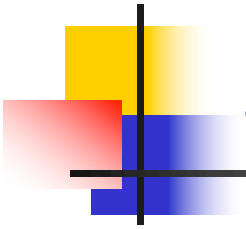
Attention

Short-term memory or working memory



Rehearsal

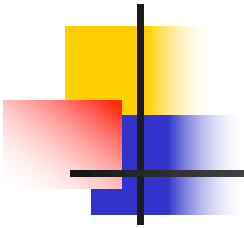
Long-term memory



Sensory memory

Buffers for stimuli received through senses

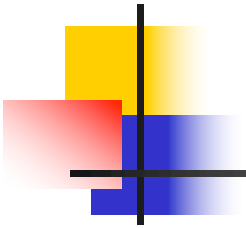
- iconic memory: visual stimuli
- echoic memory: aural stimuli
- haptic memory: tactile stimuli



Short-term memory (STM)

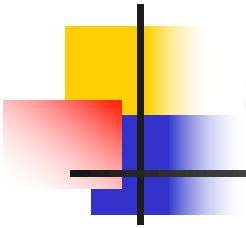
Scratch-pad for temporary recall

- rapid access ~ 70ms
- rapid decay ~ 200ms
- limited capacity - 7± 2 chunks

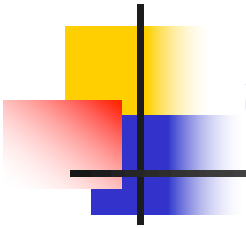


Miller's experiment and magic number 7

The Magic Number Seven, Plus or Minus Two: Some Limits on our Capacity for Processing Information. G. A. Miller, 1956



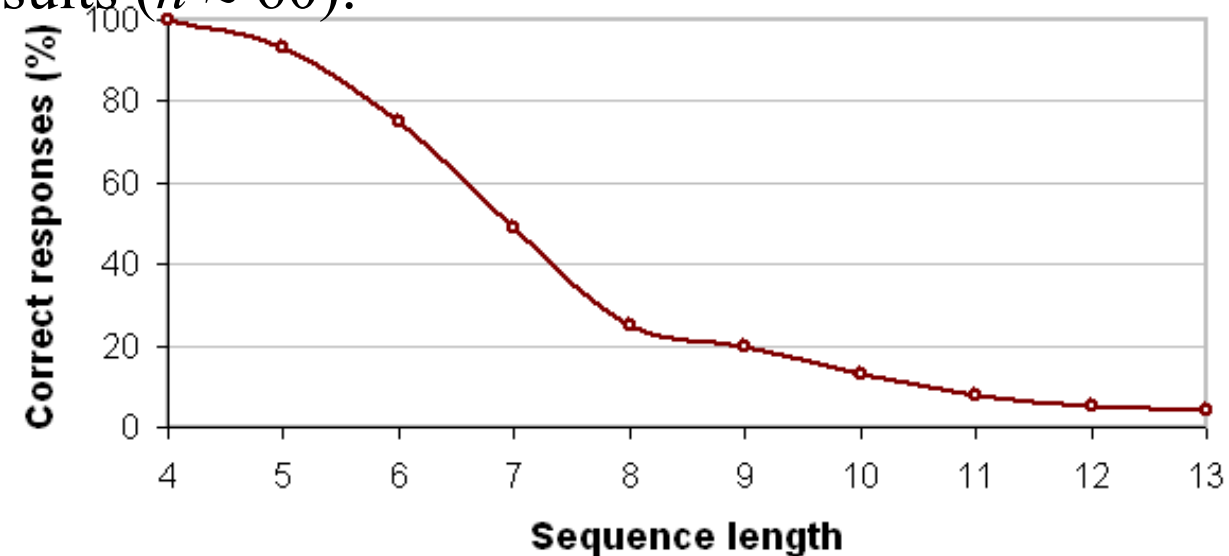
Examples



Examples

Short Term Memory Experiment

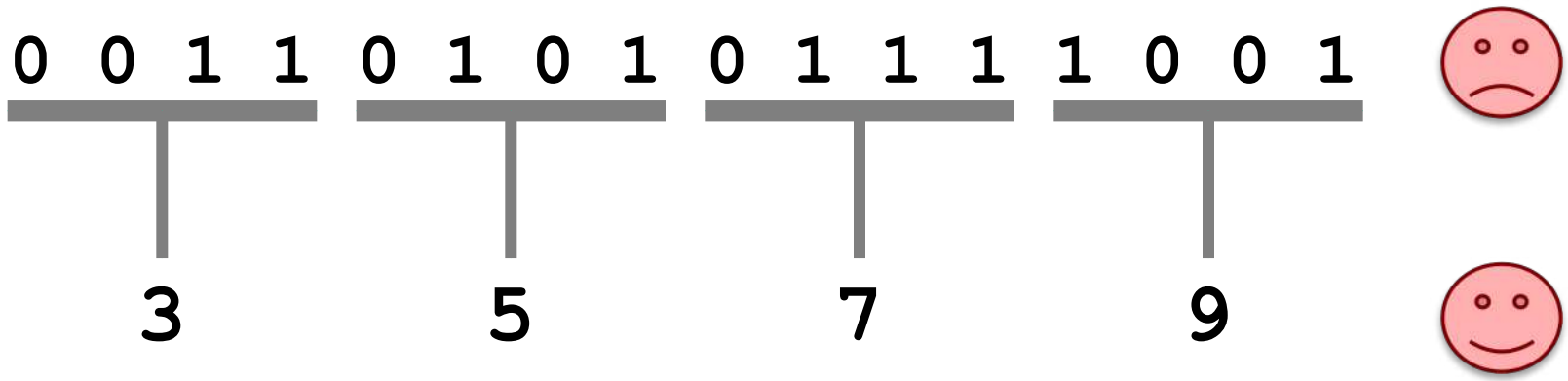
- Random sequences of digits recited to subjects
- Sequences vary from 4 to 13 digits
- After recitation, subjects copy sequence from memory to a sheet of paper
- Transcriptions on sheets scored (correct/incorrect)
- Results ($n \approx 60$):

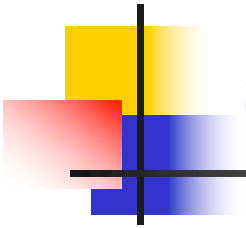


Chunking

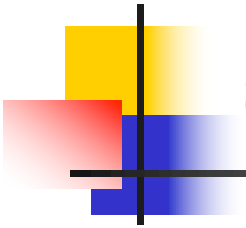
- Units in short term memory may be recoded as a chunk
- Expands capacity of short term memory

E.g., Commit to memory and recall…

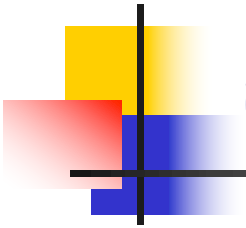




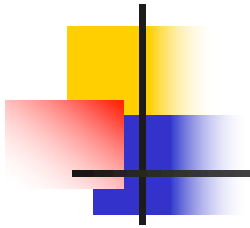
Examples



Examples



Examples



1-800-USA-RAIL

1-800-872-7245

Cashing in example

Long-term memory (LTM)

- Repository for all our knowledge
  - slow access ~ 1/10 second
  - slow decay, if any
  - huge or unlimited capacity
- Two types
  - episodic – serial memory of events
  - semantic – structured memory of facts, concepts, skills

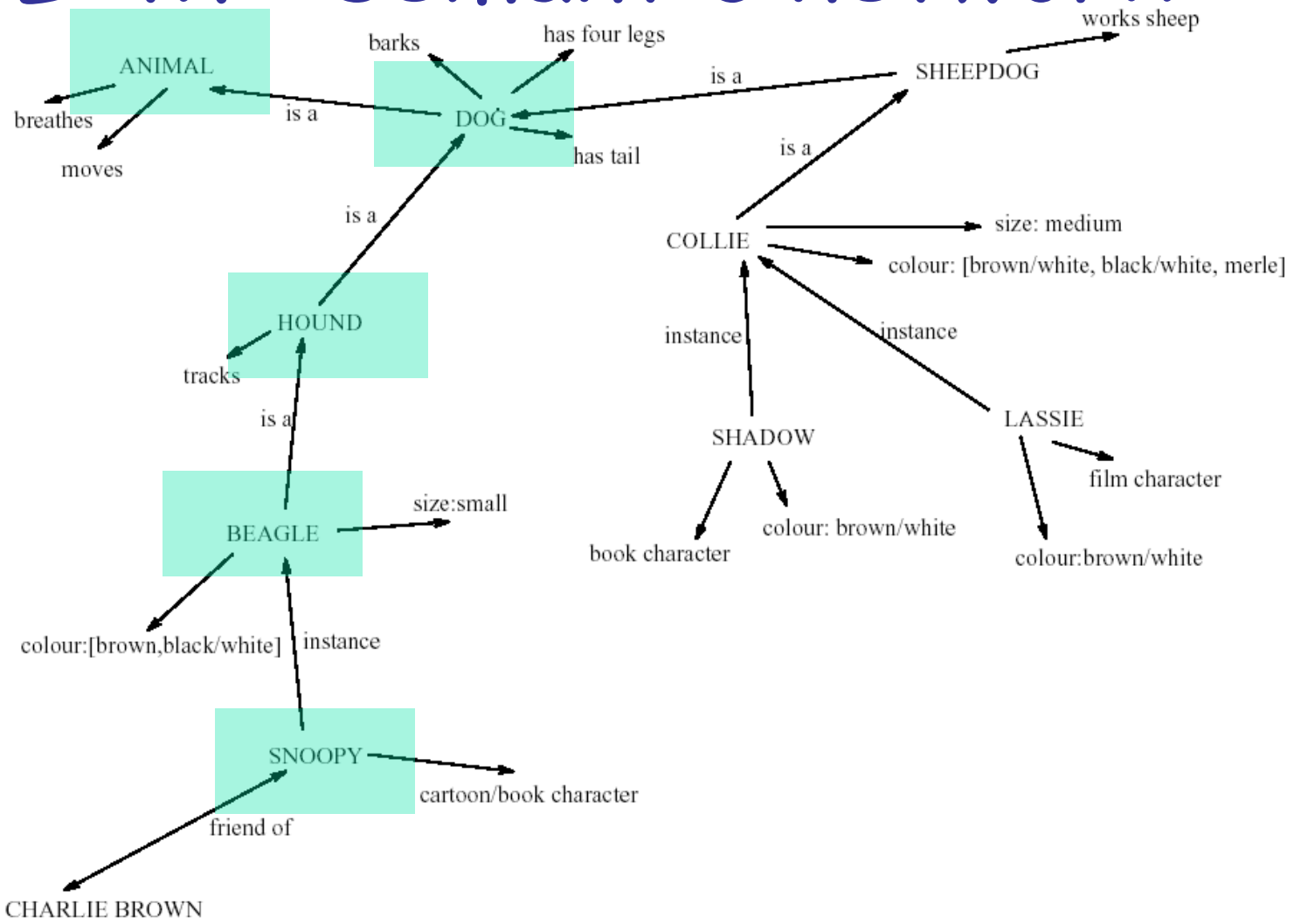
  semantic LTM derived from episodic LTM

Long-term memory (cont.)

- Semantic memory structure
  - provides access to information
  - represents relationships between bits of information
  - supports inference

- Model: semantic network
  - inheritance – child nodes inherit properties of parent nodes
  - relationships between bits of information explicit
  - supports inference through inheritance

LTM - semantic network



LTM - Storage of information

- Rehearsal

  information moves from STM to LTM

- Total time hypothesis

  amount retained proportional to rehearsal time

- Structure, meaning and familiarity

  information easier to remember

LTM - Forgetting

Decay

- information is lost gradually but very slowly

Interference

- new information replaces old: retroactive interference
- old may interfere with new: proactive inhibition

so may not forget at all memory is selective …

… affected by emotion – can subconsciously `choose' to forget

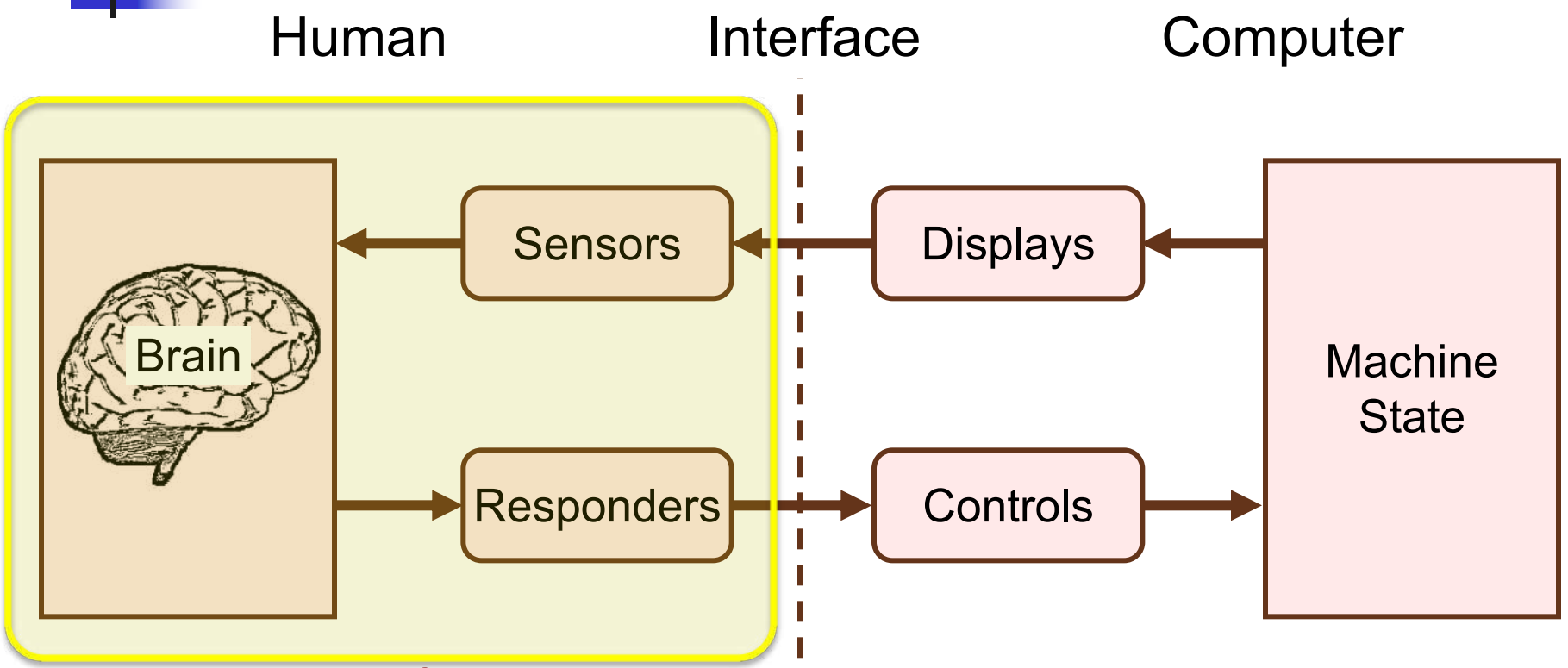
Memorable or secure?

As online activities become more widespread, people are having to remember more and more access information, such as passwords and security checks. The average active internet user may have separate passwords and user names for several email accounts, mailing lists, e-shopping sites, e-banking, online auctions and more! Remembering these passwords is not easy.

From a security perspective it is important that passwords are random. Words and names are very easy to crack, hence the recommendation that passwords are frequently changed and constructed from random strings of letters and numbers. But in reality these are the hardest things for people to commit to memory. Hence many people will use the same password for all their online activities (rarely if ever changing it) and will choose a word or a name that is easy for them to remember, in spite of the obviously increased security risks. Security here is in conflict with memorability!

A solution to this is to construct a nonsense password out of letters or numbers that will have meaning to you but will not make up a word in a dictionary (e.g. initials of names, numbers from significant dates or postcodes, and so on). Then what is remembered is the meaningful rule for constructing the password, and not a meaningless string of alphanumeric characters.

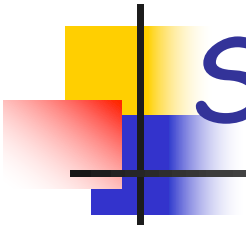
Human Factors Model



Human Performance
Skilled Behaviour
Attention
Human Error

Human Performance

- Humans uses their sensors, brain, and responders to do things
- When the three work together to achieve a *goal*, human performance arises
- Examples:
  - Tying shoelaces
  - Folding clothes
  - Searching the web
  - Entering a text message on a mobile phone



Speed-accuracy Trade-off

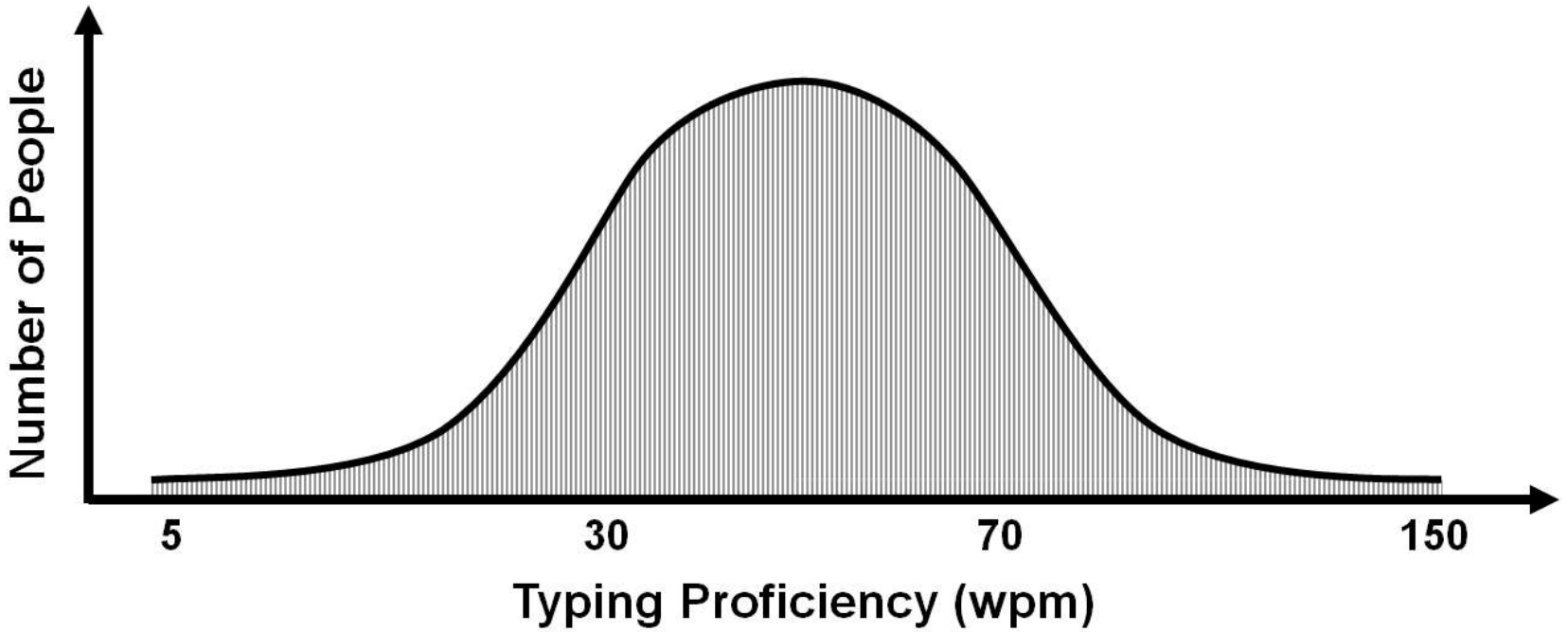
Fundamental property of human performance

- Go faster and errors increase
- Slow down and accuracy improves
- HCI research on a new interface or interaction technique must consider both the speed in doing tasks (achieving the goal!) and the accompanying accuracy

Human Diversity

- Human performance is highly complex:
  - Humans differ (age, gender, skill, motivation, etc.)
  - Environmental conditions affect performance
- Human diversity and human performance often shown in a distribution (next slide)

Human Diversity and Performance



Where are you on this chart?
Where is your mother?
Where is an 8-year old, just learning to use a computer?
Where is someone with a physical disability?
Where are you while using your mobile phone on a crowded bus (standing!)?

Reaction Time

One of the most primitive manifestations of human performance is *simple reaction time*

- Definition: The delay between the occurrence of a single fixed stimulus and the initiation of a response assigned to it[1]
- Example: pressing a button in response to the onset of a stimulus light

[1] Fitts, P. M., & Posner, M. I. (1968). *Human performance*. Belmont, CA. Brooks/Cole Publishing Company.

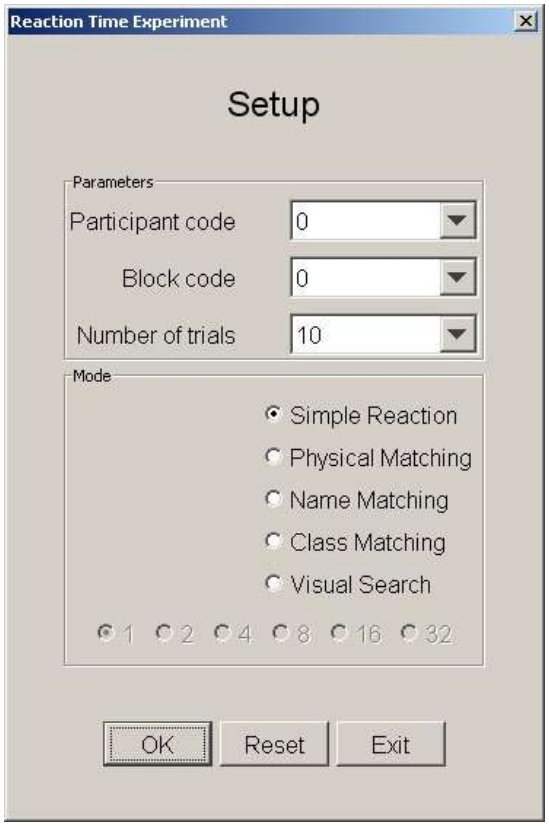
Sensory Stimuli and Reaction Time

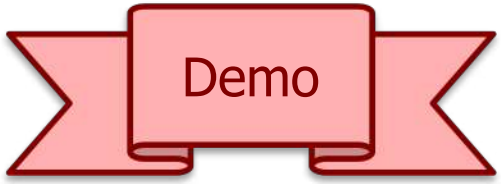
Delay time varies by type of sensory stimuli

- Approximate values[1]
  - Auditory → 150 ms
  - Visual → 200 ms
  - Smell → 300 ms
  - Pain → 700 ms

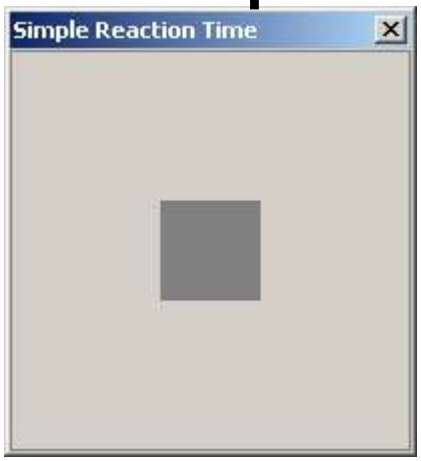
[1] Bailey, R. W. (1996). *Human performance engineering: Designing high quality, professional user interfaces for computer products, applications, and systems* (3rd ed.). Upper Saddle River, NJ: Prentice Hall.

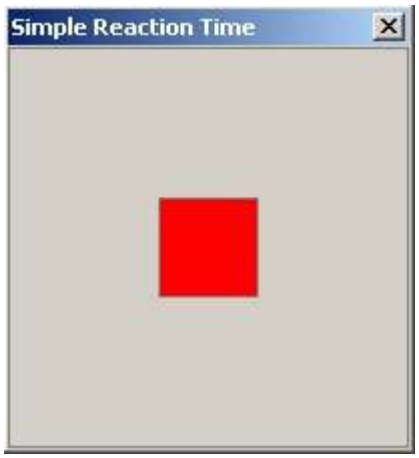
Reaction Time Experiment





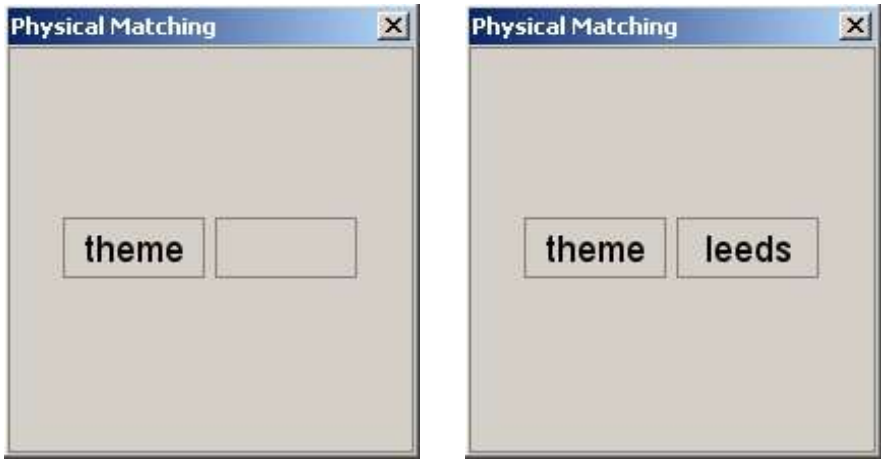
Simple Reaction Time

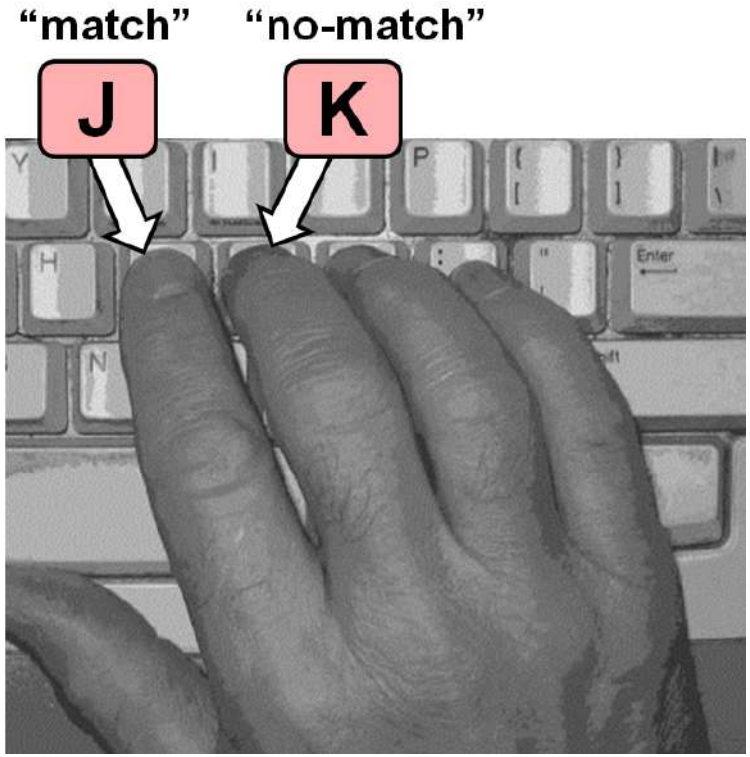




Reaction Time Experiment (2)

Physical Matching

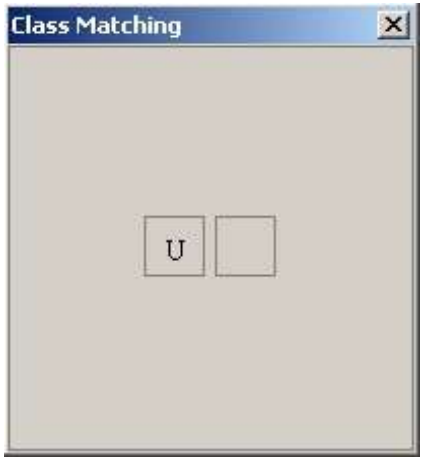


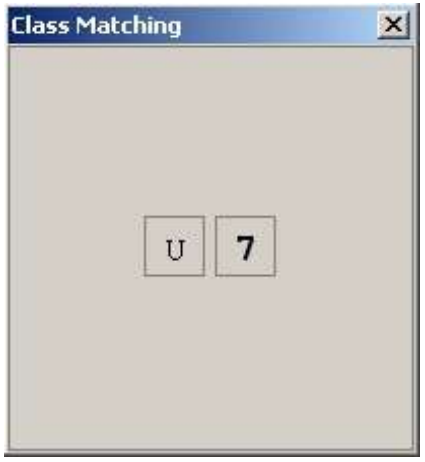


Reaction Time Experiment (3)

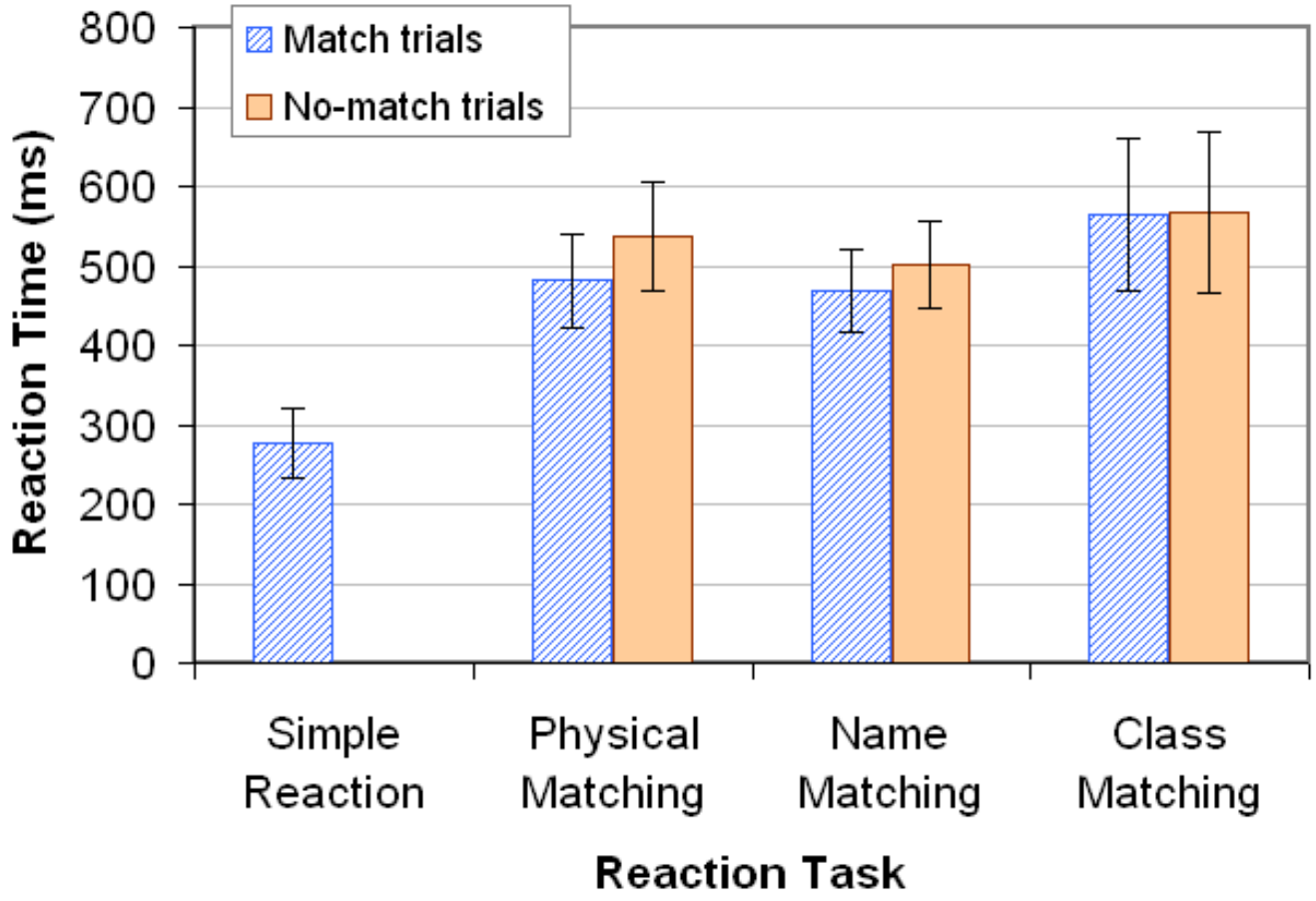
Name Matching

Class Matching



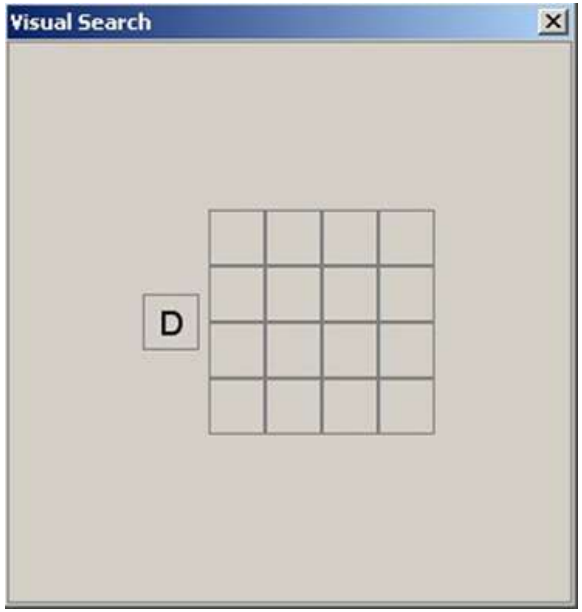


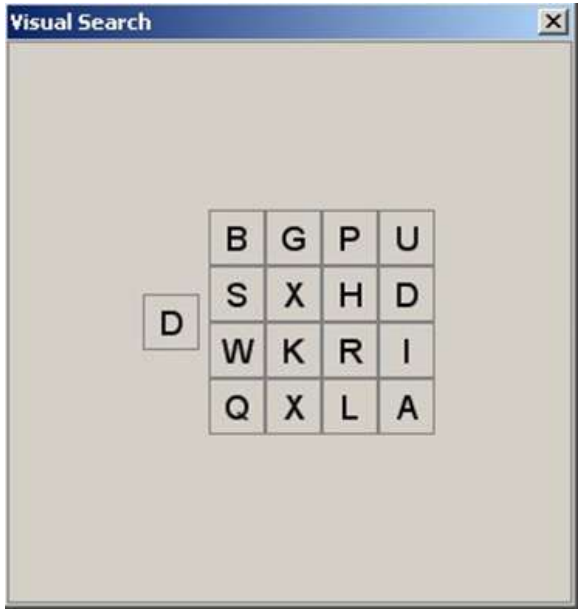
Experiment Results



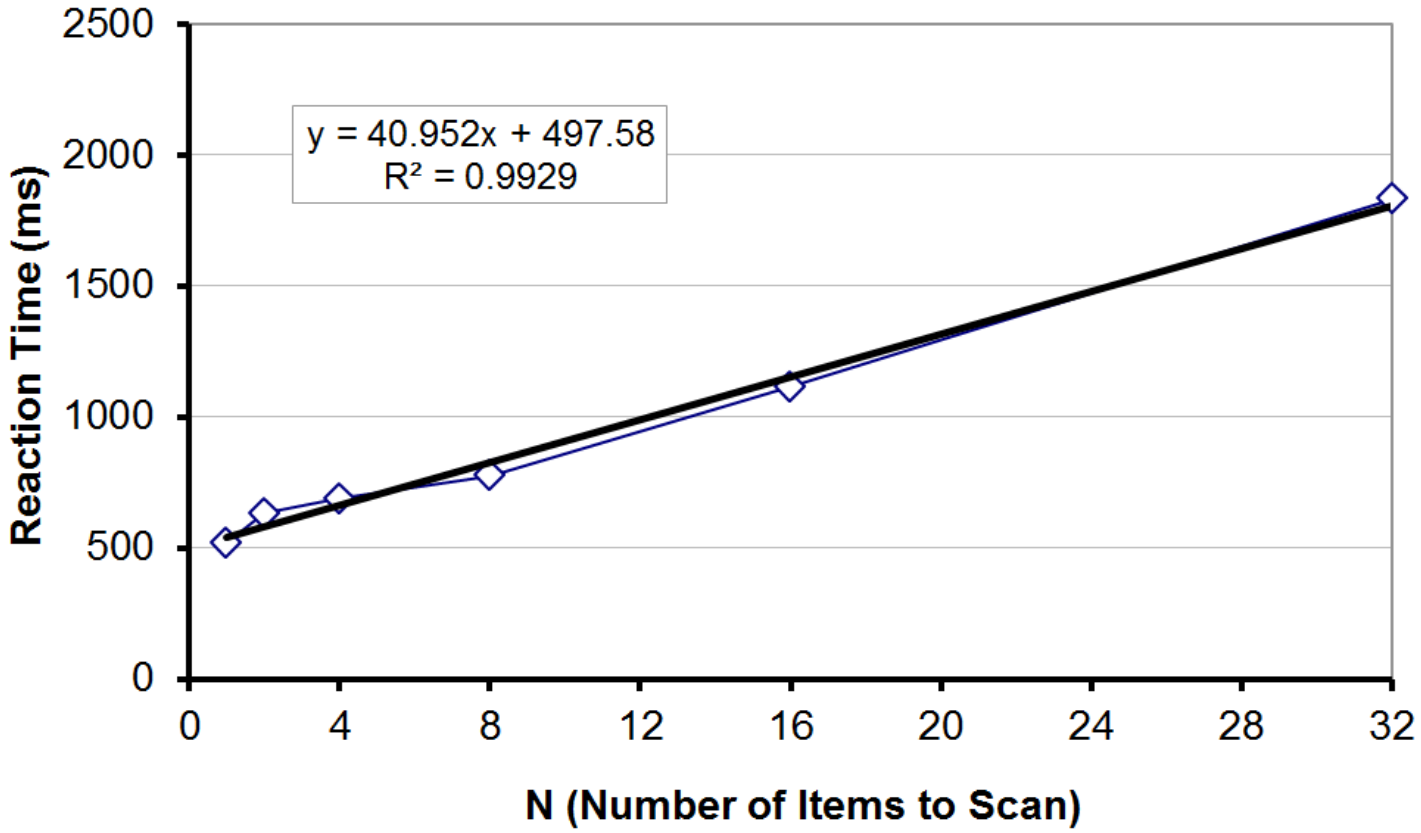
Visual Search

- A variation on simple reaction time
- User scans a collection of items looking for desired item
- Time increases with the number of items to scan
- Included in the demo software with $N = 1, 2, 4, 8, 16$, or 32 items

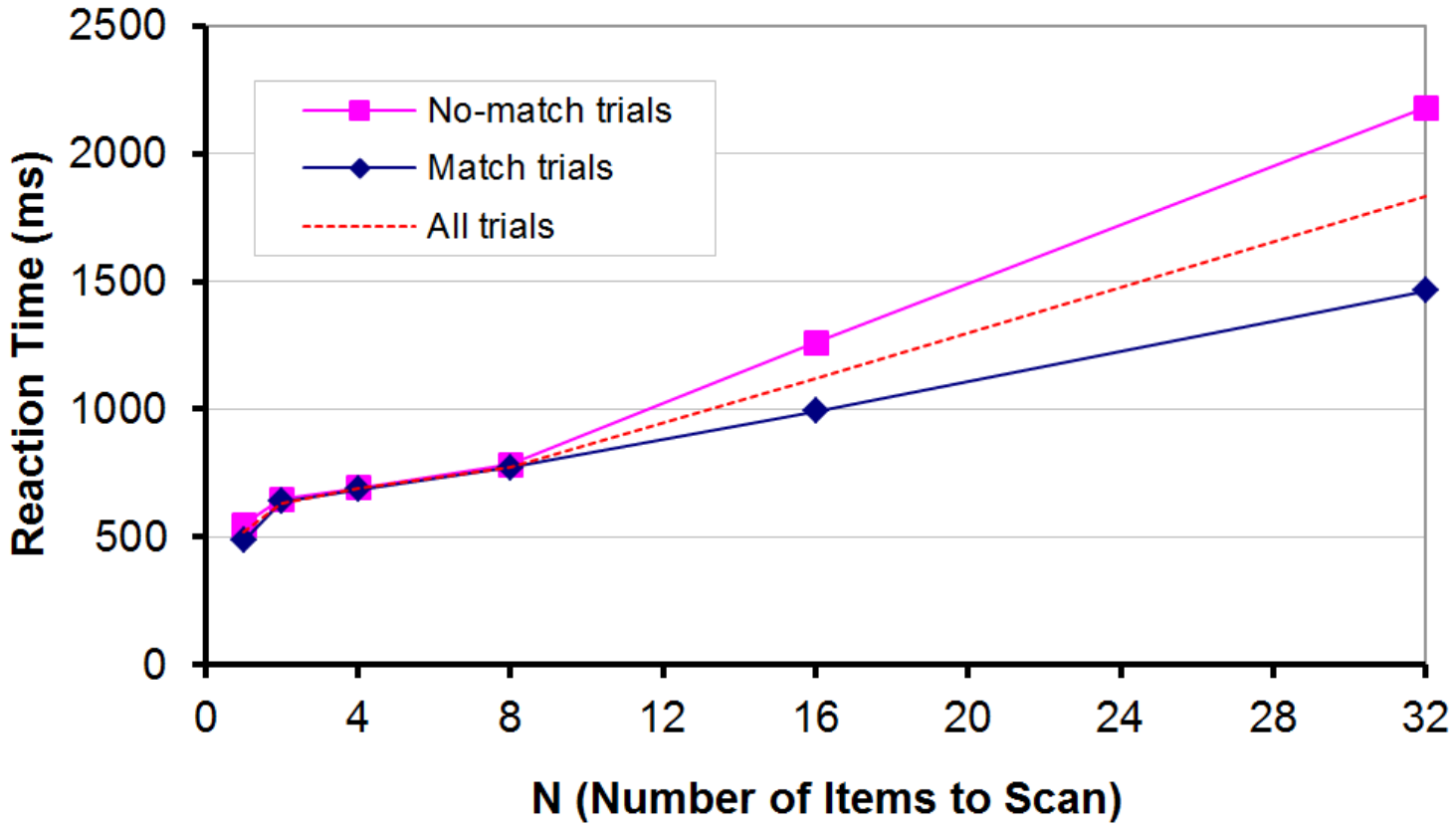




Experiment Results (1)



Experiment Results (2)



Skilled Behaviour

- For many tasks, human performance improves considerably and continuously with practice

(Note: Very little improvement with practice in the simple reaction time tasks)

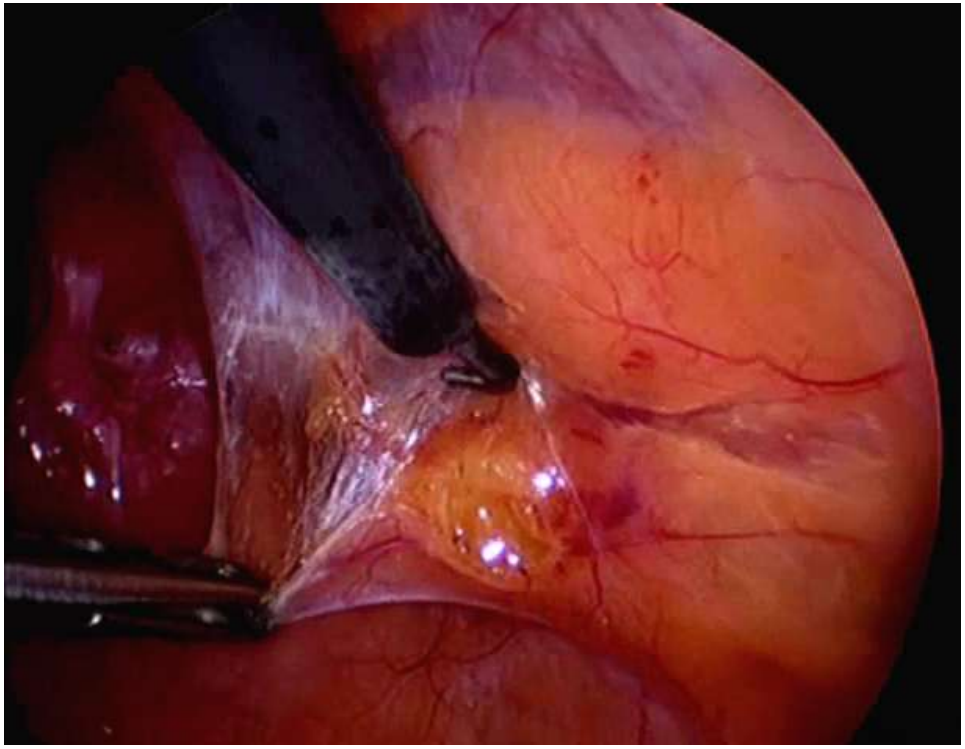
- In these tasks, there is interest in studying the progression of learning and the performance achieved according to the amount of practice
- Categories of skilled behavior:

  Sensory-motor skill (e.g., darts, gaming)

  Mental skill (e.g., chess, programming)

  Some tasks required a lot of both (next slide)

Laparoscopic Surgery[1]



[1] Photos courtesy of The Centre of Excellence for Simulation Education and Innovation at Vancouver General Hospital.

Attention

Texting while driving!

- Attention is complex:

  Which tasks require attention?

  - Can't talk and type

  Which tasks do not require attention?

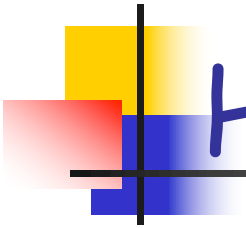
  - Can talk and walk

  What are the human limits?

Attention

Two categories of attention

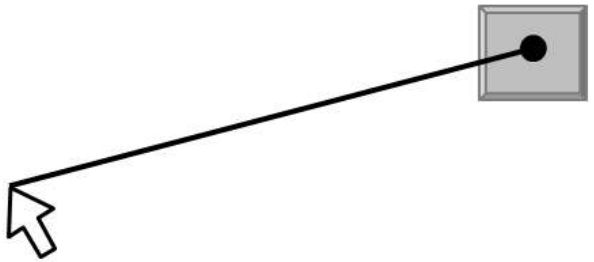
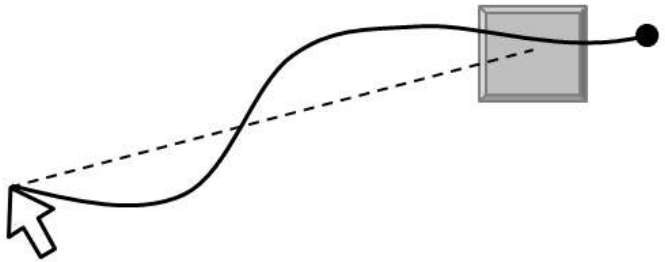
- Divided attention (attending to more than one task)
- Selected attention (attending to one task to the exclusion of others)



Human Error

- Human error can be studied from many levels
- Simple view: An error is a discrete event where the outcome deviated from the desired outcome
- But, tasks that are performed in error are often at least partly correct (next slide)

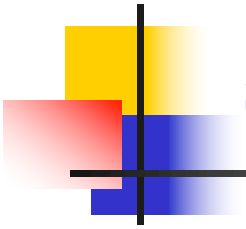
Variability and Error

	Target Selection	Text Entry
Correct		quickly
Incorrect		qucehkly

What went wrong and why?

Emotion

- Various theories of how emotion works
  - James-Lange: emotion is our interpretation of a physiological response to a stimuli
  - Cannon: emotion is a psychological response to a stimuli
  - Schacter-Singer: emotion is the result of our evaluation of our physiological responses, in the light of the whole situation we are in
- Emotion clearly involves both cognitive and physical responses to stimuli

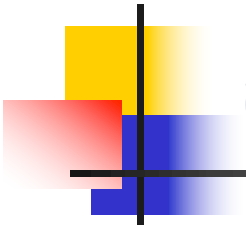


Emotion (cont.)

- The biological response to physical stimuli is called *affect*
- Affect influences how we respond to situations
  - positive → creative problem solving
  - negative → narrow thinking

"Negative affect can make it harder to do even easy tasks; positive affect can make it easier to do difficult tasks"

(Donald Norman)



Emotion (cont.)

- Implications for interface design
  - stress will increase the difficulty of problem solving
  - relaxed users will be more forgiving of shortcomings in design
  - aesthetically pleasing and rewarding interfaces will increase positive affect

Thanks!

A Game