

CPSC 532E — Week 10: Seminar
Visuomotor control; Visual awareness

- Visual-manual control
- Two visual systems
- Unconscious visual perception

1. Visual-manual control

Many tasks in life require control of the hand by the eye:

- writing (by pen or pencil)
- pointing
- holding a coffee cup

Many aspects of interface operation require such control:

- typing
- control of mouse
- laser pointer

Choice reaction time

If prepared, can react to an event within c. 130 ms
- if unprepared, can take as long as c. 700 ms
(delay due to setting up appropriate circuits)

If there are two choices, takes c. 300 ms to initiate move

In general, for n choices, takes $(Hick-Hyman\ law)$
 $a + b \log(n)$ ms

(a, b are constants that depend on stimuli)

Choice selection time (via mouse, etc.)

To select a target of width W , a distance D away, takes

$a + b \log(D/W + 1)$ ms $(Fitt's\ law)$

(a, b are constants that depend on stimuli, device)

The result of iterative control of hand by eye while
hand is underway...

Control compatibility

Visual-manual control is the result of experience

Design systems to take advantage of this. Eg.

- mouse movement direction should be maintained
 - new associations can't be easily learned
- ratio of movement size does not need to be maintained
 - can be rapidly learned

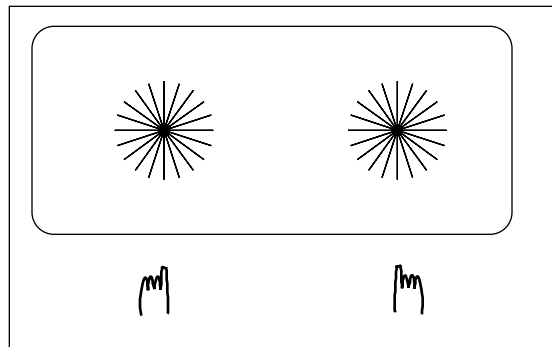
In general,

- changes in direction (e.g., orientation) are difficult to learn
- changes in magnitude are relatively easy

Simon effect

If there are two response buttons, one for each hand,
response times are shorter if

the side of the display the appropriate stimulus is on
that matches the side of the responding hand



2. Two Visual Systems

Goodale and Milner (1990s):

- visuomotor control (visual-manual, visuo-ocular, etc) involving skilled activities relies on a different visual system than the one underlying conscious perception

Two systems:

1. Ventral ("what") system

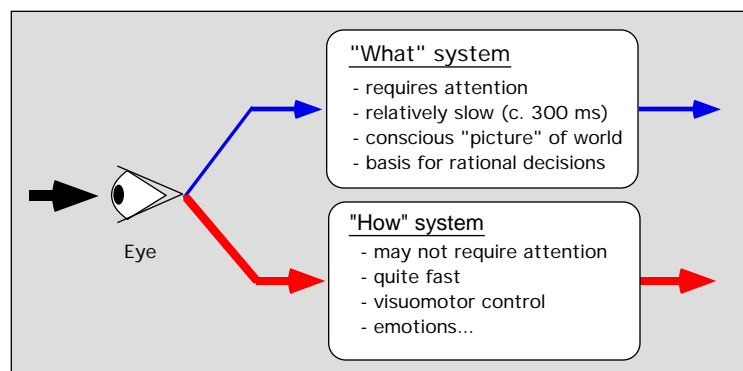
- slower; supports conscious perception
- initiation of actions

2. Dorsal ("how") system

- faster; unconscious
- control of actions

Hypothesis:

These systems are almost completely separate, with the separation extending from the eyes on...



Evidence:

Patient (DF) with *object agnosia*

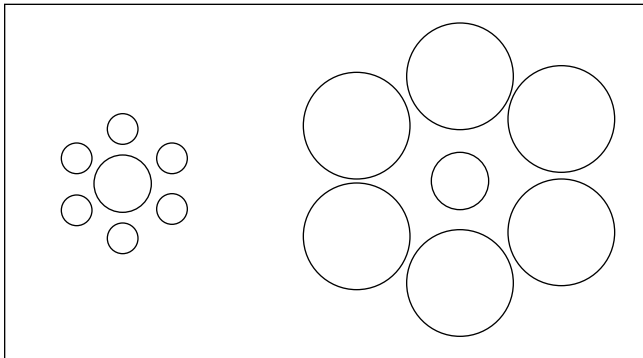
- could not see size or shape of object (including its orientation)
- could place a letter into a mail slot regardless of orientation
- “what” system was affected, while “how” was not

Patients with *optic ataxia* - can see objects, but can't reach for them accurately

- “how” system was affected, while “what” was not

Evidence (normal observers):

Ebbinghaus illusion



“what” system (size reported via verbal response)
- is susceptible to Ebbinghaus illusion

“how” system (size measured via grasp)
- is not susceptible

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Evidence (normal observers):

Changes made in position of item during saccade

Changes are not noticed by conscious perception
(change blindness)

Visuo-ocular system follows position of item, even
when position is changed during saccade

Visuo-manual system (pointing) follows position of item,
even when position is changed during saccade

“How” system can be aware of events that are not perceived
by the “what” system

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Characteristics

“What” system

- concerned with identification, learning,
social communication
- memory for several seconds
- object-centered

“How” system

- concerned with immediate action upon an object
- memory 2 seconds
- viewer-centered

Visual attention may be associated with both of these
- may be the linking mechanism?

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Implications for Visual Displays

- When designing tests, be aware of which system is being tested
 - e.g. simulators - might be best tested via responses of “how” system
- Potential to design mouse controls (or trackballs, etc) that interact optimally with “how” system
 - may lead to improved practiced performance
 - based on “closed-loop” control
- Pantomime is not a good way to study “how” system
 - controlled by “what” system

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3. Unconscious Visual Perception

Sidis (1898)

- forced-choice guessing of blurred items far greater than chance

Marcel (1983)

- effects of briefly-presented stimuli on subsequent performance -> priming

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Priming

- facilitation of ability to recognize words, etc. based on prior exposure
- e.g. presentation so brief, subject doesn't consciously see it

clown

Existence of priming shown by

- look at effect of memory on other tasks
- example:
 - show observer first part of a word
 - ask them to complete it

clo__

Look at frequency of chosen words

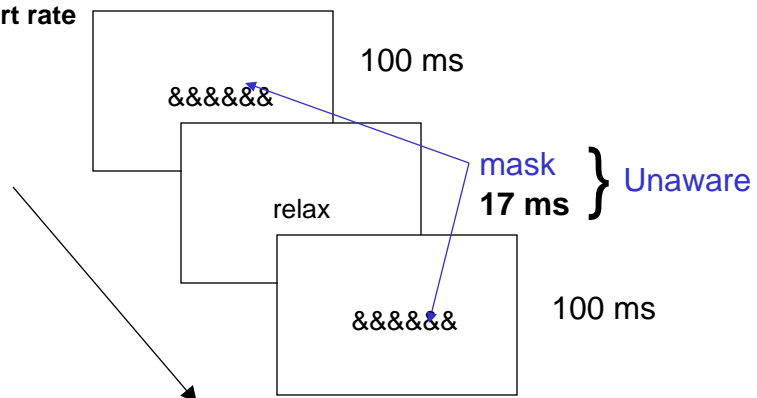
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Priming —primed word chosen
far more often than chance

(Sometimes called subliminal perception)

Emotions (Dijksterhuis, 2001)

Record blood pressure
& heart rate



Record blood pressure
& heart rate

Results

- Decrease in blood pressure and heart rate following words like “relax”
- Increase in blood pressure and heart rate following words like “angry”

Both effects occurred even though


Somehow, words can create an emotional state, even though they are not seen
- some form of unconscious perception without attention

-> visual displays for the modulation of emotional state?

Inattention blindness (IB)

Don't see unexpected objects

but, a few things do get through:

- picture of a smiley face 
(not a sad one, though)
- some emotional words (e.g. "Nazi")
- name of the observer (e.g., "Sara", "George")
 - not when one letter is changed
(e.g., "Sura", "Geosge")

Somehow, names (and some faces) can
draw attention to themselves

- some form of unconscious perception
without attention

-> visual displays for the direction
of attention?