

Attention

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Attention

What happens when we pay attention to something?

Attention often moves with the eyes, but doesn't have to. You can pay attention to things you aren't fixating, for instance.

Attention seems to improve the processing of whatever is attended.

Perhaps a way to focus resources on whatever seems important.

How can we measure and study this?

Example: Attentional Cues (Posner)

- Focus visual attention to an area by using a cue
 - “Spotlight” or “zoom lens”
- measure time to identify target item when:
 - observer does not know where item will appear
 - observer does know where item will appear
- cue is a briefly presented dot at the location of target

- no cuing: what letter appears?

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- with cuing: what letter appears?

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Results: Cue versus No Cue

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Advance knowledge of location improves performance

Results: Relative position of Cue

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Amount of reduction depends on distance from cue
-attention is like a spotlight or a zoom lens

Cue triggers “formation of a spotlight”

- whatever is in spotlight is attended
- more it is attended, the better it is processed
- size, shape of spotlight can be controlled

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Different types of cues

- a) exogenous (*outside generating*)
 - low-level “reflexes”
 - sudden changes (e.g., flash or movement)
 - draws attention automatically
- b) endogenous (*inside generating*)
 - high-level control
 - instruction (via some kind of visual sign or pattern)
 - sends attention to requested location

Exogenous Cuing

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Exogenous Cuing

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Exogenous Cuing

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Exogenous Cuing

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Endogenous Cuing

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Observer need to interpret the cue

Endogenous Cuing

(Image removed due to copyright restrictions.)

Observer need to interpret the cue

Effect of Cues

- Both types of cues control an attentional mechanism (spotlight) but reflect different strategies
- a) exogenous (*low-level control*)
 - bottom-up control of attention
 - based on what's actually happening in environment
- b) endogenous (*high-level control*)
 - top-down control of attention
 - based on what observer believes

But is attention really a spotlight?

Attentive tracking How many can you track at once?

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But is attention really a spotlight?

- People can attend to multiple locations at once
- Perhaps there are multiple spotlights?
- In many contexts, though, the spotlight metaphor works well.

Example: Visual Search

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Example: Visual Search

- Result: for some targets, search always fast
- target "pops out" of display

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Example: Visual Search

- Explanation:
 - for some properties, a unique value will draw attention (exogenous cue)
 - e.g., where's the blue dot?
 - e.g., a single large item among small ones
 - e.g., a single curved item among straight one

Search slope = 0
("pop-out")

Example: Visual Search

-However, this is not always the case

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Example: Visual Search

-Result: for some targets, search is slow

- effort needed

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Example: Visual Search

Explanation:

- need to combine properties to detect target

-combination is not automatic

-spotlight of attention is needed to "weld"
properties together

-search is a serial process - time needed
depends on number of items

-spotlight travels at about 50 ms/item

Feature Integration Theory

-Anne Triesman

There are maps of different features in the brain.

Attention is the glue that binds different features
together.

What happens when attention is not available to
do the gluing?

Illusory Conjunctions

- Displayed for less than 200msec followed by a pattern mask
- Subjects reported the digits and then details of the letters

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Illusory Conjunctions

- S's good at reporting digits
- S's made errors reporting letters and colours
 - more of the errors were 'conjunction' errors
- conjunction error - S's says they saw a red letter T and a blue X
- Was taken as support for FIT

- These days many people don't believe in FIT
- Pop-out occurs for things that probably aren't represented in maps, e.g. 3D shape
- Illusory conjunctions still demand an explanation, though.
- Attention seems to change the way that collections of features are represented.

Attention also improves spatial resolution
(Yeshurun and Carrasco)

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Unlike most tasks, texture segregation is not easiest at the fovea, but rather peaks at moderate eccentricities.

Remember how receptive field sizes increase with eccentricity... so there will be an eccentricity at which the receptive fields (filters) are the optimal size for the texture.

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Unlike most tasks, texture segregation is not easiest at the fovea, but rather peaks at moderate eccentricities.

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Three different viewing distances:

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When target location is cued, performance peaks at a greater eccentricity, and performance at the fovea is impaired.

Explanation:

Attention acts to shrink receptive fields, improving spatial resolution.

In this texture segregation task, this can lead to performance decrements when the filters are already too small for the texture (namely, at the fovea).

Attention also alters perception of time

-car crashes

Time expansion demo

-when your attention is drawn to something it seems to last longer

-open questions:

- can you do more work with this extra mental time?
- is time supramodal?

Change Blindness

■ We are surprisingly poor at noticing certain large-scale events going on around us

■ Magicians have known about that for ages (sleight of hand)

First experiments were done using saccades

But much simpler demonstrations have since been developed

Some change blindness demos...

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But here you can see the change...

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Also works in real life situations:

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Explanation of Change Blindness

- Attention is needed to see change
 - without it, observers are “change blind”
- The impression we have of rich sensory representations is illusory
 - Actual sensory representations are sparse
 - Little is retained over time

Notes on Change Blindness

1. In everyday life, we usually see change

-if something changes, creates a motion signal
-motion is an exogenous cue; draws attention

-if something interferes with drawing of attention
(flicker, occlusion) then attention doesn't go to change
-> won't see it

-attentional distraction is a major cause of
traffic accidents (e.g., cell phone usage)

Notes on Change Blindness

2. There is no accumulation of built-up representation

-if observer looks at picture for several seconds
before flicker sequence begins -> no effect

-representation built up by attention (token) stays
built up only as long as attention stays on it

-token “dissolves” after attention withdrawn

-token “remapped” after flicker/blind/saccade

Attention acts like a hand:

-token exists as long as pieces of input are “held”

Notes on Change Blindness

3. If we only see a few things at a time, why do we have the impression of seeing lots?
- whenever we need to see something, we look at it; no need for rich representations
 - “just in time” vision
 - this works because the world is fairly stable
 - world acts as “outside memory”
 - example: refrigerator light
 - only on when needed -> looks like it's always on

Selective Listening (Cherry and many others)

- Stimulus: two audio streams: one input per ear
Task: repeat (“shadow”) what is being said

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The two audio streams are independent of each other (streams don't interact)

- Select one of the streams (left or right)
repeat (“shadow”) what is being said

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after the listener has finished shadowing,
test what they remember from other stream...

- Result
 - Listeners acquire almost nothing from unattended stream
- If we don't attend to something, we won't hear it
- Instead of a complete, detailed world, we only hear a small part of it
 - yes dear, of course dear, you're so right dear

- Does anything get through from unattended channel?
 - large change in volume
 - change in gender of speaker
 - **not** a change in language
- Again, some things “draw attention” to themselves
 - processed “without attention”

Attention and Eye Movements

Important differences between attention and eye movements:
You can attend to different spatial scales
You can attend to more than one thing at once
You can attend to things in other modalities, probably via some central mechanism

These differences imply that the brain mechanisms of attention must in part be distinct from those for eye movements.

However, it is likely that attentional mechanisms overlap with those for eye movements (e.g. frontal eye fields).

Attention in the Brain

- The parietal lobe seems to be important
 - It is active when people move their attention around
- When the parietal lobe is damaged, disorders of attention result

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Neglect

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Mr. P. neglected the left side of his body and of the world. When asked to lift up his arms, he failed to lift his left arm but could do so if one took his arm and asked him to lift it. When asked draw a clock face, he crowded all the numbers onto the right side of the clock. When asked read compound words such as ice cream and football he read cream and ball. When he dressed, he did not attempt to put on the left side of his clothing and when he shaved he shaved only the right side of his face. He ignored tactile sensation on the left side of his body. Finally, he appeared unaware that anything was wrong with him and was uncertain as to what all the fuss was about.

Parietal hemi-neglect: disorders of attention/consciousness

neglect of half of body
neglect of half visual field
neglect of half object, half word
neglect of half spatial imagination

parietal cortex lesions

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Artist self portrait

With right parietal
Damage

(Image removed due
to copyright restrictions.)

Process of recovery

Summary

Attention is necessary to see, visibility is not sufficient.

Attention is the gateway to awareness, but also has a myriad of other effects on perception, from low-level to high-level

- improves spatial resolution
- dilates time
- speeds responses
- integrates features

Attention is probably not just one thing, but a loose assortment of related phenomena