

Visual dynamics

PSY 200

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Lecture 10

Why computer monitors work.

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Flicker

- A flashing light looks constant if it is presented rapidly enough
- The frequency of flashing at which subjects do not detect flicker is called the *Critical Flicker Frequency (CFF)*
 - ♦ about 50 Hertz (50 on-off cycles in a second)
 - ♦ 20 millisecond durations

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CFF

- Establishes minimum characteristics of electronic devices
- Lights flicker at 120 Hz
 - ♦ we spend a lot of time in darkness
- Computer (Cathode Ray Tube, CRT) monitors and TV's flicker at around 60 Hz
 - ♦ better monitors go faster
 - ♦ Liquid Crystal Display (LCD) monitors work differently
 - » Although some still flicker



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Phosphor

- The phosphor on a computer screen typically glows less than 10 milliseconds
 - ♦ ten thousandths of a second
- The gun reactivates the phosphor every 17 milliseconds
- Thus, at any given time 1/3 of the screen is dark
 - ♦ the percept persists in your head!



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Persistence

- What is the source of the persisting percept?
 - ♦ Receptors in the eye?
 - ♦ Receptive fields?
 - ♦ Network interactions?
 - ♦ Cognitive (memory)?
- Studies support network interactions

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Experiment

- Bowen, Pola & Matin (1973)
 - ♦ subjects adjust duration of a blank stimulus so onset of probe matched *perceived* offset of the target



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Strange property

- As the target's duration or luminance *increases*
 - ♦ its persistence *decreases*

The graph plots Persistence (milliseconds) on the y-axis (0 to 300) against Stimulus duration (milliseconds) on the x-axis (0 to 300). Four data series are shown for different luminance levels: 0.038 ft lam (circles), 0.077 ft lam (squares), 0.151 ft lam (triangles), and 2.818 ft lam (inverted triangles). All series show a downward trend, indicating that persistence decreases as stimulus duration increases. Higher luminance levels result in lower persistence values for the same duration.

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Networks

- Feedback is important
- Produces a persisting response
- Demonstration

The diagram shows a network of four pink circular nodes. Three nodes are arranged in a triangle at the top, with bidirectional arrows between each pair, representing a fully connected recurrent network. A fourth node is positioned below the center of the triangle, with arrows pointing from each of the three top nodes to it, representing a common inhibitory or excitatory input. A yellow box at the bottom labeled "Input from eyes" has an arrow pointing to this bottom node.

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Explanation

- Francis, Grossberg & Mingolla (1994)
- Something has to *reset* the network
 - ♦ else it would keep "persisting" forever
- Two mechanisms
 - ♦ (1) new inputs inhibit old responses
 - ♦ (2) afterimages act as new inputs
- Note: afterimages get stronger as duration and luminance increase!

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Explanation

- Offset of input from the eyes produces an after response
 - ♦ e.g., due to competition from orthogonally tuned cells
- Offset response inhibits persisting response

This diagram is similar to slide 8 but includes a vertical column of four green nodes below the pink nodes. Dashed arrows indicate bidirectional connections between the pink nodes and the green nodes. A yellow box labeled "Input from eyes" has an arrow pointing to the bottom-most green node. This represents an inhibitory input that can be activated when the visual input is offset.

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Explanation

- As the target's duration or luminance *increases*
 - ♦ the afterimage produced at target offset increases in strength
 - ♦ so there is stronger inhibition to break the feedback
 - ♦ so the persistence of the original percept *decreases*

The graph is identical to the one in slide 7, showing persistence vs stimulus duration for four different luminance levels. It illustrates that as stimulus duration and luminance increase, the persistence of the percept decreases.

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Wait a minute

- If visual percepts persist for over 100 milliseconds, why doesn't the world seem blurry?
 - ♦ There should be smears of objects as they move or as we move
- There must be something else preventing such blurring
 - ♦ masking

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No mask

- Write down all the letters you see

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No mask

- Write down all the letters you see

R F
L P
M Q

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No mask

- Write down all the letters you see

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Masking demonstration

- Write down all the letters you see

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Masking demonstration

- Write down all the letters you see

Y S
D H
W F

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Masking demonstration

- Write down all the letters you see

X X X X
X X X X
X X X X

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Significance

- The mask appeared *after* the target turned off
- The target was presented all by itself for a *brief* period of time
- However, our visual system is unable to develop a complete percept of a scene in a such a period of time
 - Thus, the XXX mask interferes with processing of the letters by shortening their persisting responses
 - And prevents perceived blurring of changing scenes

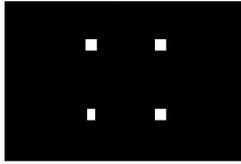
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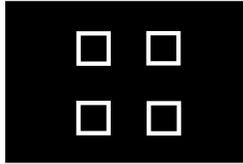
Metacontrast

- Masks do not have to “write over” the target to have an effect
- In metacontrast masking the mask and target do not overlap in space and (often) in time (CogLab)

Target



Mask

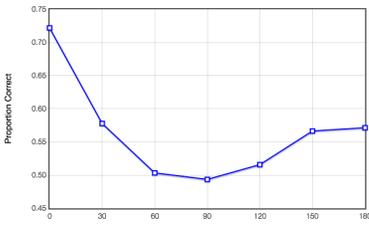


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Metacontrast

- Correct identification of the narrow target is affected by the Stimulus Onset Asynchrony (SOA) of the target and mask (111 participants)
 - Worse between 60-90 milliseconds



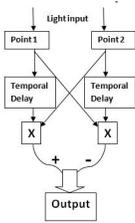
SOA (ms)	Proportion Correct
0	0.75
30	0.60
60	0.52
90	0.50
120	0.52
150	0.55
180	0.55

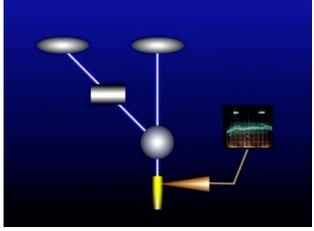
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Motion

- In simple animals (like flies and frogs), we know how motion is detected
 - Demo on web page
- Reichardt detector





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Detecting Motion

- Humans have something like Reichardt motion detectors
 - at lots of different positions in the visual field
 - sensitive to lots of different motion directions
 - sensitive to lots of different motion speeds
- Think of them as receptive fields that vary in both space and time
- Many aspects of how we perceive motion follow from the properties of Reichardt motion detectors

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Apparent Motion

- When objects move, there is a continuous path of motion
- Reichardt motion detectors do not require continuous motion
 - and, continuous paths are not necessary for motion to be seen

Time1



Time2



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Apparent Motion

- For just two stimuli, it does not depend on
 - color
 - shape
 - attention
 - cognitive priming

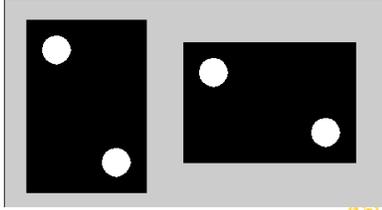


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Apparent Motion

- The percept of motion does depends on
 - stimulus duration
 - interstimulus interval (50-200 msec)
 - distance

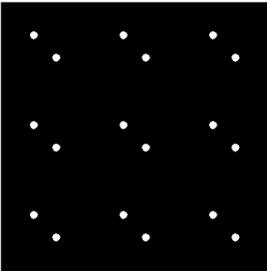


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Apparent Motion

- Weird grouping effects (not fully understood)



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Timing

- For a Reichardt detector to indicate motion, the signal from the second area must follow the signal from the first by just the right length of time
- Vary the Interstimulus Interval (ISI) between the stimuli
 - The time between offset of the first stimulus and onset of the second stimulus

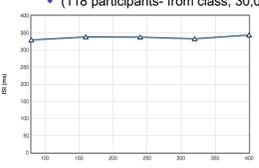


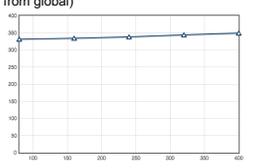
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Korte's laws

- Apparent motion was highly studied at the beginning of the 20th century
 - Korte (1915) noted that to get good motion, you needed to increase the ISI between the stimuli as the distance between them increased
- CogLab data
 - (118 participants- from class, 30,041 from global)



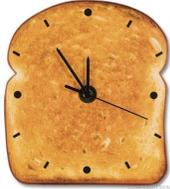


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Motion representation

- One conclusion of studies of apparent motion is that motion is a fundamental percept
 - It has an explicit representation in the visual system
- You could imagine otherwise, we can be aware of something moving without actually seeing the movement
- Apparent motion is the source of motion for all movies and animation



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Motion aftereffect

- Just like for color and orientation, we might expect an aftereffect of motion
- competition between opposite directions of motion
 - Left-right
 - Up-down
- habituating gate
- offset of one direction leads to rebound in other

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After effect

- Motion can be adopted by non-moving stimuli
 - http://www.michaelbach.de/ot/mot_adapt/index.html

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Conclusions

- Dynamic vision
 - flicker
 - persistence
 - network dynamics
 - Masking
 - Reichardt detectors
 - Apparent motion
 - Motion aftereffect
- Also used to investigate other areas of cognition and types of mental problems

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Next time

- Attention
- What is attention?
- What does it do?
- CogLab on Simon Effect due.
- *How could you not see it?*

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