Visual dynamics

PSY 200

Greg Francis

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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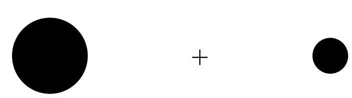
Experiment

- 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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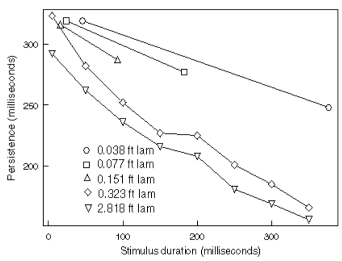
Strange property

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



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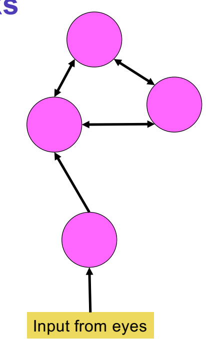
Networks

- Feedback is important
- Produces a persisting response
- Demonstration



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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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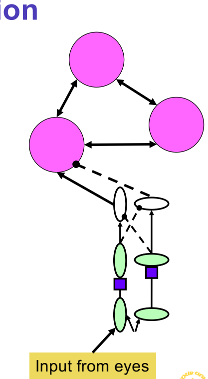
Explanation

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



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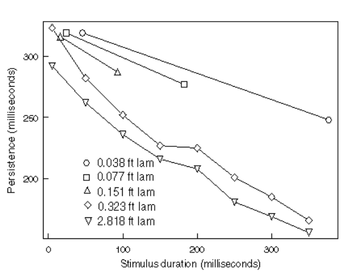
Explanation

- 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*



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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)

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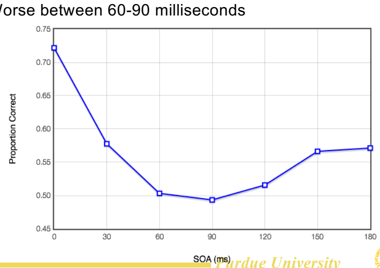
Metacontrast

- 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



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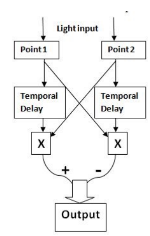
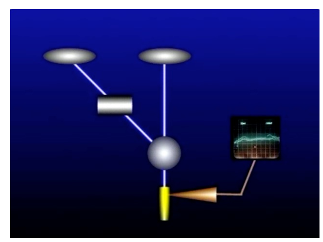
Motion

- 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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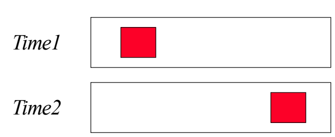
Apparent Motion

- 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



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Apparent Motion

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

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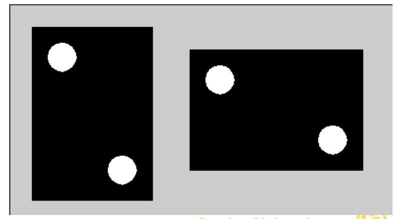
Apparent Motion

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



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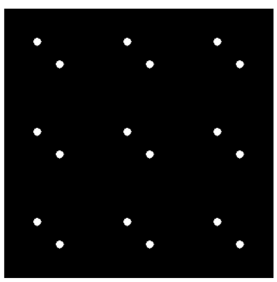
Apparent Motion

- Weird grouping effects (not fully understood)



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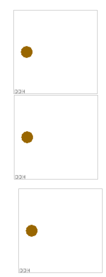
Timing

- 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



ISI too short

ISI about right

ISI too long

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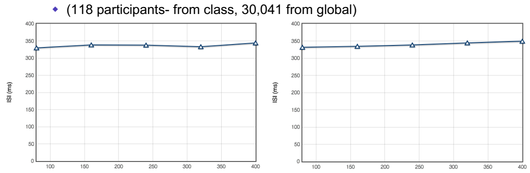
Korte's laws

- 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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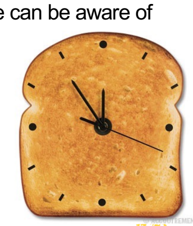
Motion representation

- 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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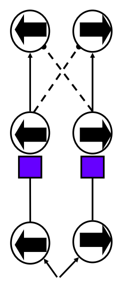
Motion aftereffect

- 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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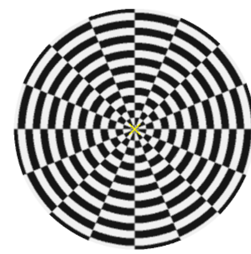
After effect

- 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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