Spatial frequency tuning

PSY 310

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Lecture 09

Waves in the brain.

What letter do you see?

- D, E, or F?
Visual angle

- Sizes of objects are in terms of visual angle
- Visual angle changes with distance
Visual angle

- Sizes of objects are in terms of visual angle
- Visual angle changes with distance
Visual angle

- So how does the visual system respond
- Consider the response of ganglion cells
  - Similar for orientation-sensitive cells
- If you sit close…

Visual angle

- So how does the visual system respond
- Consider the response of ganglion cells
  - Similar for orientation-sensitive cells
- If you sit further…
**Visual angle**

- So how does the visual system respond
- Consider the response of ganglion cells
  - Similar for orientation-sensitive cells
- If you sit at the back…

**Spatial frequency**

- We can think of how the visual system interprets information in terms of spatial frequency
Spatial frequency
- This image contains lots of different frequencies of sine waves
- Vertically, it changes low contrast
Spatial frequency

- The question is how sensitive are we to contrast at different spatial frequencies?

Spatial frequency

- Most people report the lines fade into the background along a curve something like
  - Contrast Sensitivity Function
Spatial frequency

- There is a similar effect for this odd grating
- The receptive field responds better to some frequencies than others

Spatial frequency

- There is a similar effect for this odd grating
- A larger receptive field responds better to lower frequencies
Spatial frequency

- There is a similar effect for this odd grating
- A larger receptive field responds better to lower frequencies
  - You can make the same kind of observations about orientation-sensitive cells

Visual cortex

- Measure contrast sensitivity for orientation-sensitive cells
- Different cells prefer sine waves of different frequencies
- Fourier analysis?
Visual perception

- Does this have anything to do with visual perception?
- Easy to show with an adaptation experiment
- Show a stimulus, lots of cells respond
Visual perception

- The pattern across the cells indicates information about the grating
  - For example, it's spatial frequency

Visual perception

- Change the spatial frequency of the image
  - And the cell pattern responses change
Visual perception

- Change the spatial frequency of the image
  - And the cell pattern responses change

Suppose we start with the high frequency (small bars) grating
- We get this pattern
Visual perception

- Over time, all of these cells weaken their response
  - More for the ones that respond strongest

- After adaptation
- Look at a the grating of intermediate spatial frequency
- The relative pattern may be more like the low frequency grating
Spatial frequency

- Try it!
Conclusions

- Spatial frequency in visual cortex
- Different receptive fields are sensitive to different ranges of spatial frequencies
  - It’s actually more complicated than this
- Provides a language to explain a variety of percepts
- F-E-D image
- Spatial frequency adaptation

Next time

- Higher level visual processing
- Dorsal and ventral streams of the brain