COGS 101A: Sensation and Perception

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UCSD

Lecture 4:

Coding Concepts – Chapter 2

Course Information

- Class web page: http://cogsci.ucsd.edu/ desa/101a/index.html
- Professor: Virginia de Sa
  - ⋆ I'm usually in Chemistry Research Building (CRB) 214 (also office in CSB 164)
  - ⋆ Office Hours: Monday 5-6pm
  - ⋆ email: desa at ucsd
  - ⋆ Research: Perception and Learning in Humans and Machines

For your Assistance

TAS:

- Jelena Jovanovic OH: Wed 2-3pm CSB 225
- Katherine DeLong OH: Thurs noon-1pm CSB 131

IAS:

- Jennifer Becker OH: Fri 10-11am CSB 114
- Lydia Wood OH: Mon 12-1pm CSB 114

Course Goals

- To appreciate the difficulty of sensory perception
- To learn about sensory perception at several levels of analysis
- To see similarities across the sensory modalities
- To become more attuned to multi-sensory interactions

Grading Information

- 25% each for 2 midterms
- 32% comprehensive final
- 3% each for 6 lab reports - due at the end of the lab
- Bonus for participating in a psych or cogsci experiment AND writing a paragraph description of the study

You are responsible for knowing the lecture material and the assigned readings. Read the readings before class and ask questions in class.

Academic Dishonesty

The University policy is linked off the course web page.

You will all have to sign a form in section

For this class:

- Labs are done in small groups but writeups must be in your own words
- There is no collaboration on midterms and final exam

Last Class

We learned about the cells in the Retina

This Class

Coding Concepts – Every thing after transduction (following Chris Johnson's notes)

Remember:The cells in the retina are neurons

neurons are specialized cells that transmit electrical/chemical information to other cells

neurons generally receive a signal at their dendrites and transmit it electrically to their soma and axon.

At the axon terminals they release neurotransmitter that acts on the dendrites of the next set of neurons

Neurotransmitter(NT) release can be graded or all/none (spikes, action potentials)

Coding in the Retina

Light turns off receptors (reduces neurotransmitter release)

Spontaneous firing rate, **Baseline firing rate** firing rate with no stimulus

Inhibitory Neurotransmitter - Neurotransmitter that produces an Inhibitory post synaptic potential (IPSP) and reduces likelihood of neurotransmitter release in target neurons

Excitatory Neurotransmitter - Neurotransmitter that produces an Excitatory post synaptic potential (EPSP) and increases likelihood of NT release in target neurons

There is a "dark current" of charged particles (ions) flowing in/out of receptors (NT released in dark)

Coding in the Retina

Photoreceptors spontaneously release NT in the dark

On the ON-center bipolar cells this acts as an inhibitory transmitter

On the OFF-center bipolar cells this acts as an excitatory transmitter

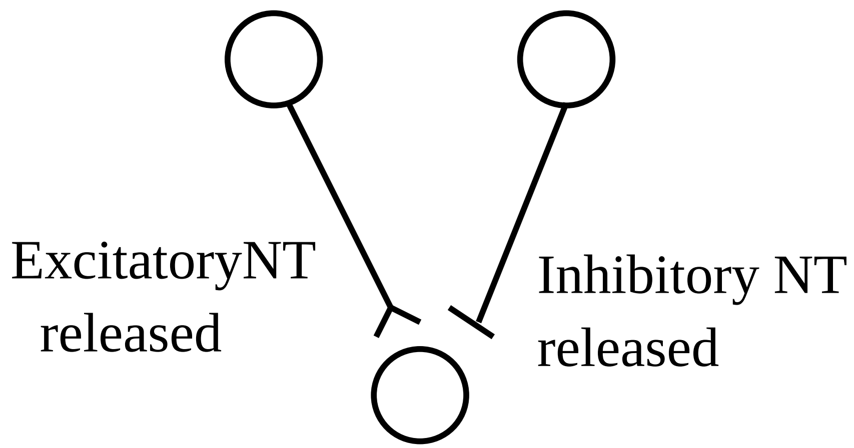
Bipolars spontaneously release excitatory NT

So in the dark the photoreceptors inhibit the ON-center bipolars which prevents the ganglion cells from firing

With a spot of light, photoreceptors decrease release of inhibitory NT this allows bipolars to release more excitatory NT and excite the ganglion cells

Schematics

Book (and others use the following schematics)



Lateral Inhibition

One of the most fundamental coding principles in the nervous system (appears all over the brain)

Example in the retina:

Ganglion cells are excited by NT release from bipolars

Bipolars also excite amacrine cells

Amacrine cells can inhibit nearby ganglion cells

Receptive Fields (RF)

The **receptive field** of a visual neuron is the area of retina over which light stimuli change the response of that neuron (in general area over the receptor surface)

Measuring receptive field demo

RFs vary in size (A ganglion cell that receives input from Rods (via bipolars) is likely to have a larger RF

Stimulating photoreceptors may lead to **excitation** of a target cell or **inhibition**

Target neuron sums the excitatory and inhibitory effects to determine the net effect (how much release of NT)

We will often draw a schematic where we draw a picture of the receptor surface and draw + where light has an excitatory effect on our measured neuron and - where it has an inhibitory effect

Most ganglion cells have a center surround organization

Light in the center of the RF excites the ganglion cell, light in the surround inhibits it, or vice-versa

So what happens when we consider light spots of different sizes? (do on board)

Note: the same photoreceptor can be part of the excitatory subfield of the RF of one ganglion cell and part of the inhibitory subfield of the RF of another ganglion cell (all based on the circuitry between them)

A great set of flash lecture notes

link to notes

http://www.med.uwo.ca/physiology/courses/sensesweb by Tutis Vilis, University of Western Ontario, Canada

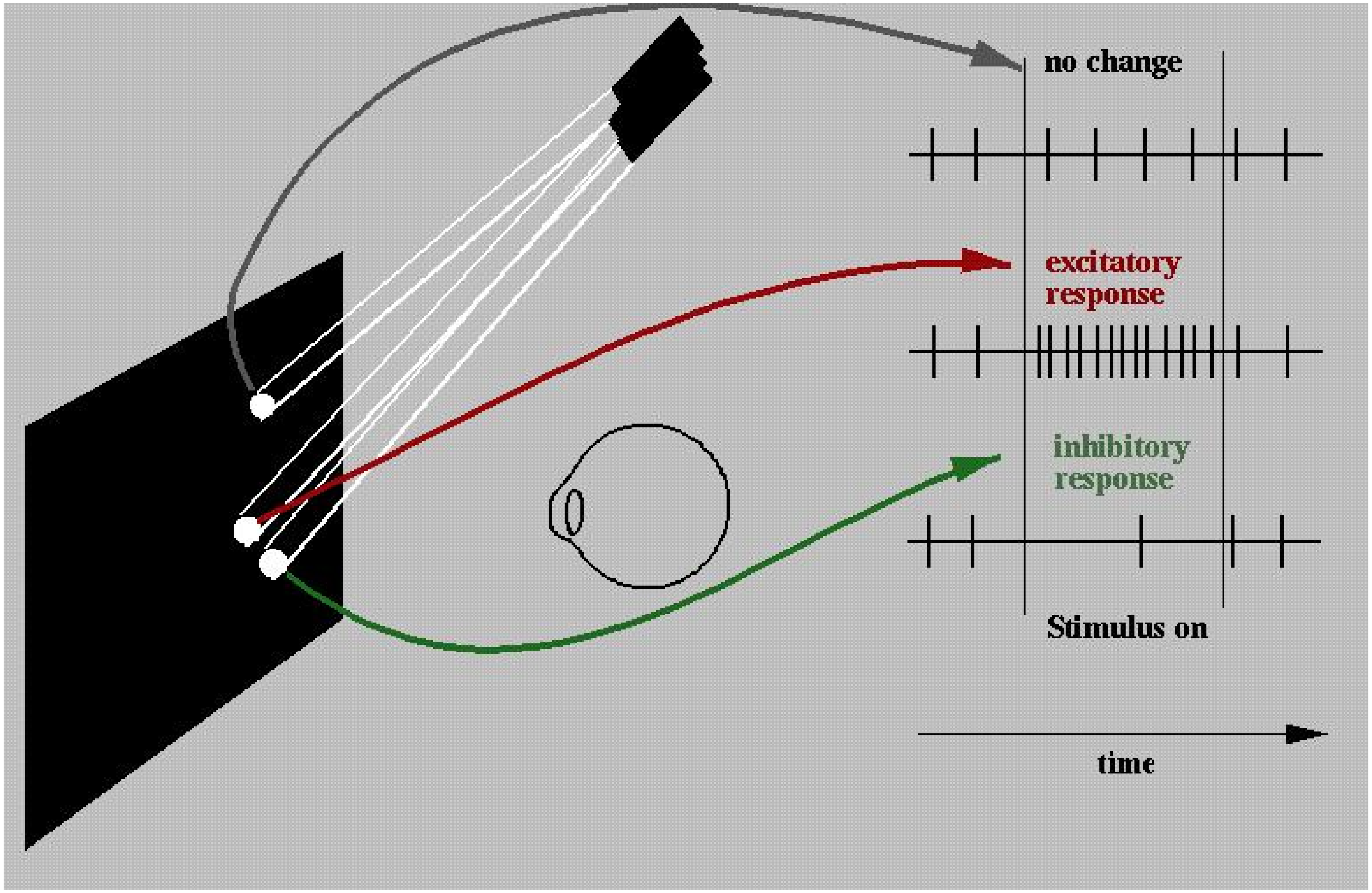
Review of Flash Notes

Ganglion cells have center-surround receptive fields

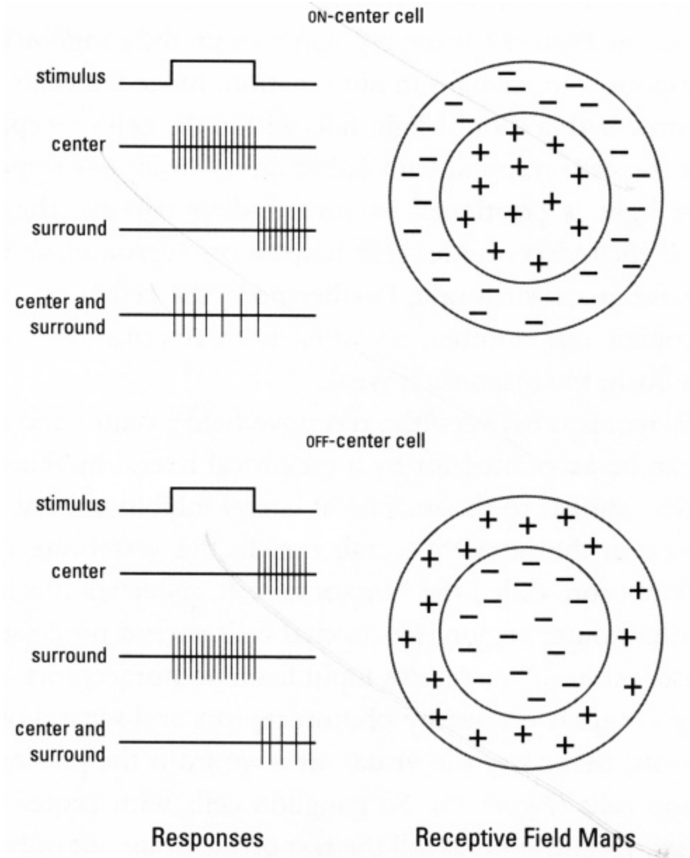
Center can be On-center or Off-center (and surround is opposite)

The surround inhibition is mediated by the horizontal cells and amacrine cells

Ganglion cell responses



Ganglion cell responses



http://zeus.rutgers.edu/~ikovacs/SandP/prepI_3_1.html

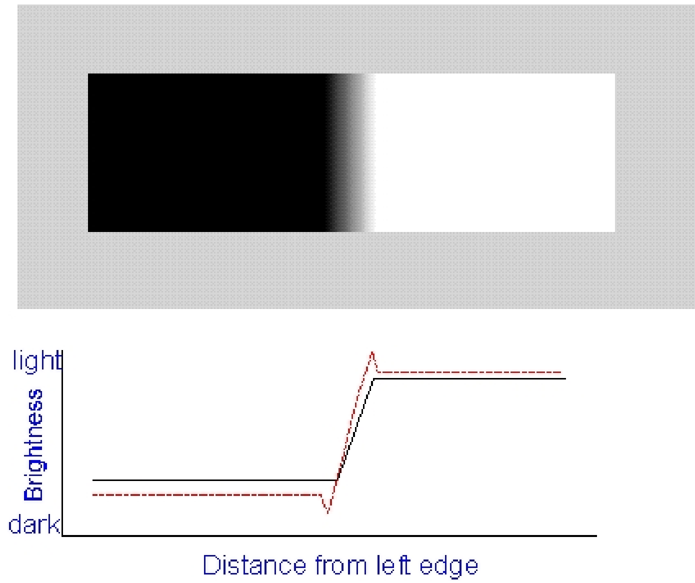
Mach Band Effect

Exaggerates contrast at edges – helps to make objects stand out from background

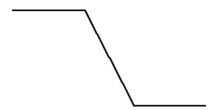
If graph of light intensity versus visual field is a step function

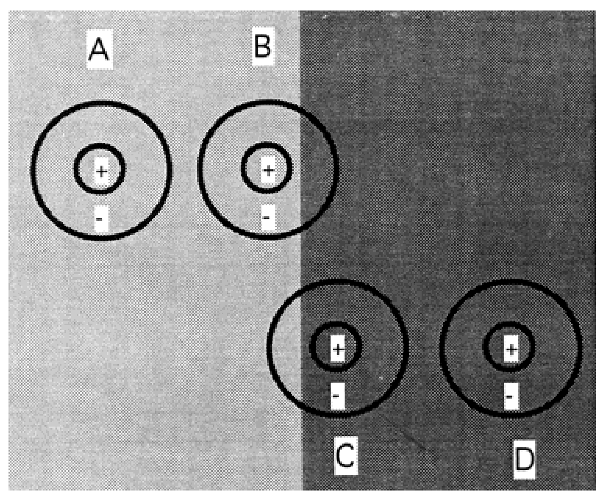
Graph of perception of brightness is different

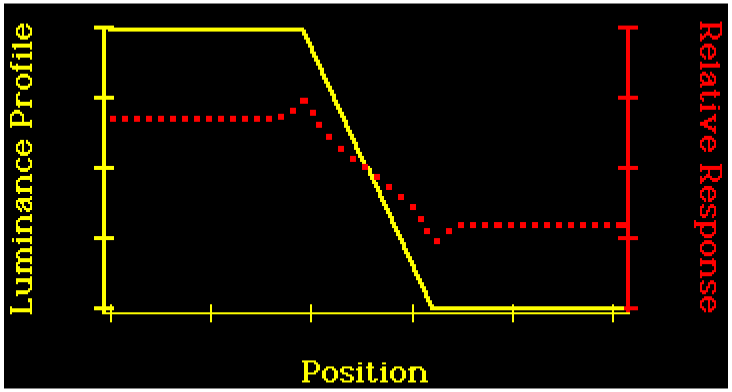
Lateral inhibition in Mach bands



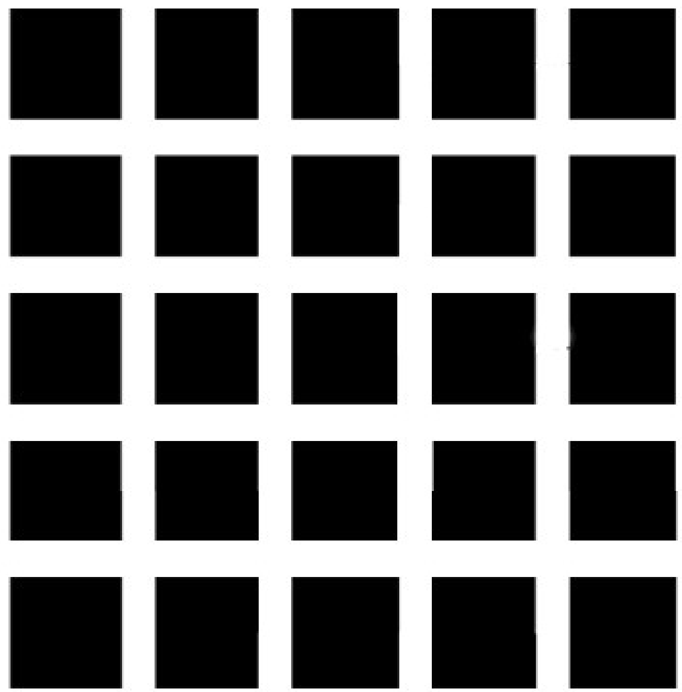
Lateral inhibition in Mach bands






Luminance Profile
Relative Response
Position

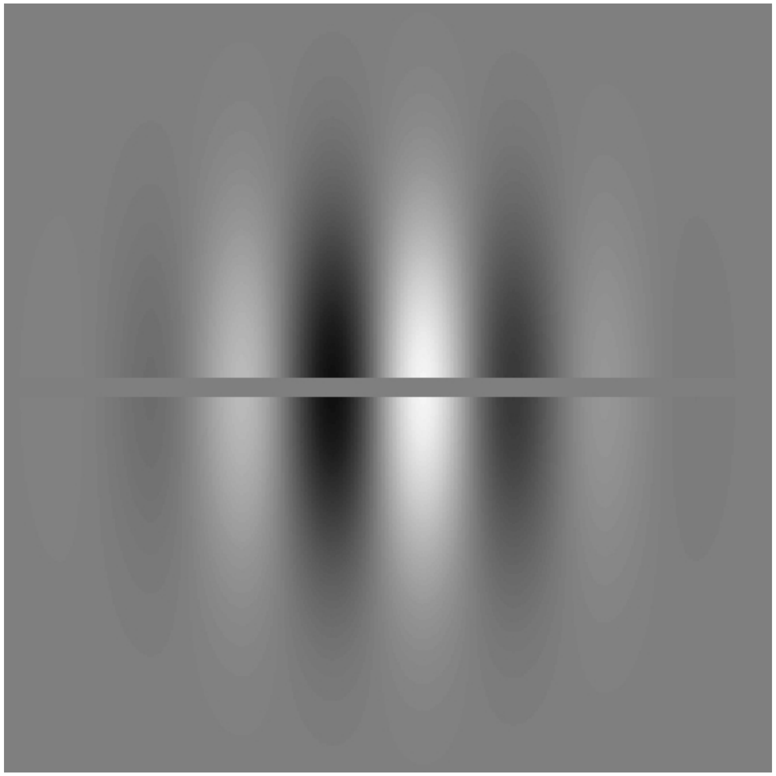
Lateral inhibition in Hermann grid illusion



Can you explain why you see gray spots at the intersections of the white lines?

Grating Induction (another lateral inhibition effect)

Discovered by McCourt

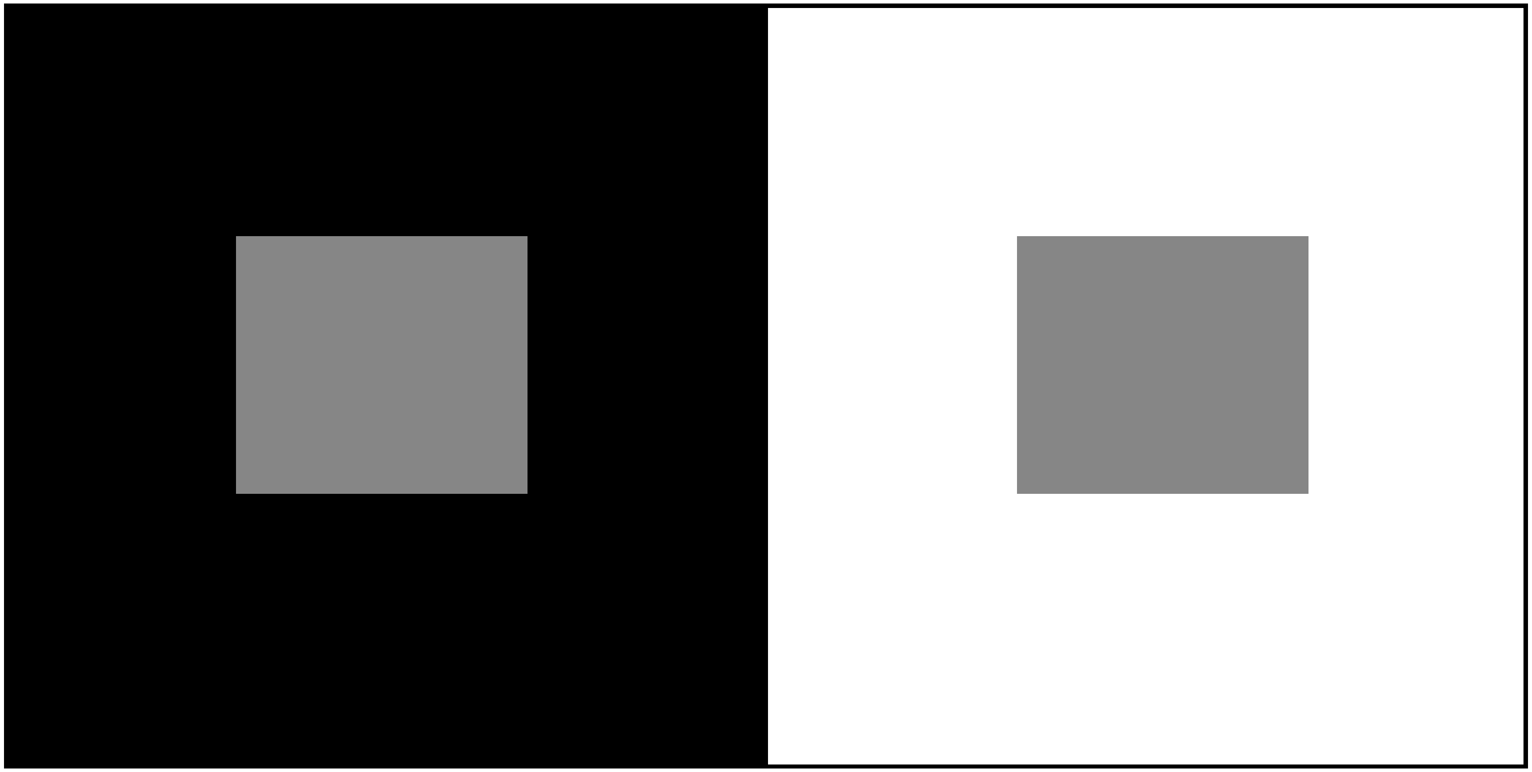


move horizontally move vertically

http://www.psychology.psych.ndsu.nodak.edu/mccourt/website/htdocs/HomePage/Pro
cts/Brightness/GI/grating

Perceived contrast of illusory grating decreases with increasing grating frequency and with real patch height

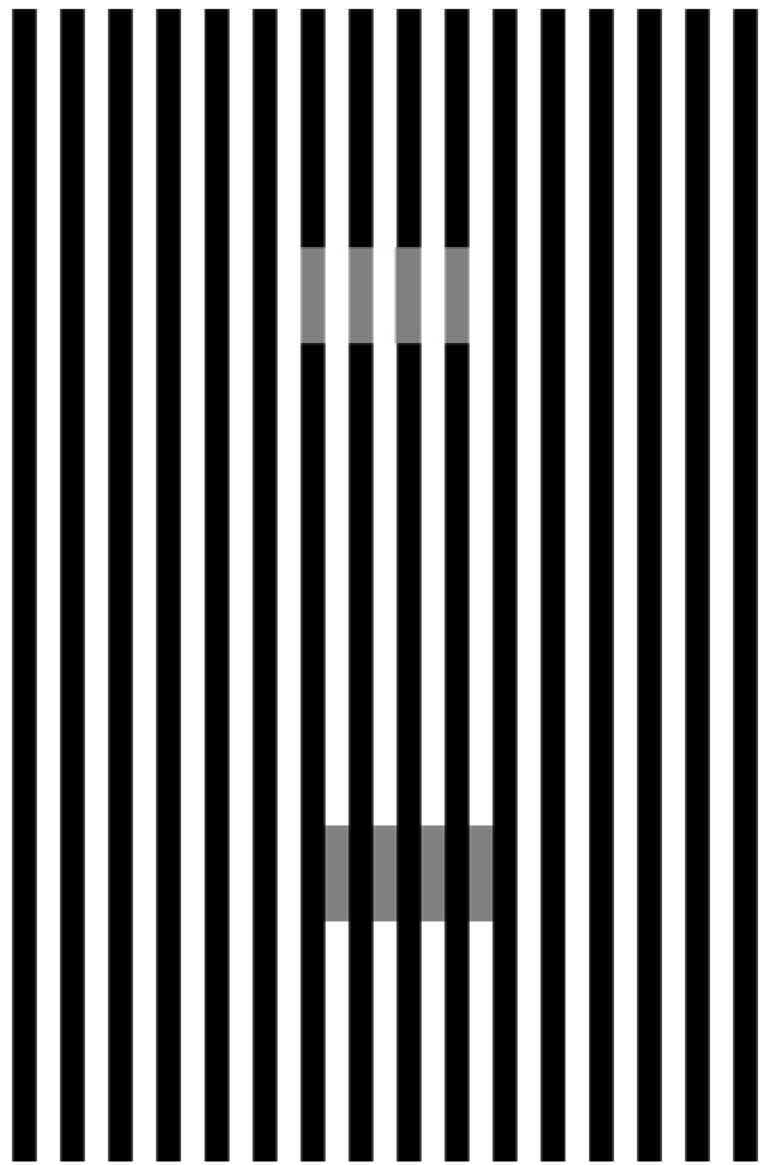
Simultaneous Brightness Contrast



Start Applet

Simultaneous Brightness Contrast decreases with increasing test

White's Effect?



Wertheimer-Benary Cross

http://www.uni-mannheim.de/fakul/psycho/irtel/cvd/C2600.html

Next Class

Dark adaptation lab – Don't be more than 15 minutes late!