

Cognitive (Neuro) Psychology

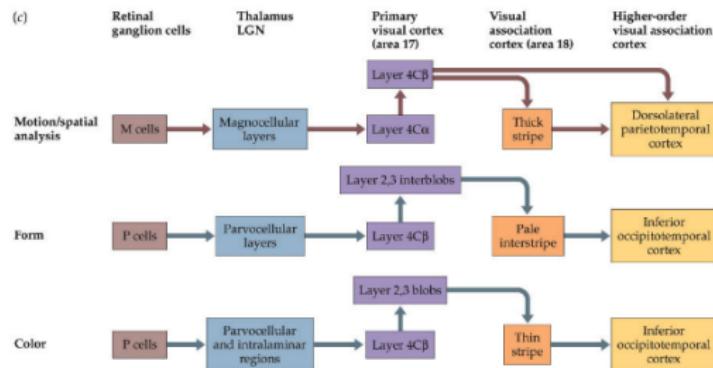
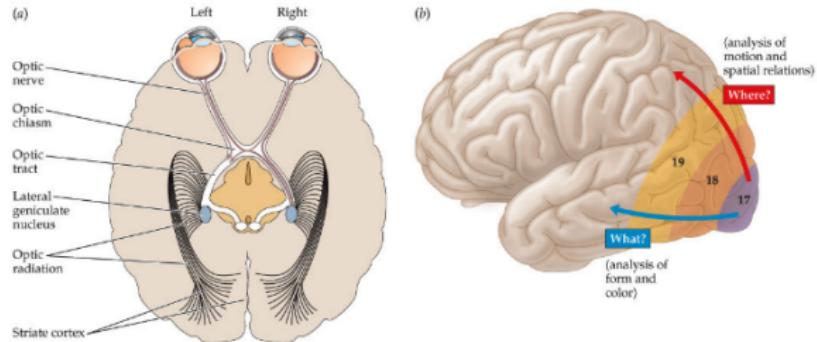
Pattern vision

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Technische Universität Berlin

July 2016

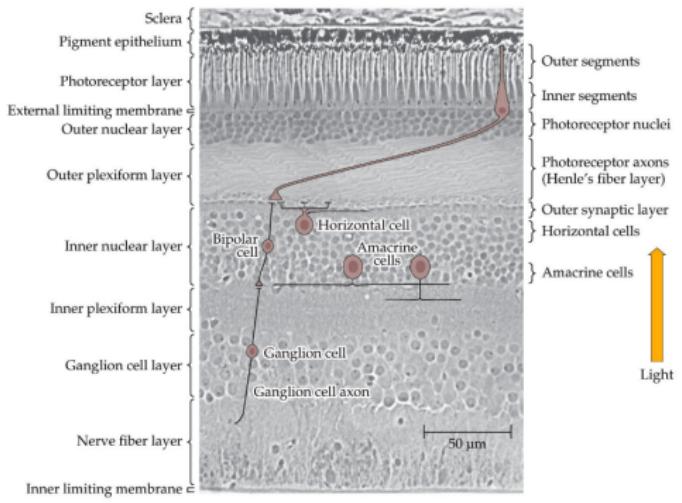
Cortical visual pathways



SENSATION & PERCEPTION 2e, Figure 3.1

Path of image processing: eye to brain

- eye

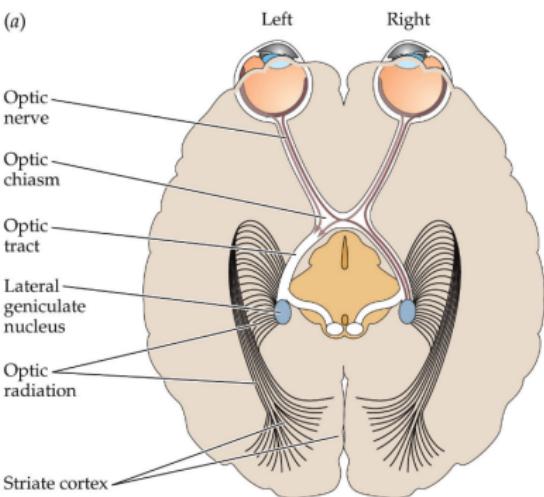


SENSATION & PERCEPTION 2e, Figure 2.7

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Path of image processing: eye to brain

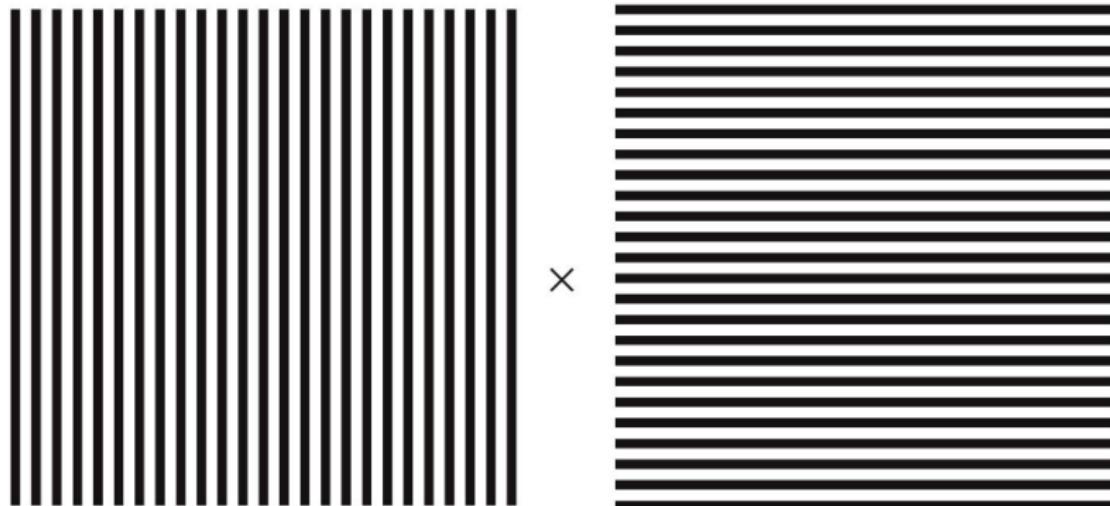
- eye
- lateral geniculate nucleus LGN
- primary visual cortex V1



SENSATION & PERCEPTION 2e, Figure 3.1 (Part 1)

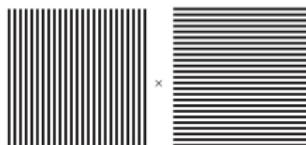
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Basic visual functions: Acuity



Acuity: the smallest spatial detail that can be resolved

Basic visual functions: Acuity

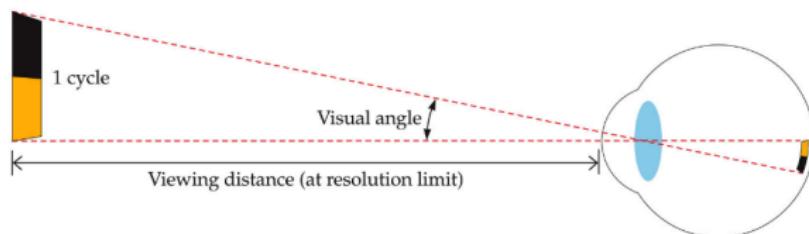


Acuity: the smallest spatial detail that can be resolved

How to measure acuity?

Visual angle of one cycle of the grating

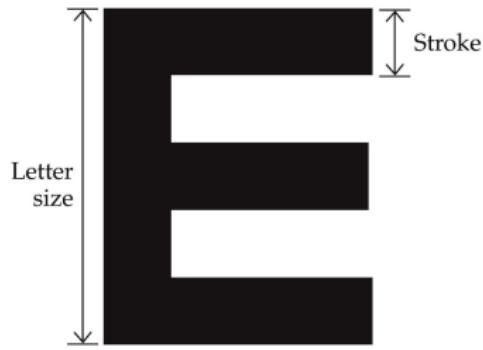
- $\text{atan}\left(\frac{\text{size}}{\text{distance}}\right) = \text{atan}\left(\frac{2}{6500}\right) = .017$



How to measure acuity?

Snellen E test

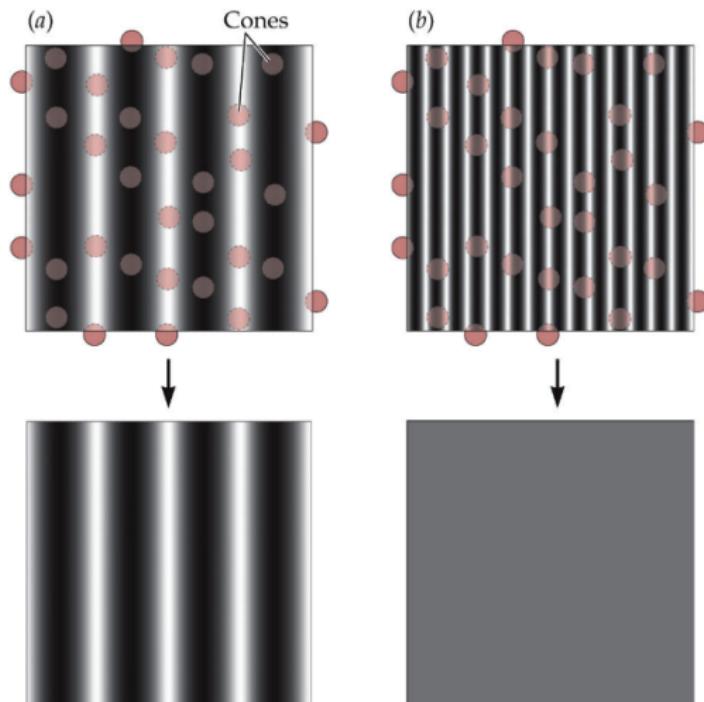
- eye doctors use distance to characterize acuity
- "20/20 vision" your distance/normal vision distance



SENSATION & PERCEPTION 2e, Figure 3.5

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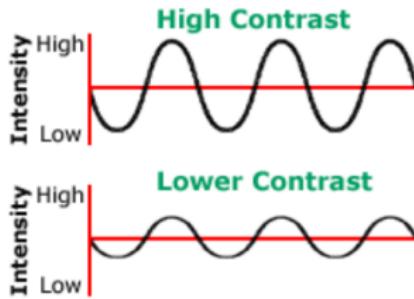
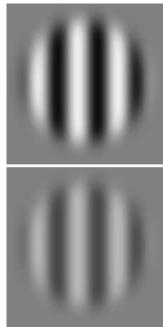
Resolution acuity limits spatial vision



SENSATION & PERCEPTION 2e, Figure 3.4

Acuity for low contrast stimuli

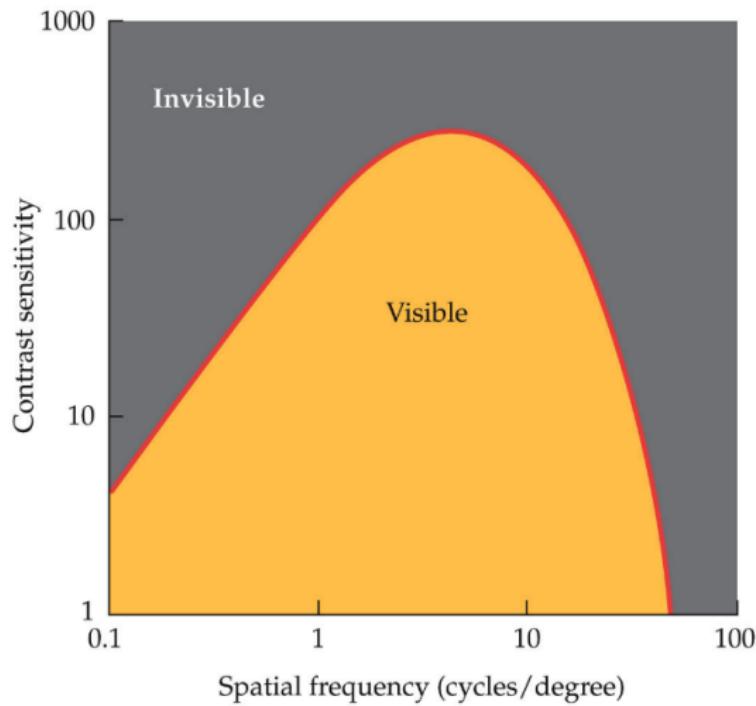
- Contrast



- Spatial frequency



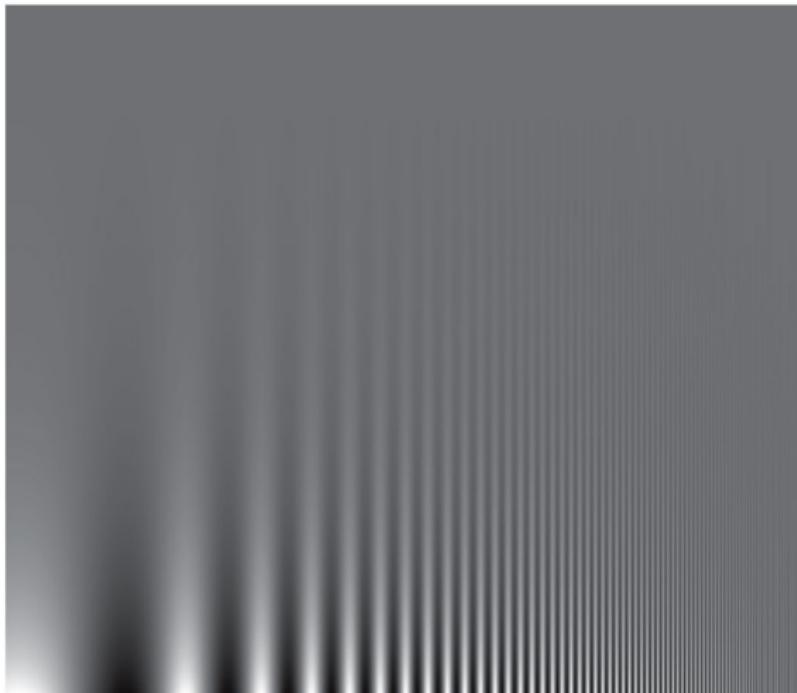
Contrast Sensitivity Function - CSF



SENSATION & PERCEPTION 2e, Figure 3.7

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Contrast Sensitivity Function - CSF

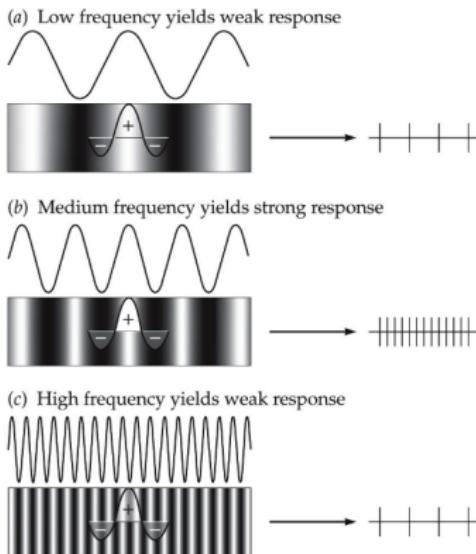


SENSATION & PERCEPTION 2e, Figure 3.8

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Retinal ganglion cell responses to stripes

- sensitivity to spatial frequency

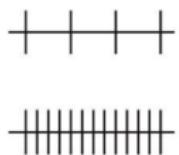
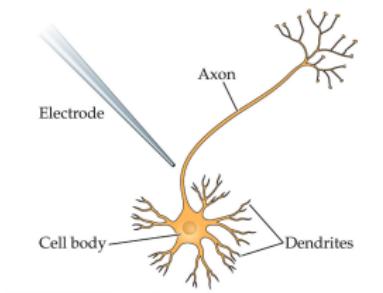
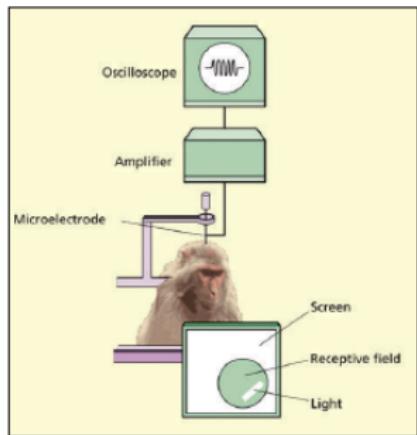


SENSATION & PERCEPTION 2e, Figure 3.9

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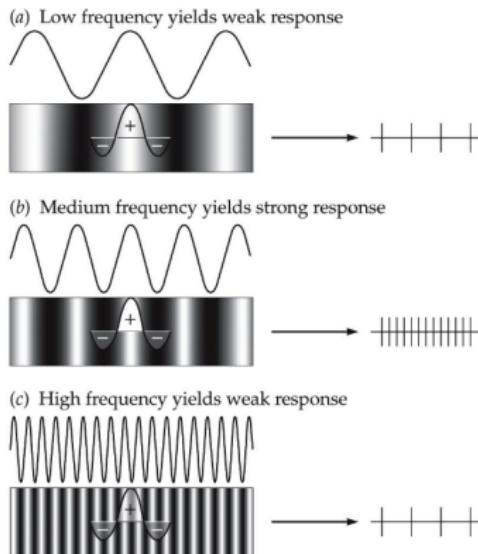
Detour - single cell recordings

- recordings of action potentials in monkeys
- “spike” counts



Retinal ganglion cell responses to stripes

- sensitivity to spatial frequency



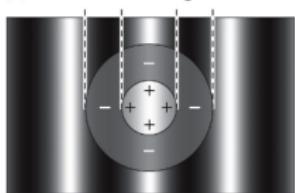
SENSATION & PERCEPTION 2e, Figure 3.9

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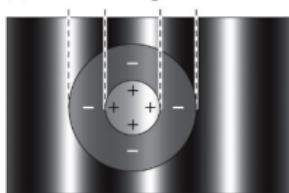
Retinal ganglion cell responses to stripes

- sensitivity to spatial phase

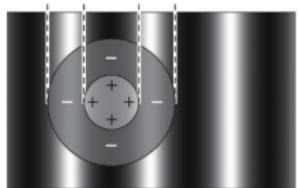
(a) 0° – Positive response



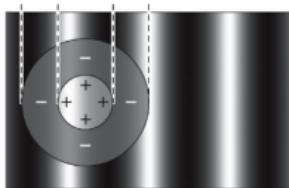
(b) 90° – No response



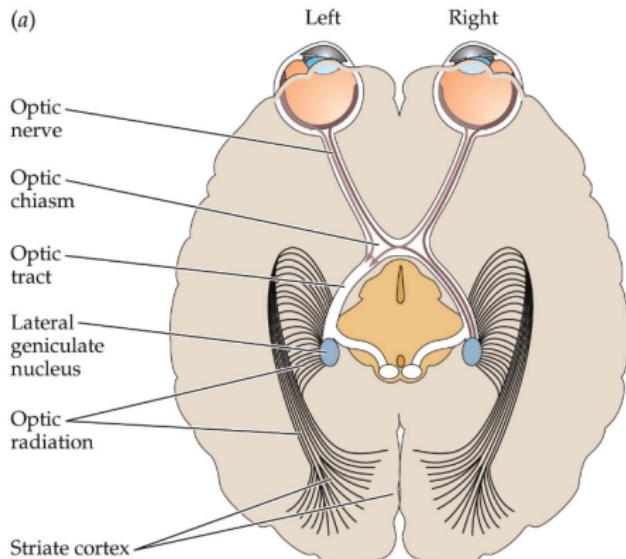
(c) 180° – Negative response



(d) 270° – No response



Down the visual pathway



SENSATION & PERCEPTION 2e, Figure 3.1 (Part 1)

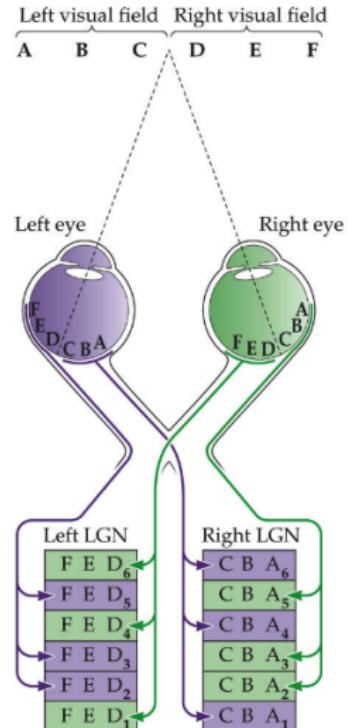
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The Lateral Geniculate Nucleus - LGN

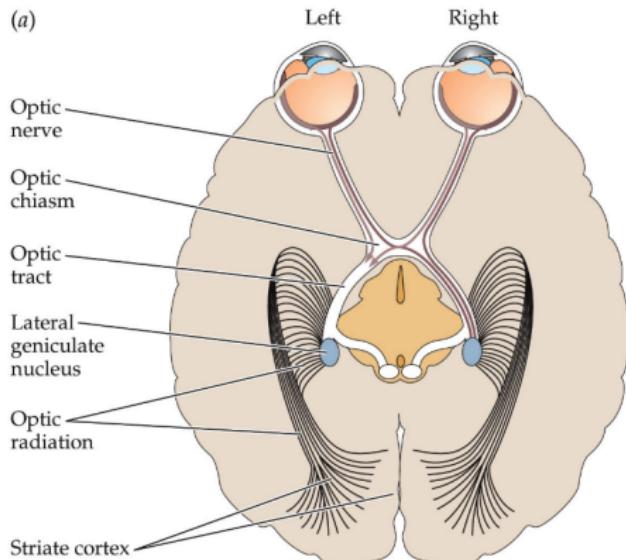


- parvocellular layers - details of stationary targets
- magnocellular layer - large, fast-moving objects

The Lateral Geniculate Nucleus - LGN



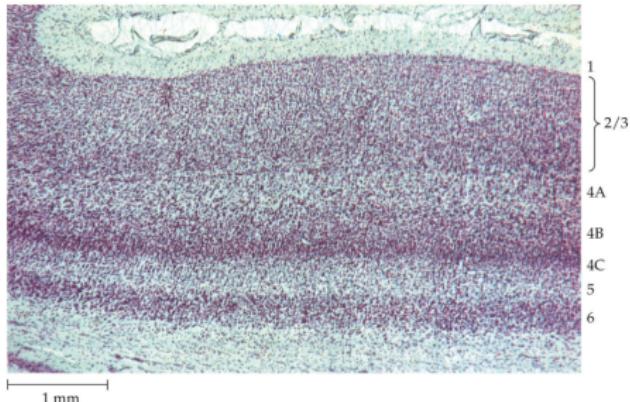
Down the visual pathway



SENSATION & PERCEPTION 2e, Figure 3.1 (Part 1)

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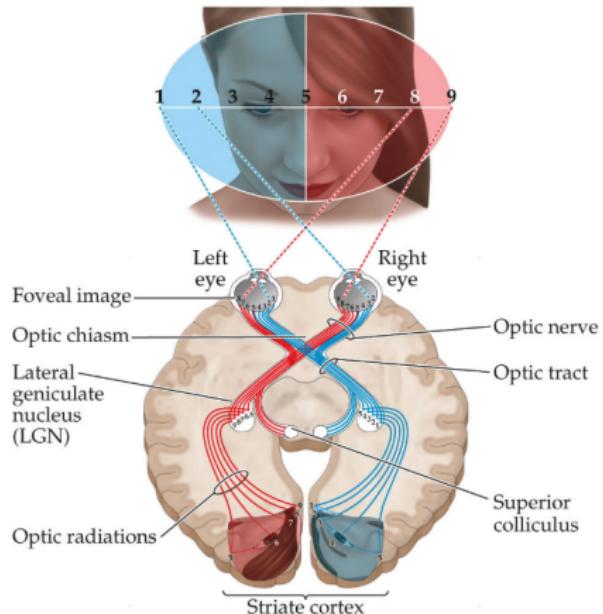
The Primary Visual Cortex - V1



- parvocellular layers - 4C β
- magnocellular layer - 4C α

The Primary Visual Cortex - V1

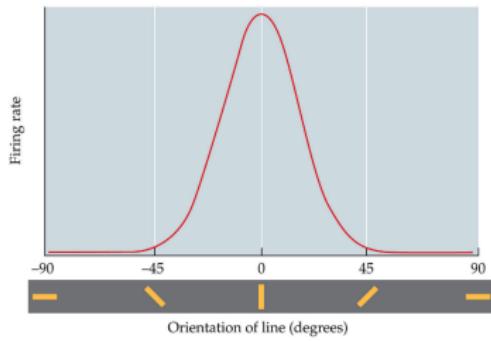
- Topography and magnification



The Primary Visual Cortex - V1

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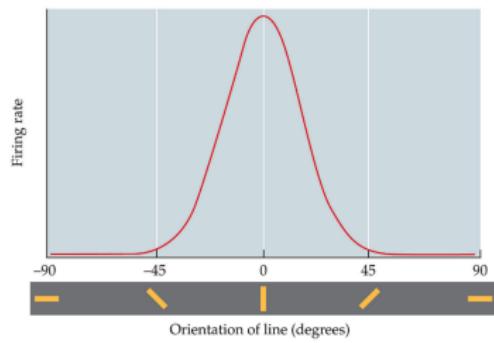
V1 neurons are orientation selective



SENSATION & PERCEPTION 2e, Figure 3.16

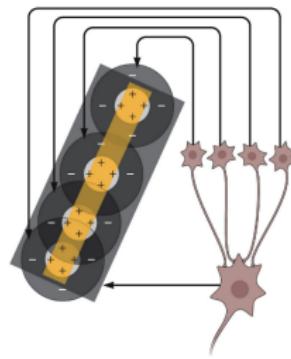
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V1 neurons are orientation selective



SENSATION & PERCEPTION 2e, Figure 3.16

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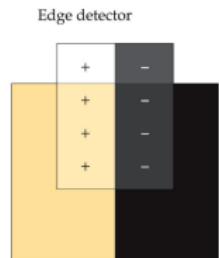


SENSATION & PERCEPTION 2e, Figure 3.17

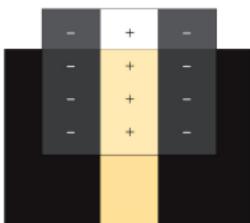
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Simple and complex cells in V1

Simple



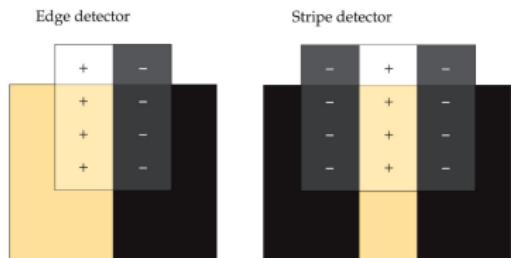
Stripe detector



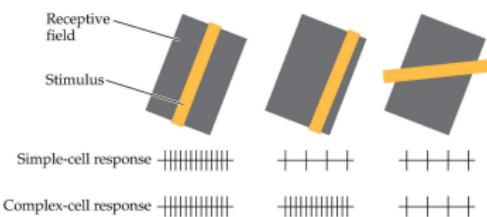
Complex

Simple and complex cells in V1

Simple

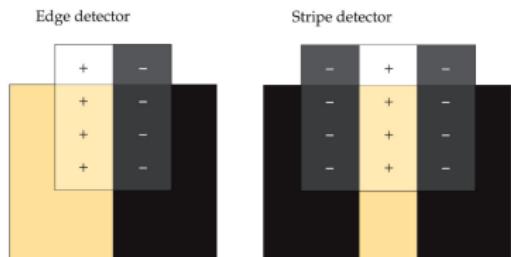


Complex

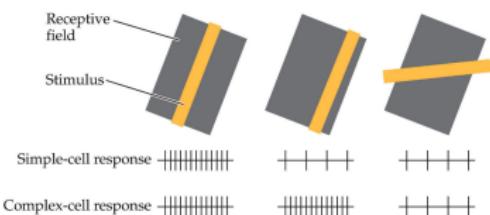


Simple and complex cells in V1

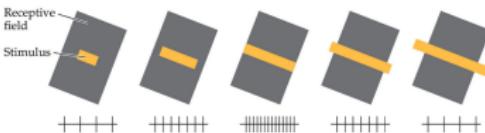
Simple



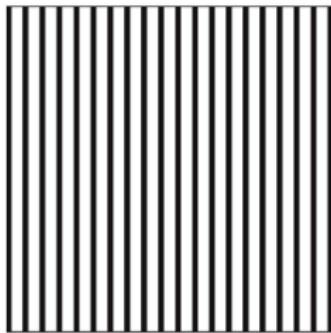
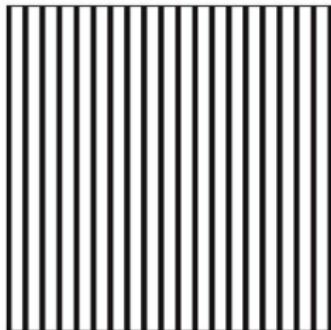
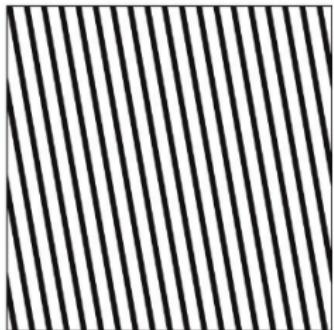
Complex



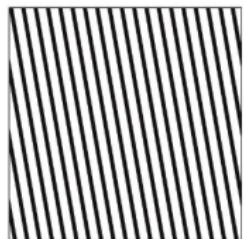
End-stopped



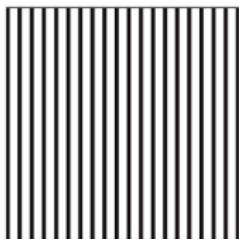
Selective adaptation: the psychologist's electrode



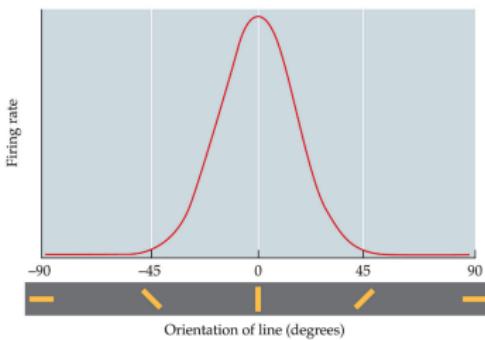
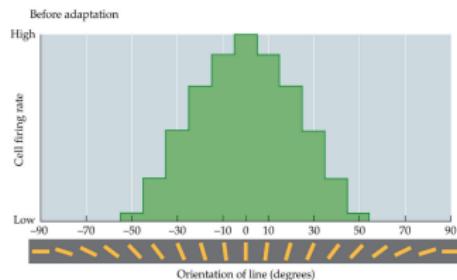
Selective adaptation: the psychologist's electrode



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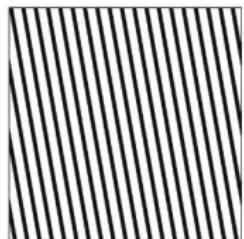
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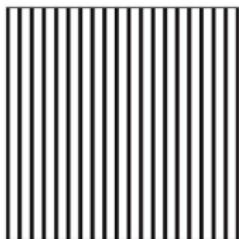
SENSATION & PERCEPTION 2e, Figure 3.16

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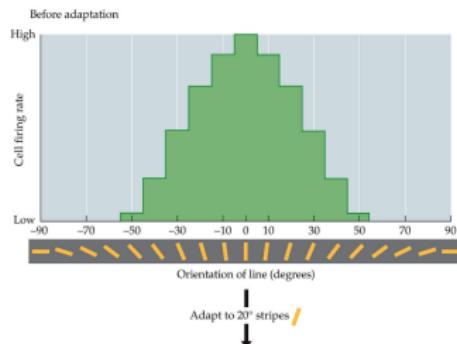
Selective adaptation: the psychologist's electrode



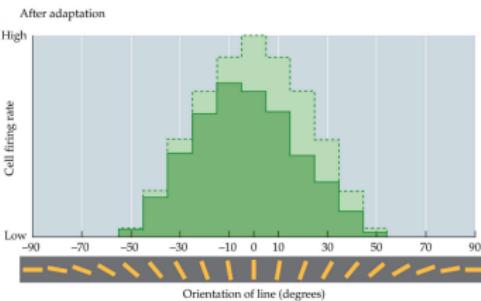
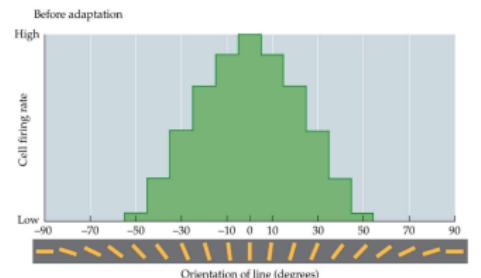
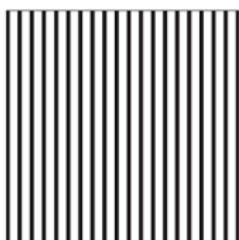
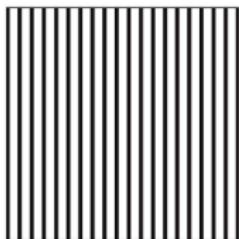
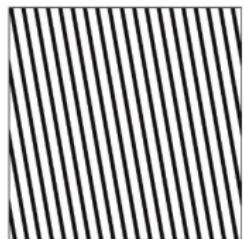
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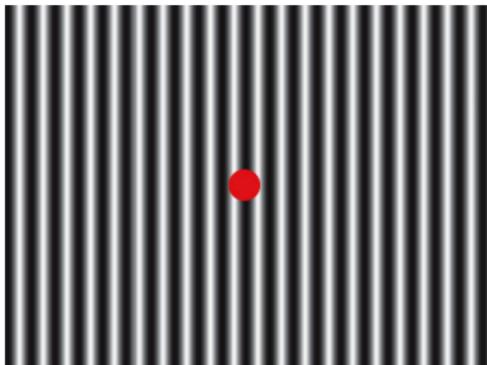
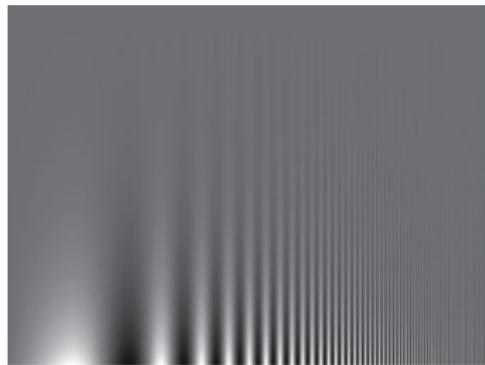
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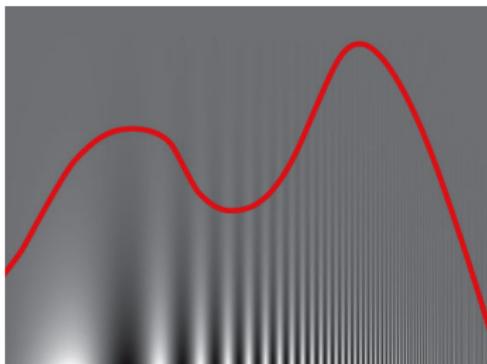
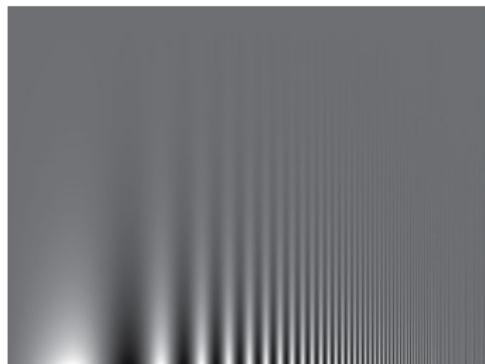
Selective adaptation: the psychologist's electrode



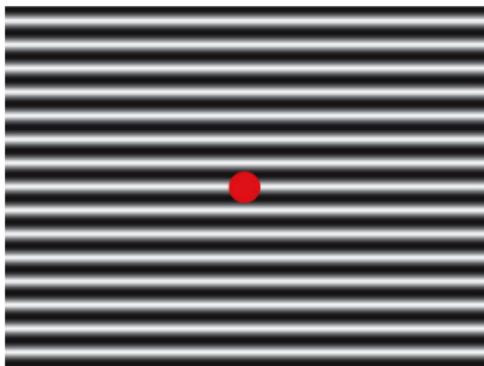
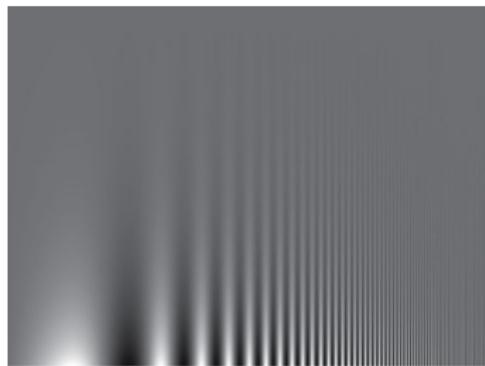
Selective adaptation: the psychologist's electrode



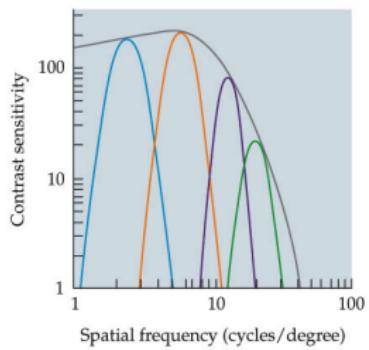
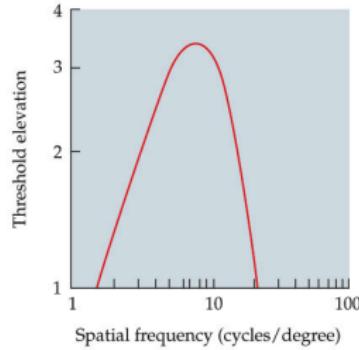
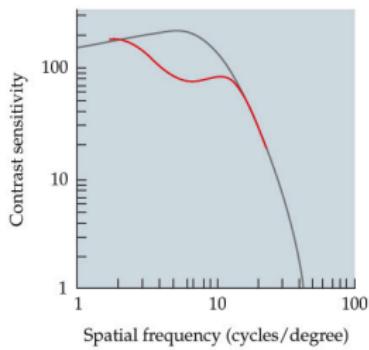
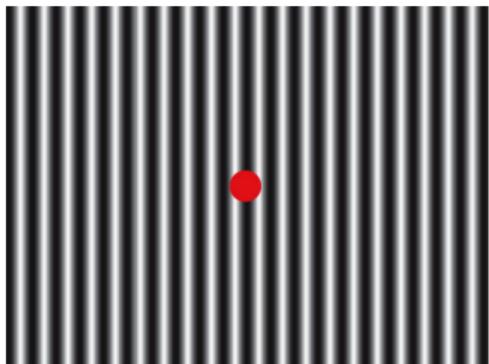
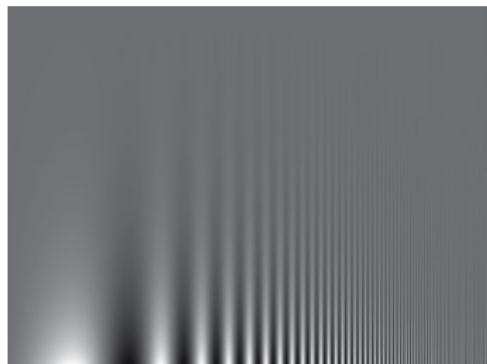
Selective adaptation: the psychologist's electrode



Selective adaptation: the psychologist's electrode



Selective adaptation: the psychologist's electrode

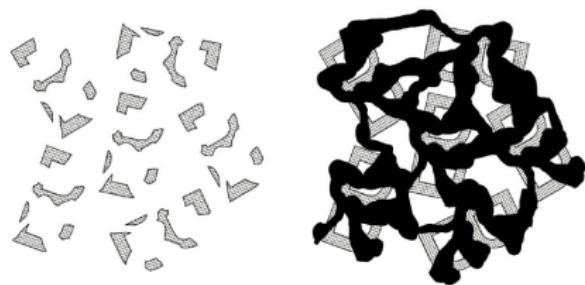


Spatial frequency tuned pattern analyzers in human vision

Summary

- Cognitive Psychology is the experimental study of human cognition
- Cognitive Psychology combines a number of different approaches including behavioral experiments, computational modelling and the study of the brain
- Cognitive Psychology focusses on the study of human cognition and as such is a subfield of Cognitive Science which also considers other cognitive agents
- The study of Human Cognition becomes increasingly transdisciplinary recognizing the usefulness of a diverse set of different approaches

Tutorial: how to measure perception?



Thinking

How can you find out what's happening in someone's head? In normal life? In science?

References

- Eysenck & Keane
- Ward, J. (2010). *The student's guide to cognitive neuroscience* (2nd ed.). Taylor & Francis, Psychology Press: Hove and New York.
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