



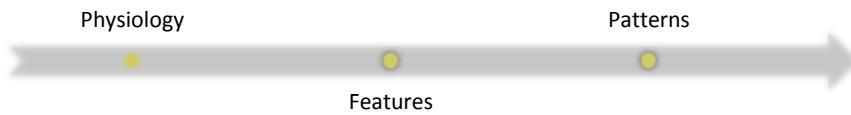
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Visual Pattern Recognition

Taylor J. Meek

October 22, 2009

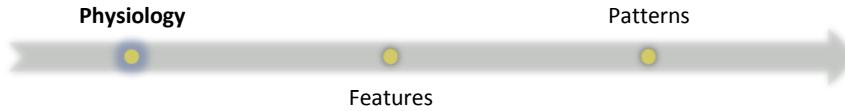


Difference Detectors and Visual Aftereffects

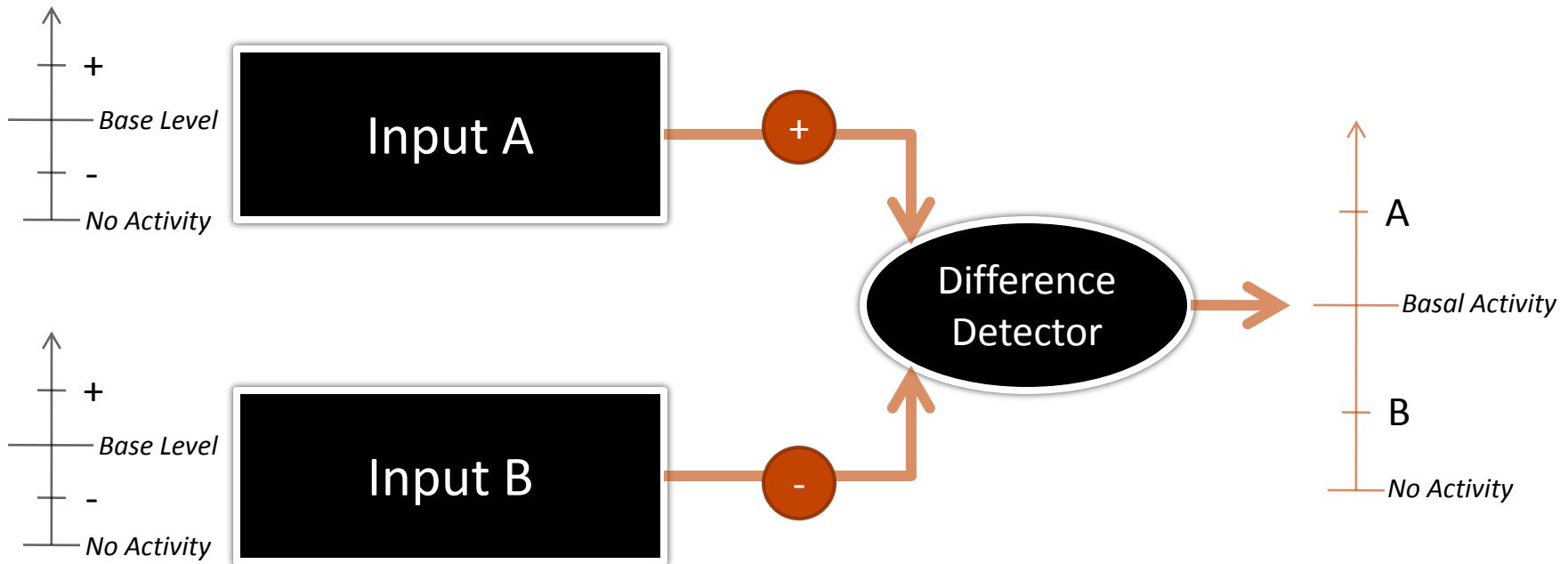
Finding the Feature Detectors

Building Feature Detector Systems

PHYSIOLOGICAL VISUAL SYSTEM



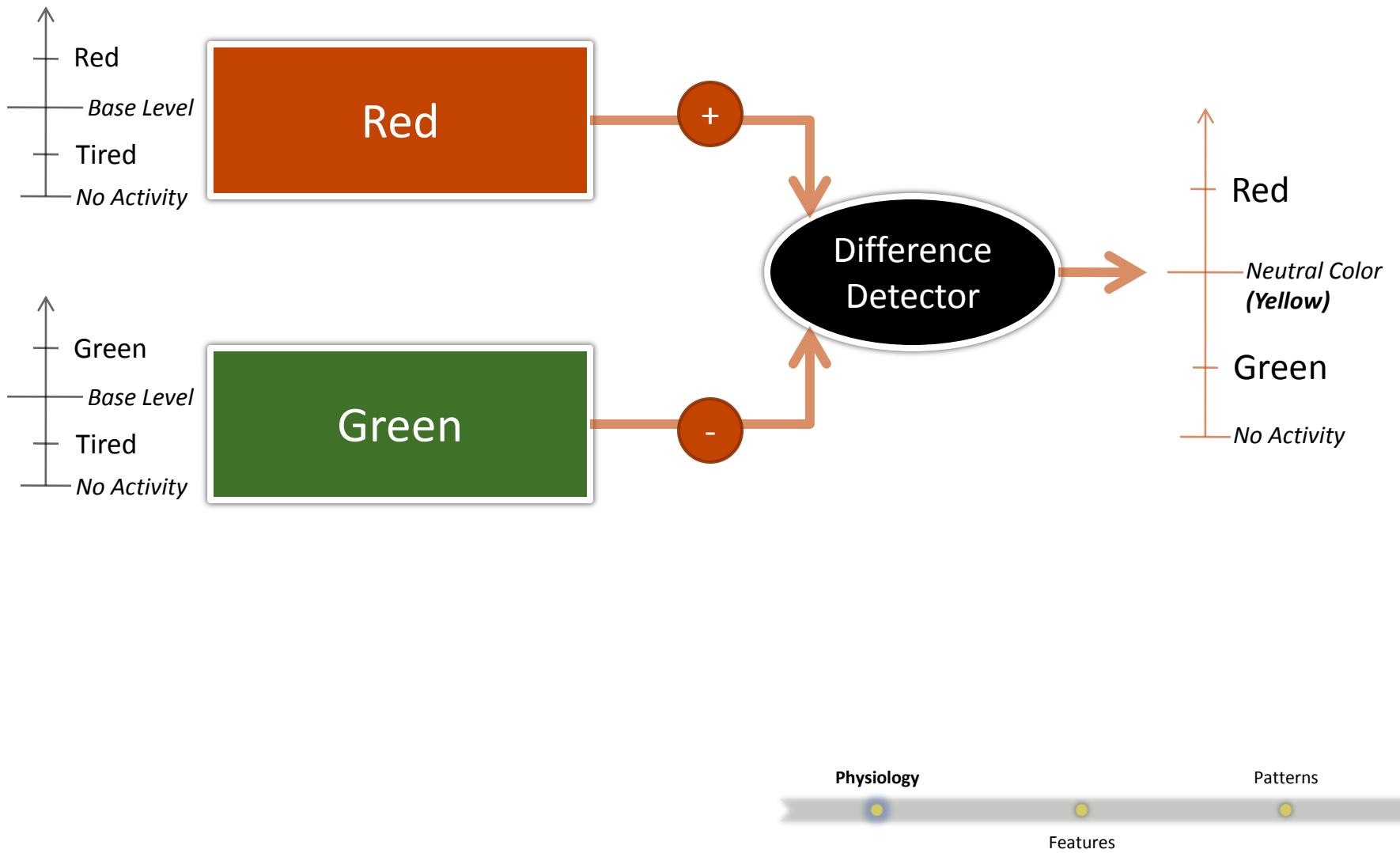
Difference Detectors



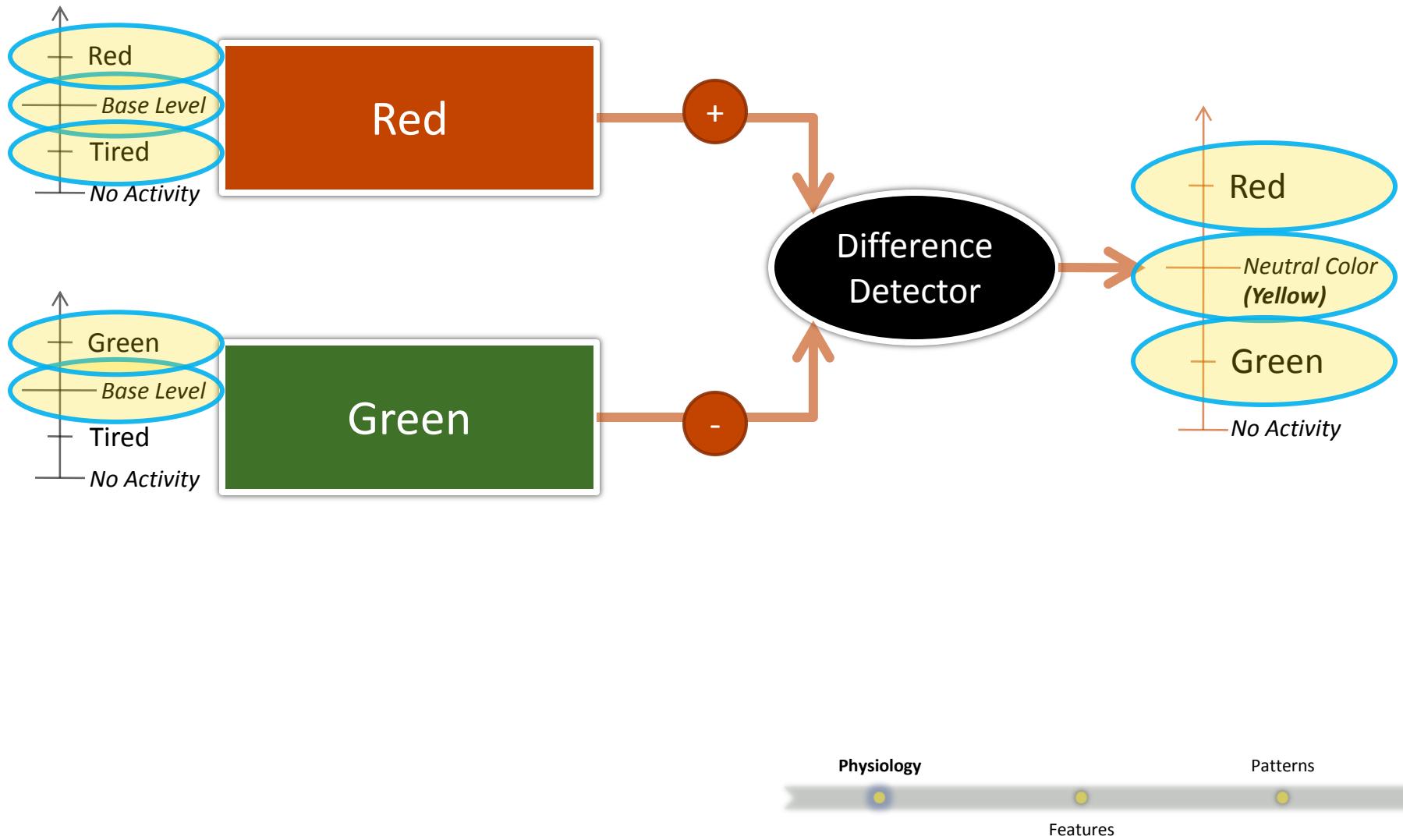
Physiology



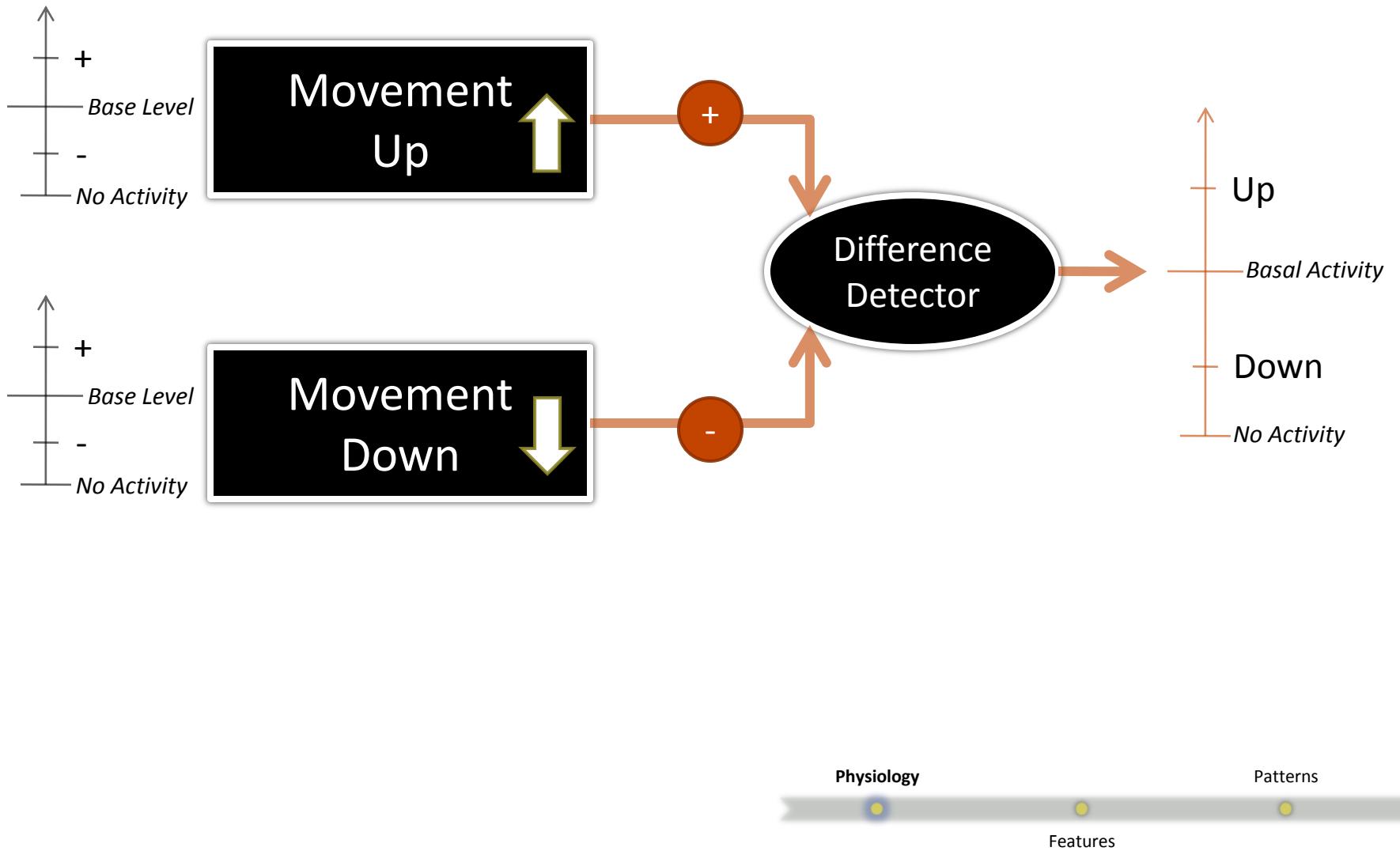
Difference Detectors



Difference Detectors



Difference Detectors

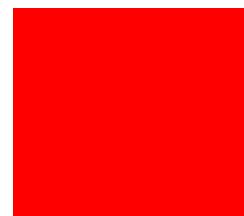
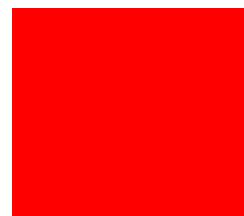
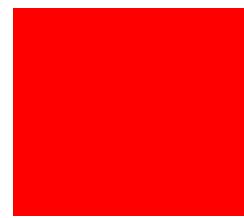
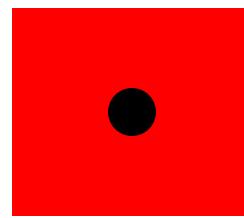
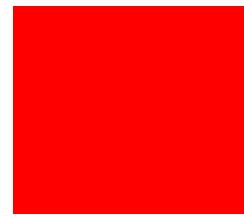
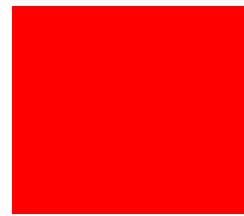
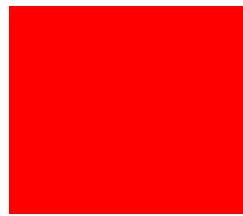


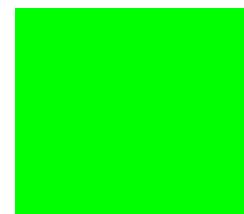
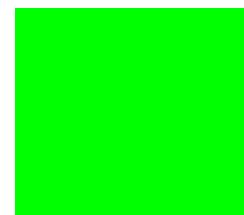
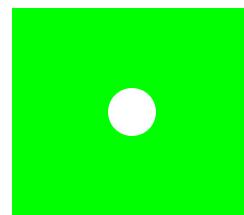
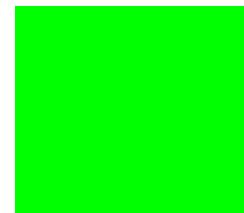
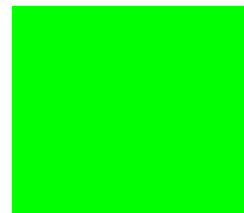
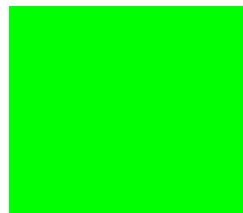
Aftereffects

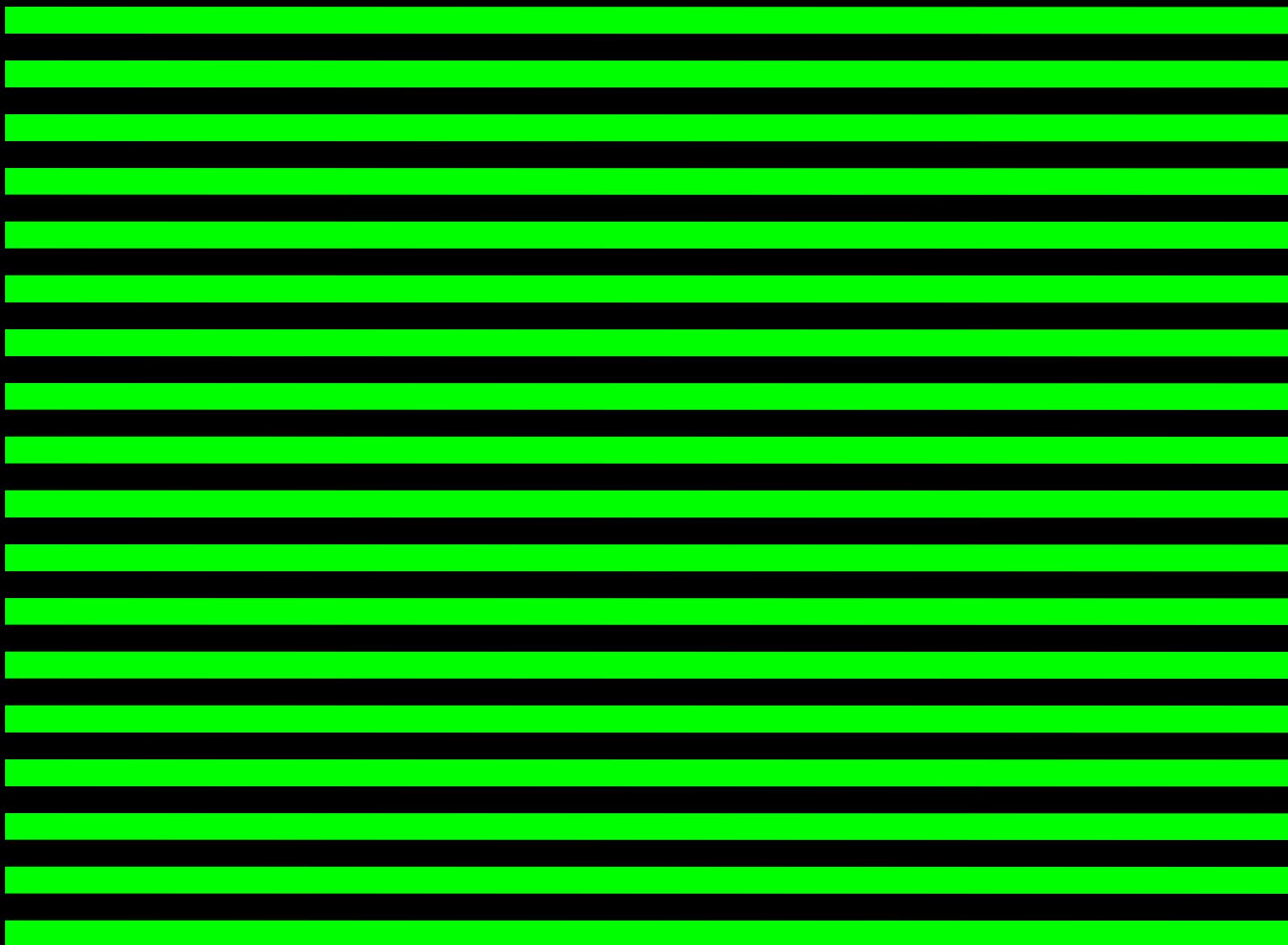
Complementary Color Photoreceptors

Something More Abstract

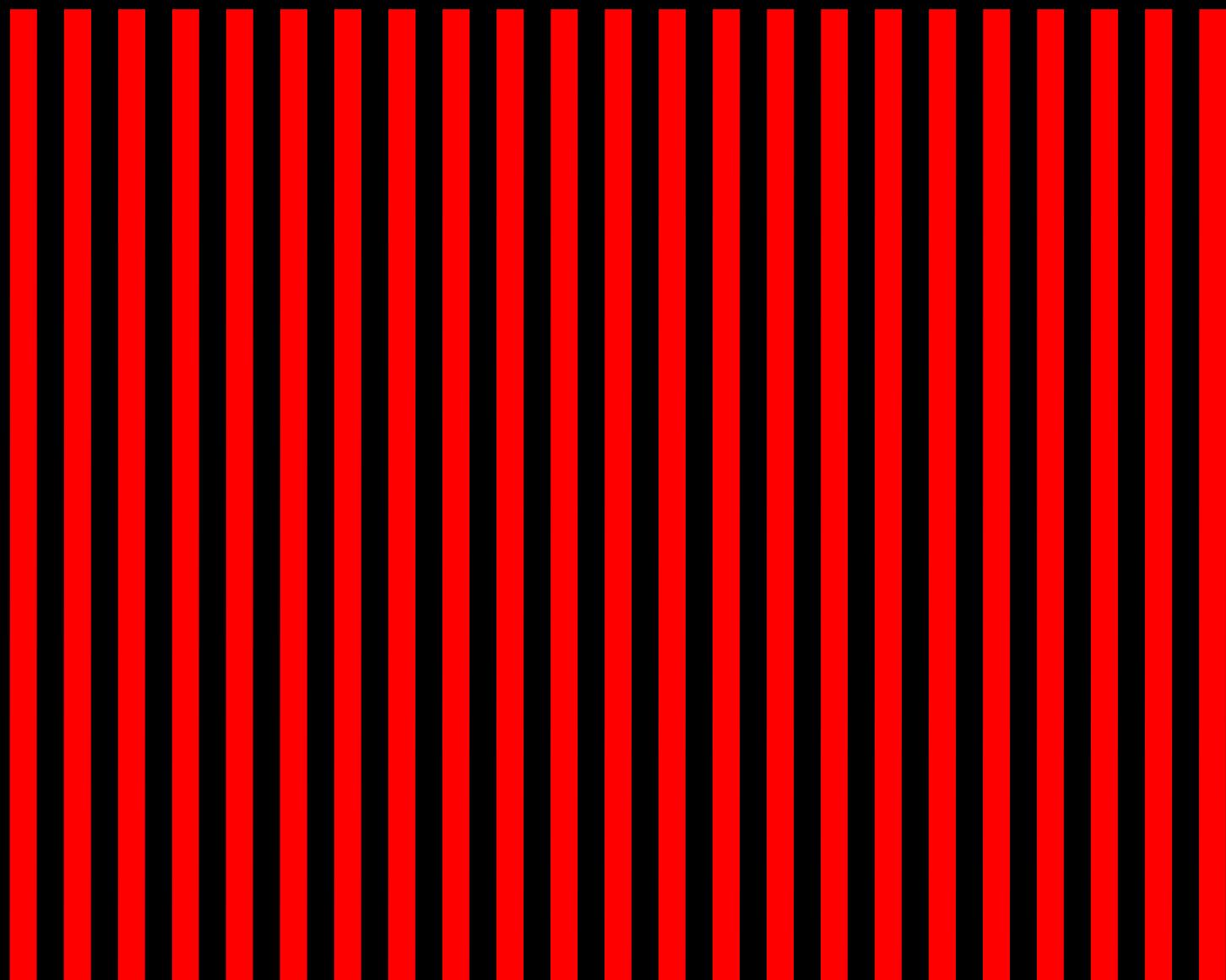
“The McCollough Effect”



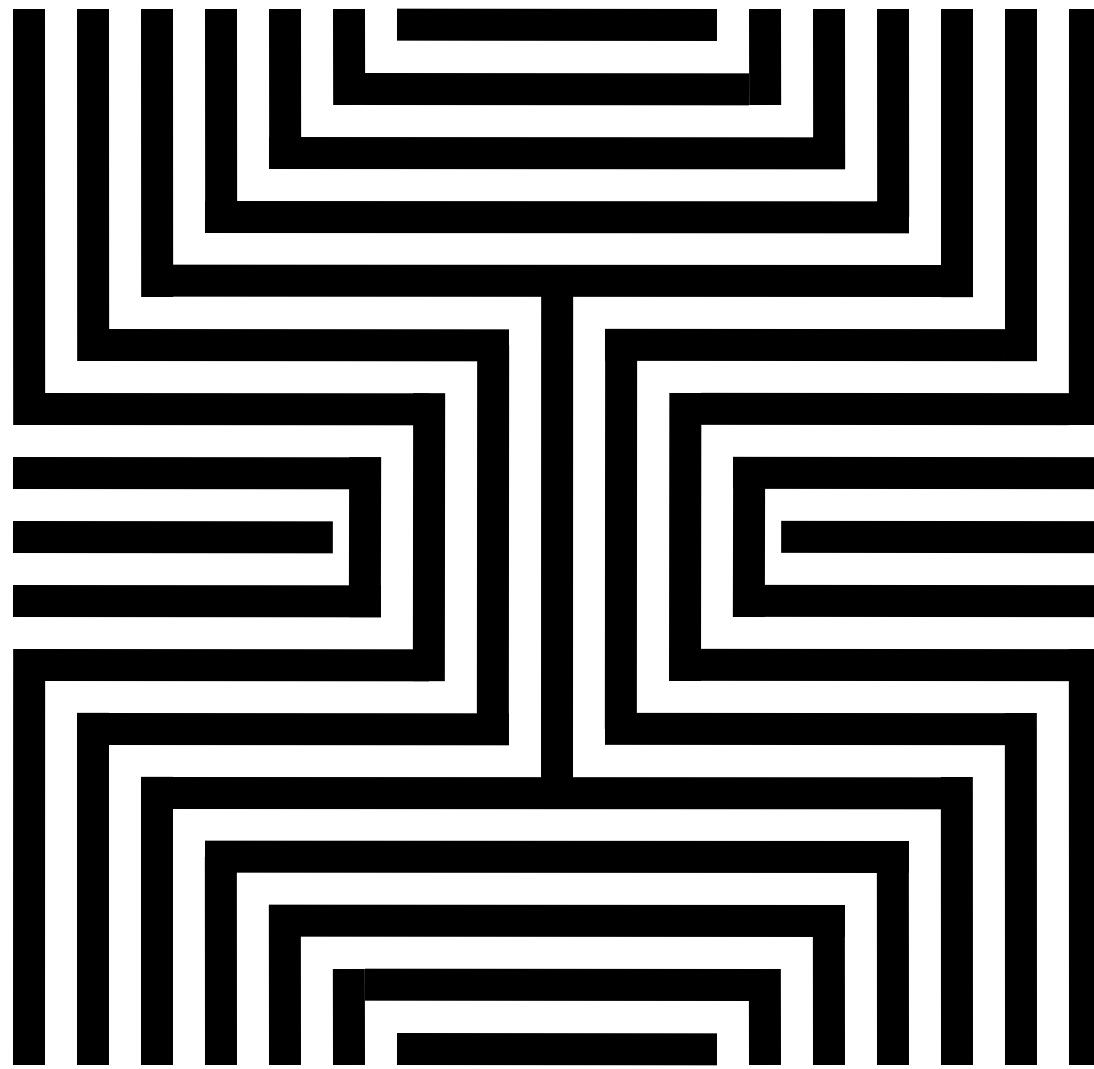




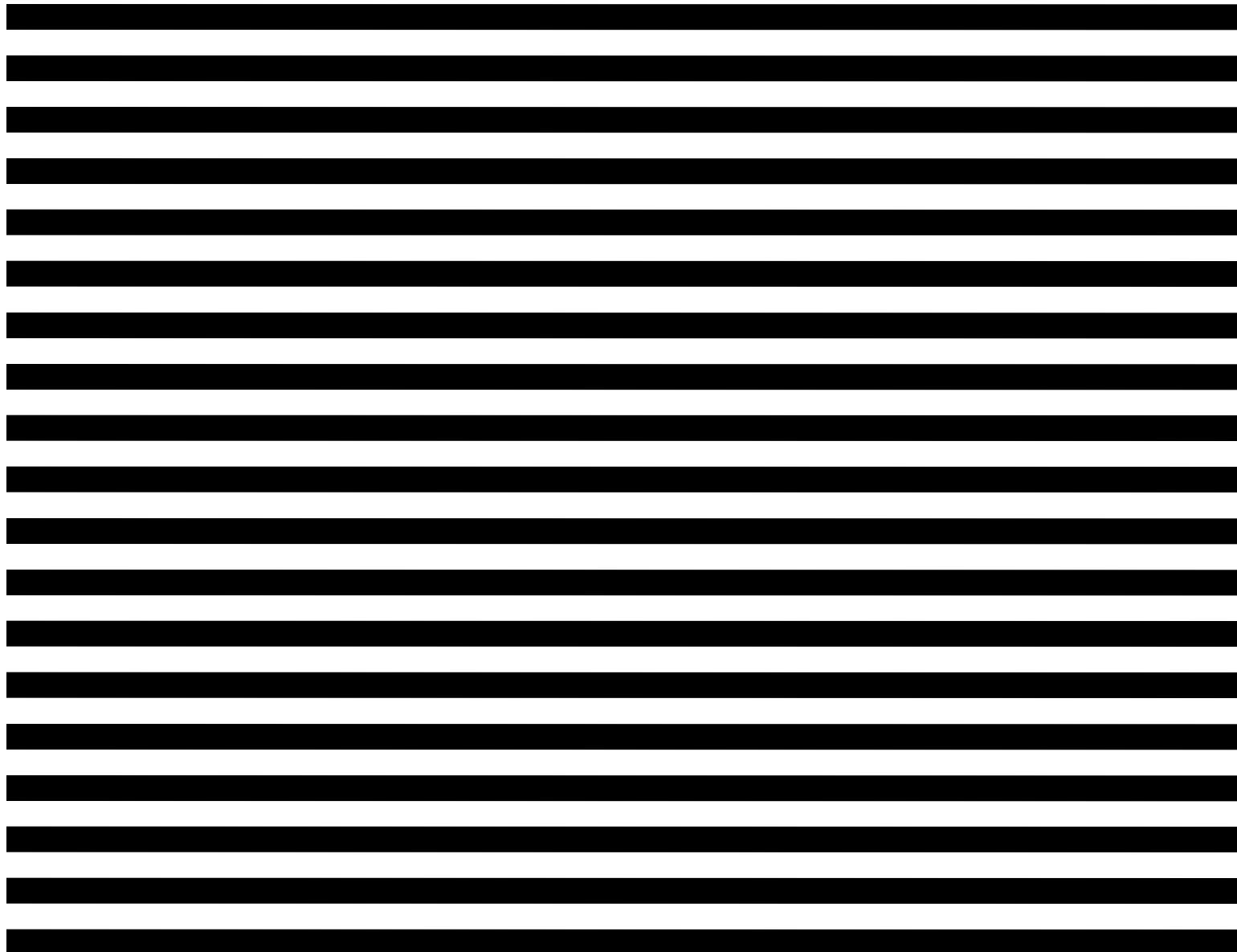
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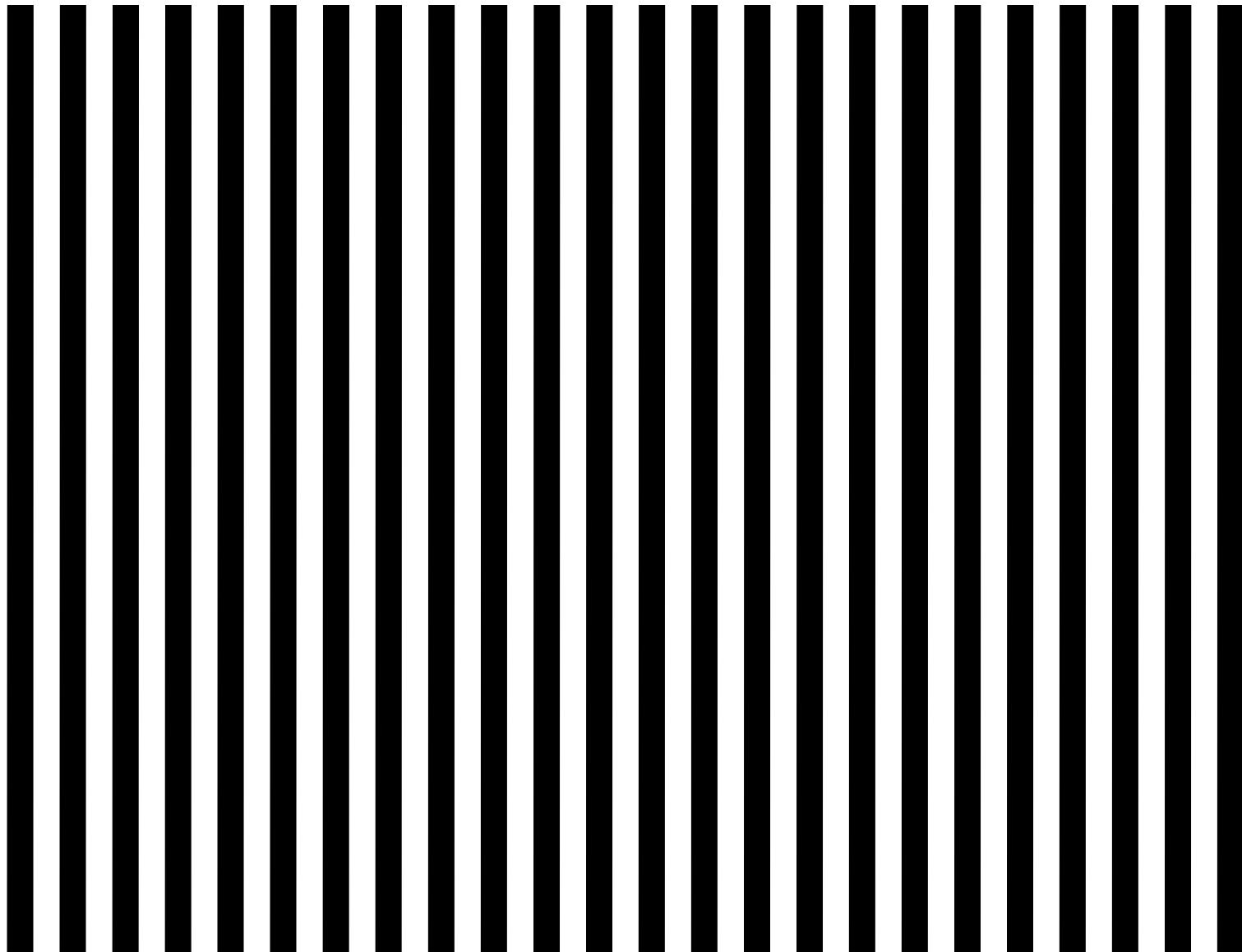


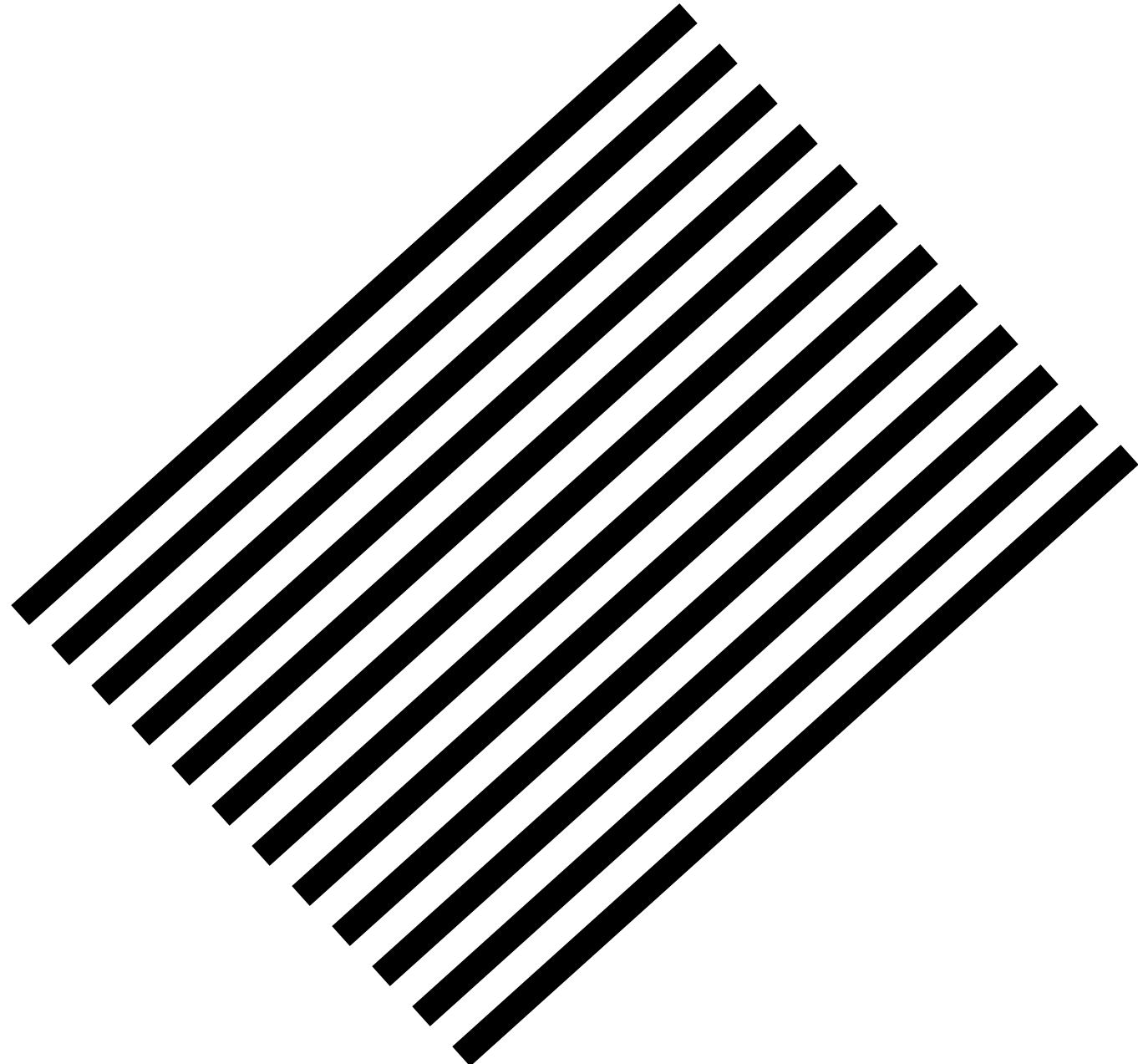
(Gibson & Harris 1968 in Lindsay & Norman 1977)



(Gibson & Harris 1968 in Lindsay & Norman 1977)







Difference Detectors

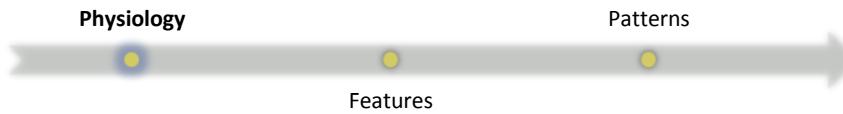
So what?

Eye Transfer

Color Desensitization

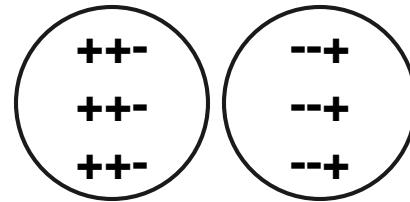
Motion Detector Desensitization

Orientation-specific Line Detectors

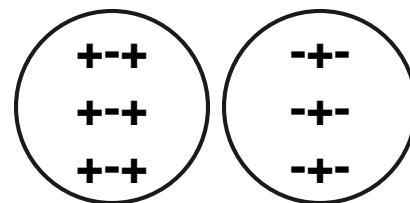


Feature Detectors

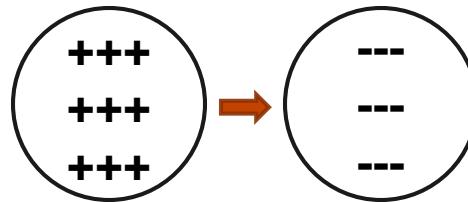
Edge



Slit/Line



Dimness

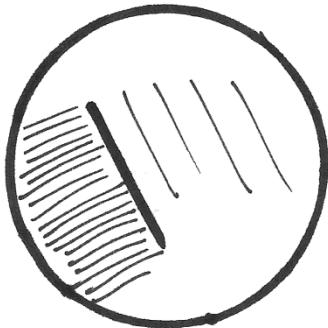


Physiology

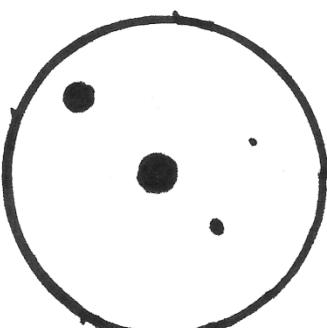


Features

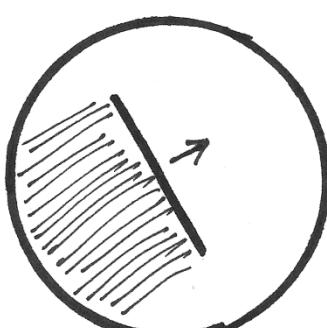
Physiological Feature Detectors



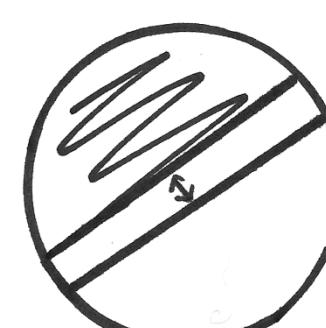
Edge



Convex Edge



Moving Contrast
(Edge)



Dimness



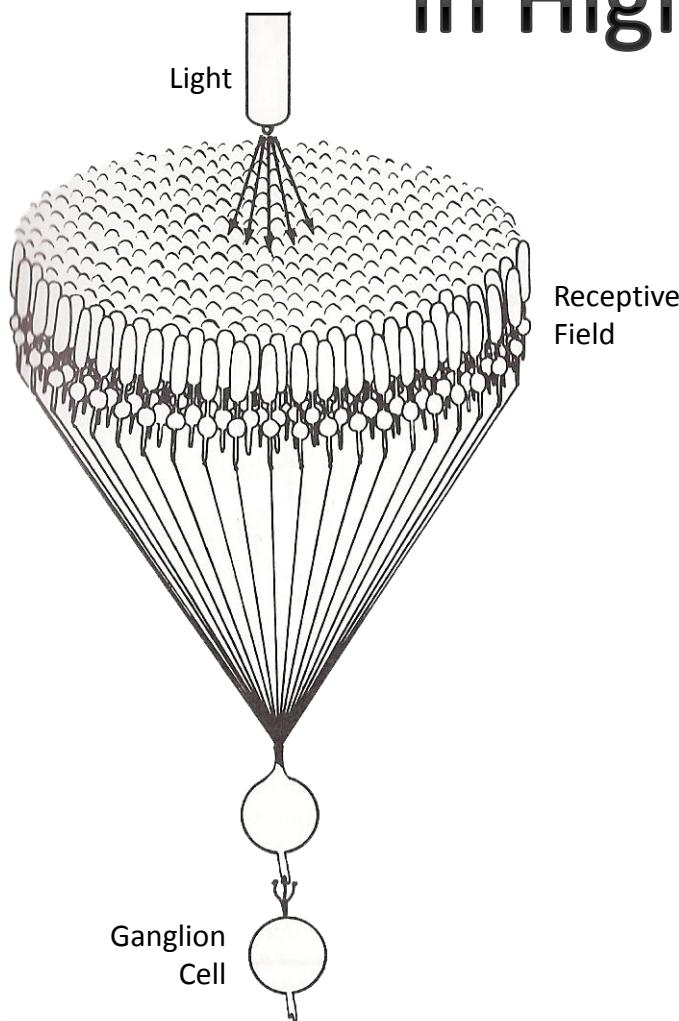
<http://flickr.com/photos/thomashawk/90125879/>
Toad by Thomas Hawk, under CC License

Physiology



Patterns

Feature Detectors in Higher-Order Species



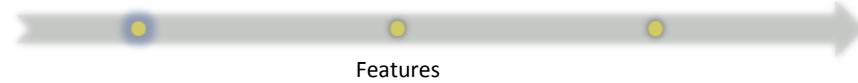
Ganglion & Bi-Polar Cells

- On-Center, Off-Surround
- Off-Center, On-Surround
- Light Onset, Extinction
- Peculiar Receptive Fields
- Color Specificity, Contrast
- Movement (Directional)

(Lindsay & Norman 1977, p.215)

Physiology

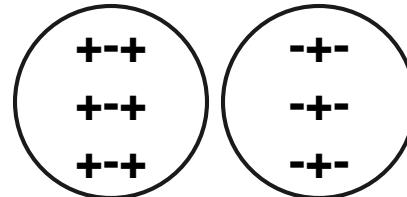
Patterns



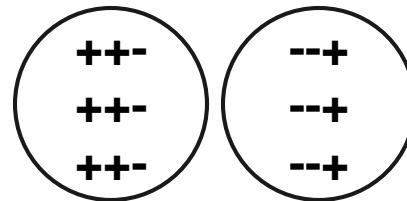
Simple Feature Detector Cells in Higher-Order Species

Selective to:
Location
Type
Orientation/direction
Width

Slit and Line



Edge



Physiology

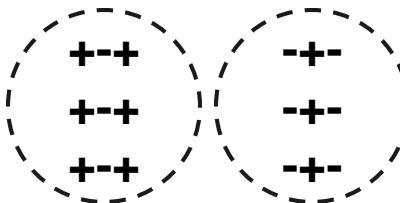
Patterns



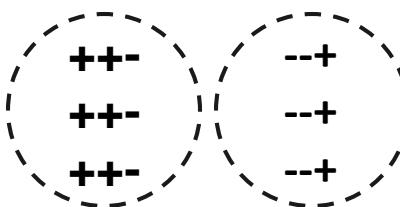
Complex Feature Detector Cells in Higher-Order Species

Selective to:
~~Location~~
Type
Orientation/direction
Width

Slit and Line



Edge



Physiology

Patterns

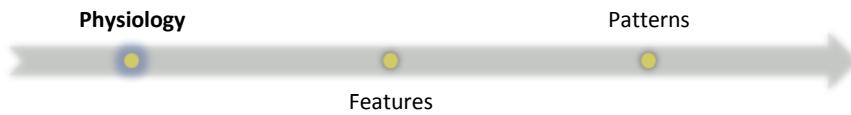


Hyper-Complex Feature Detector Cells in Higher-Order Species

Size/Endpoint Termination

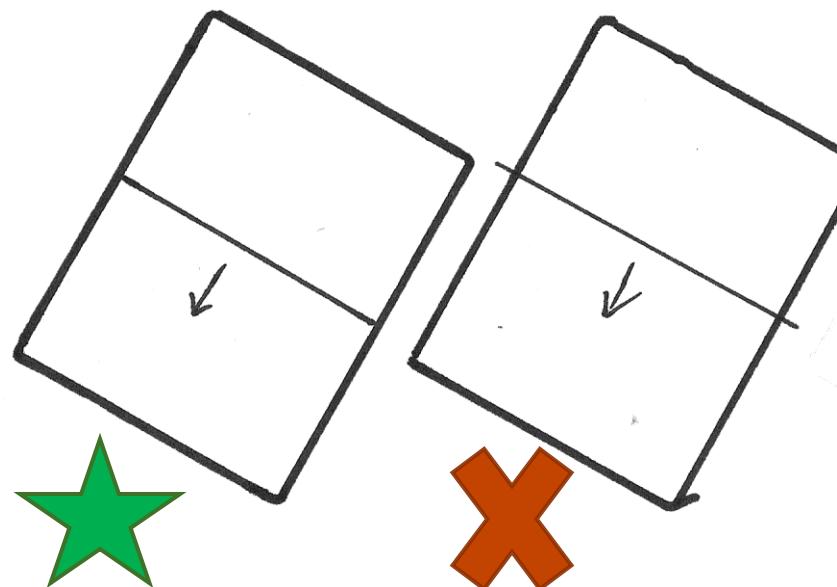
Movement (Axial Bidirectional)

Angle



Hyper-Complex Feature Detector Cells in Higher-Order Species

Size/Endpoint Termination



Physiology

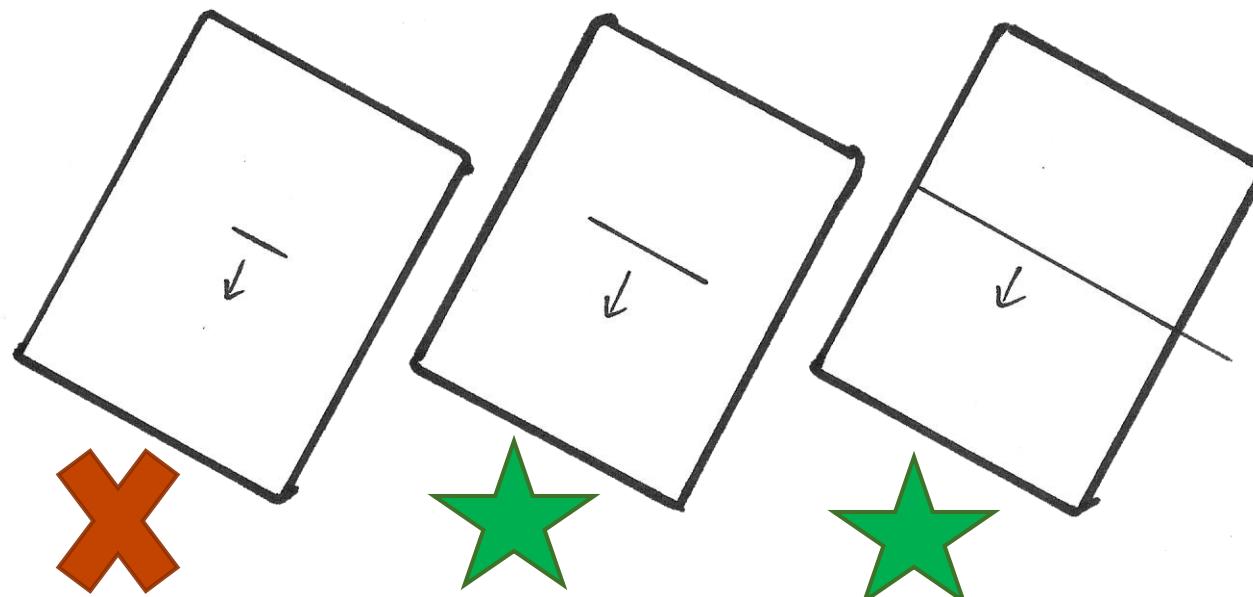


Patterns

Features

Hyper-Complex Feature Detector Cells in Higher-Order Species

Size/Endpoint Termination



Physiology

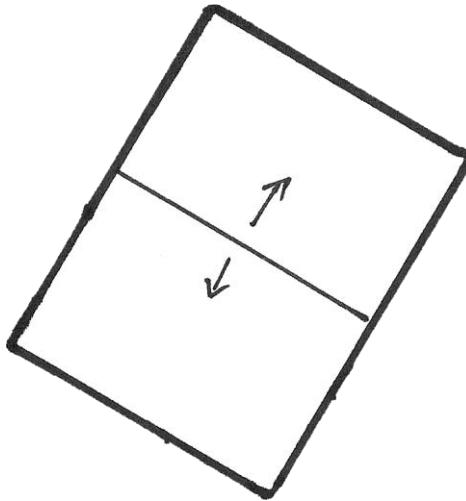


Patterns

Features

Hyper-Complex Feature Detector Cells in Higher-Order Species

Movement (Bidirectional)



Physiology

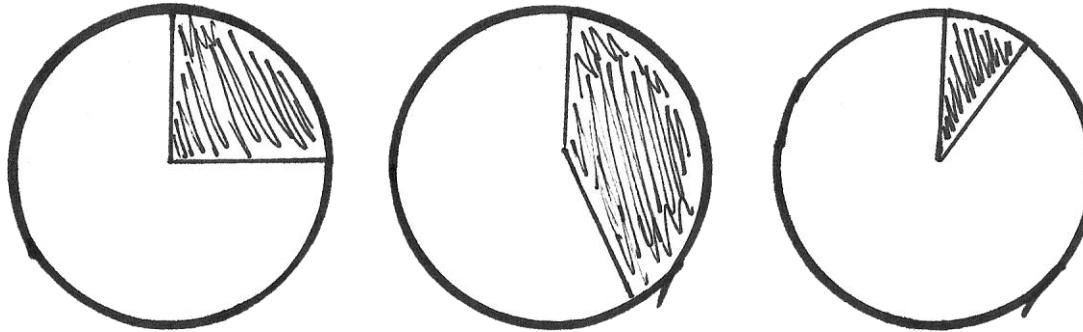


Patterns

Features

Hyper-Complex Feature Detector Cells in Higher-Order Species

Angle

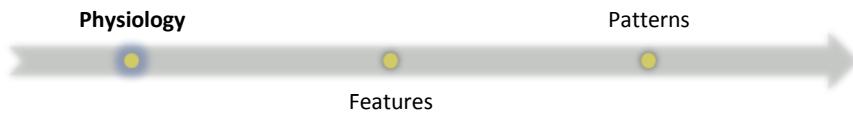
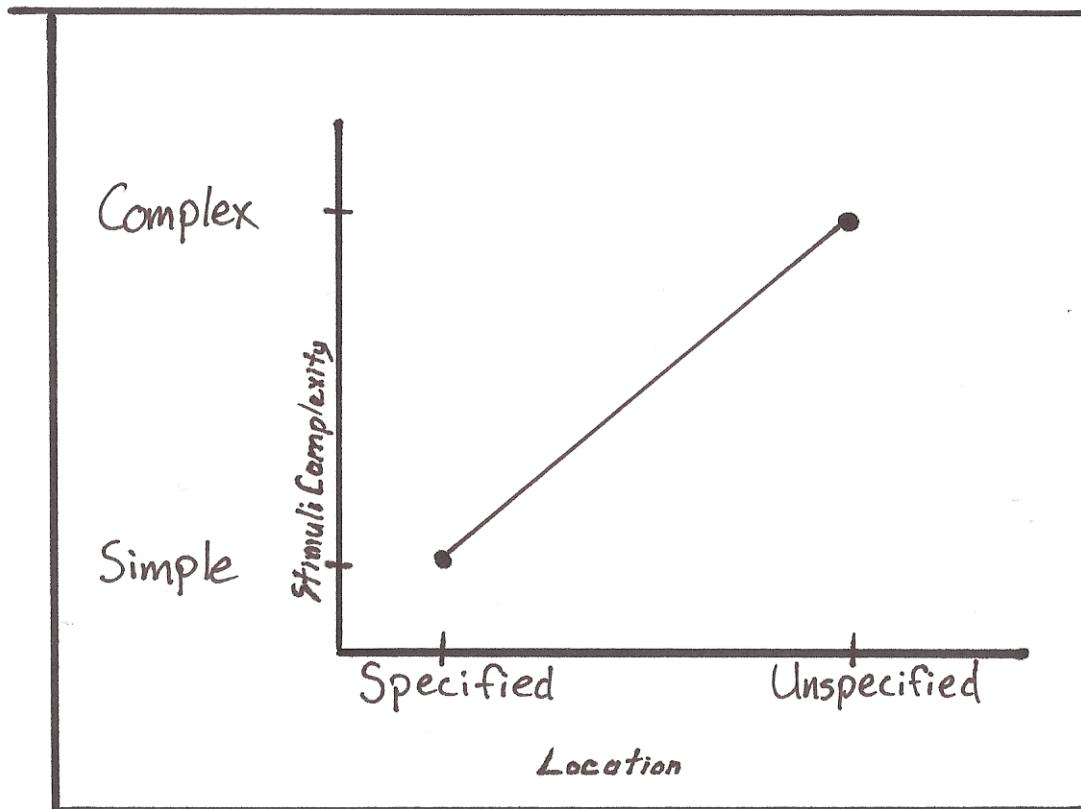


Physiology

Patterns



Higher-Level Feature Detector Cells in Higher-Order Species

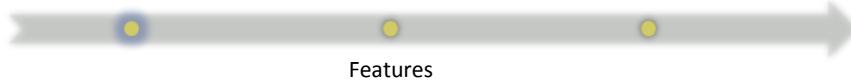


Higher-Level Feature Detector Cells in Higher-Order Species



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The Monkey Paw by John "Jay" Glenn, under CC License

Physiology



Higher-Level Feature Detector Cells in Higher-Order Species

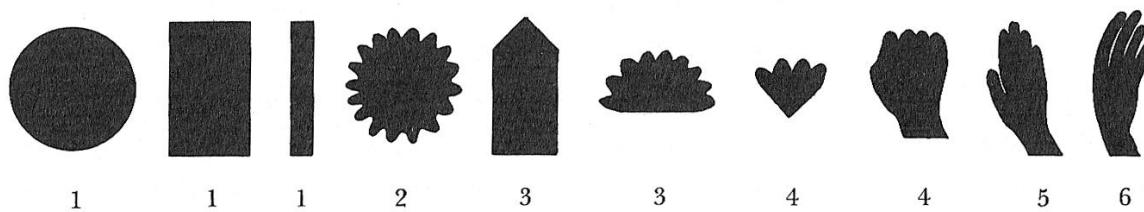
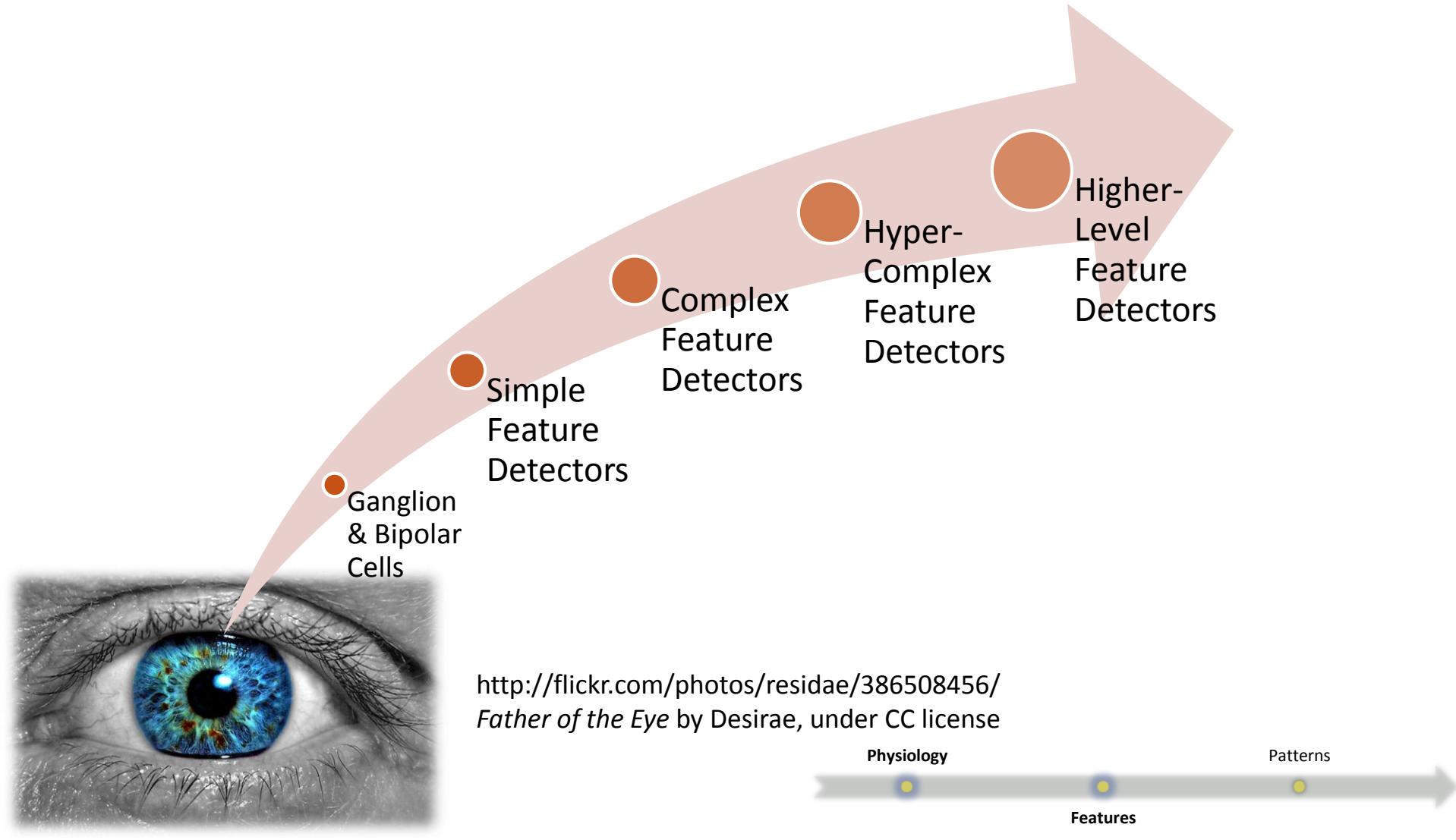


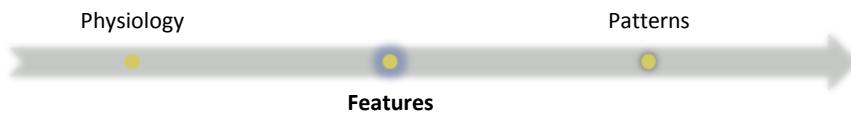
FIGURE 6-45 *Examples of shapes used to stimulate an inferotemporal unit apparently having very complex trigger features. The stimuli are arranged from left to right in order of increasing ability to drive the neuron from none (1) or little (2 and 3) to maximum (6). (From Gross et al., 1971, reproduced from Gross, 1973.)*

Building Up Complex Feature Detectors

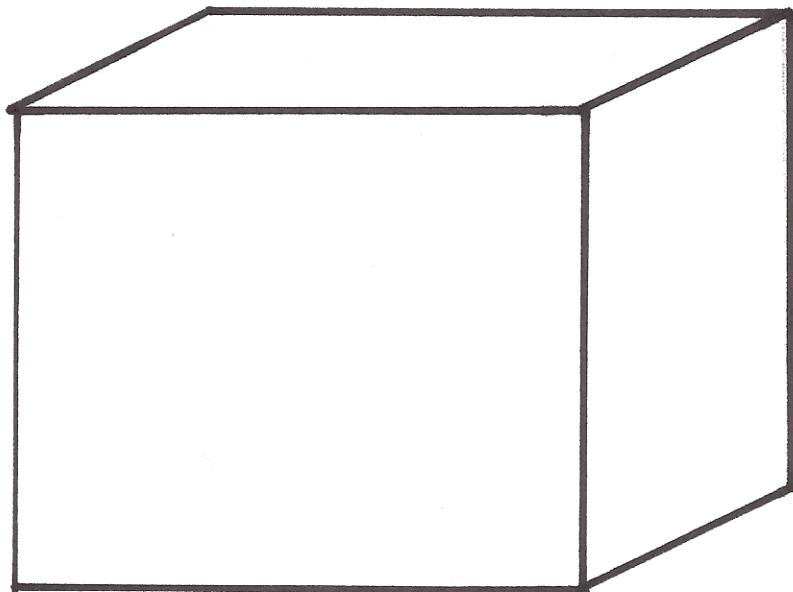


Features and Grouping
Geon Theory

COGNITIVE FEATURE DETECTION



Features and Objects



Physiological Nystagmus

Jiggly Eye Movements



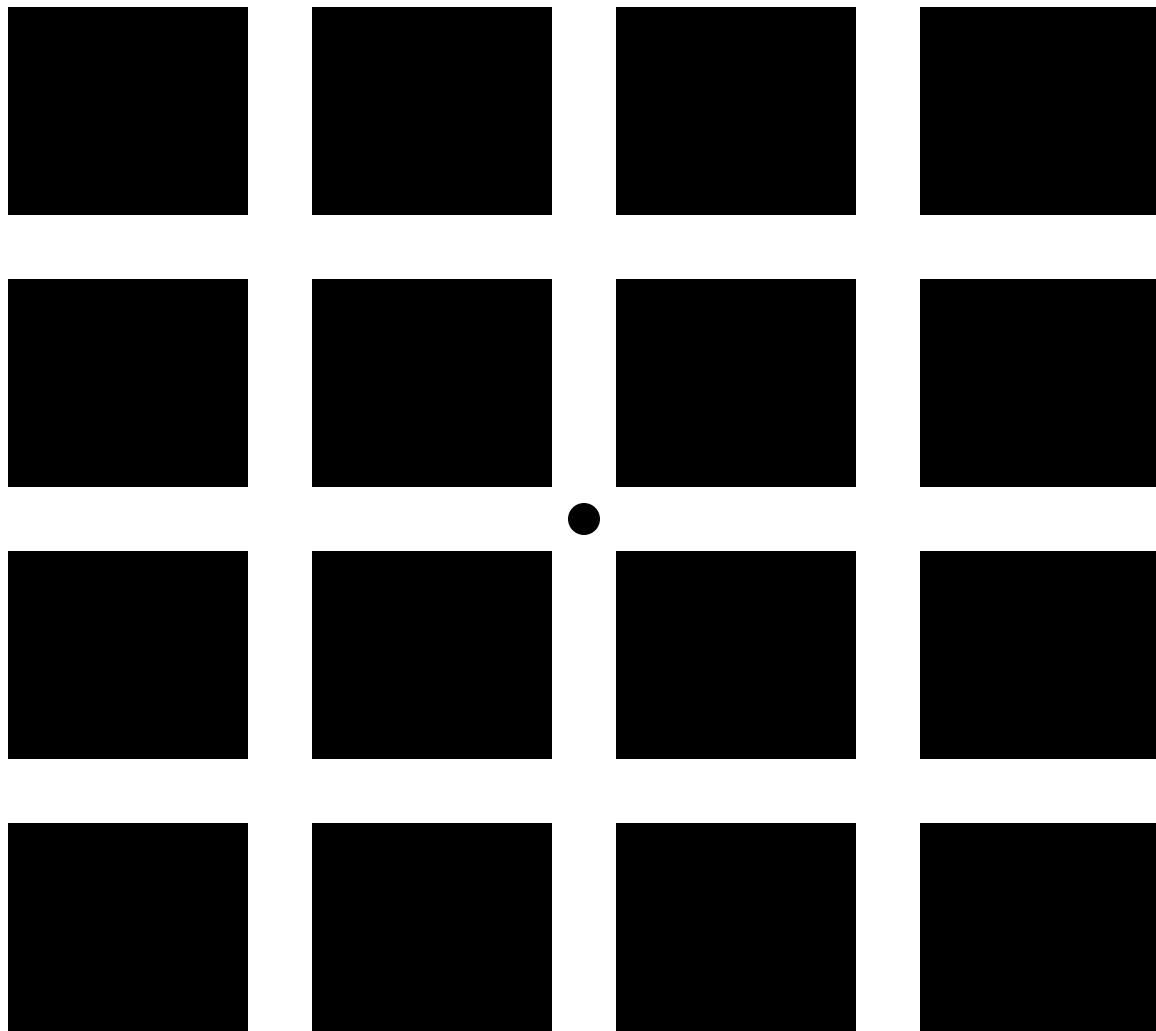
http://en.wikipedia.org/wiki/Image:Optokinetic_nystagmus.gif
Available under GNU Free Documentation License,
http://commons.wikimedia.org/wiki/Commons:GNU_Free_Documentation_License

Physiology



Features

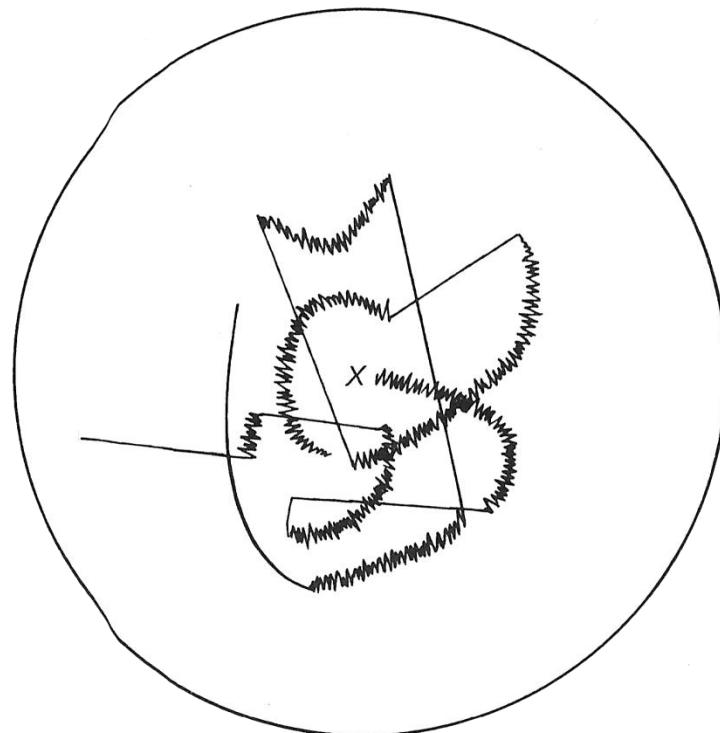
Patterns



(Verheijen 1961 in Lindsay & Norman 1977)

Physiological Nystagmus

Jiggle Eye Movements



Physiology

Patterns



Features

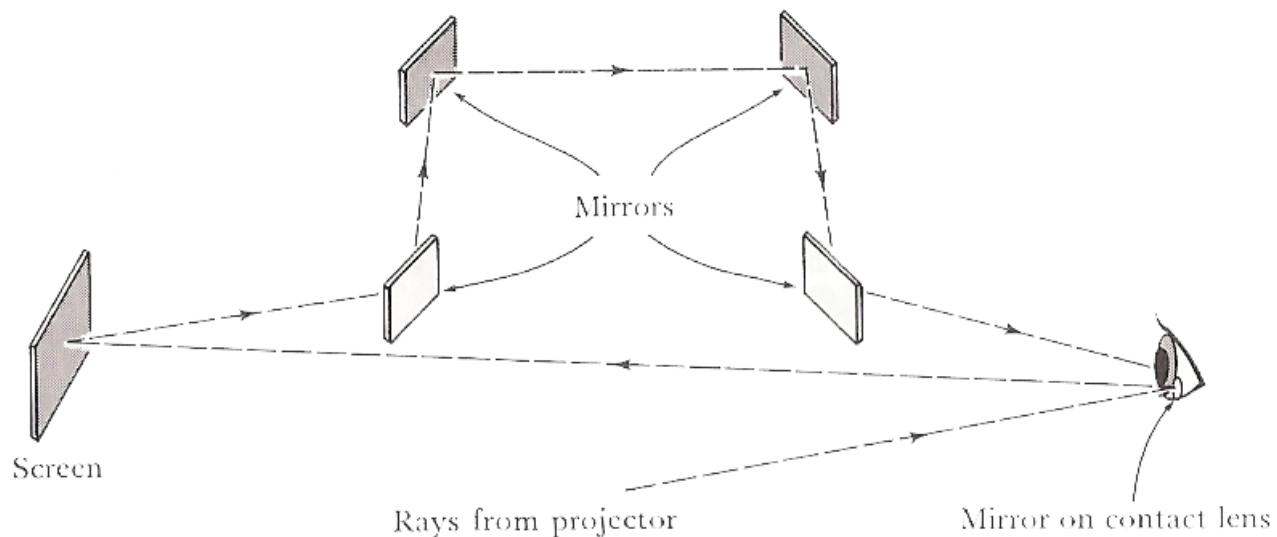


Physiological Nystagmus

Jiggly Eye Movements

FIGURE 1-42

From Riggs, Ratliff, Cornsweet, and Cornsweet (1953).

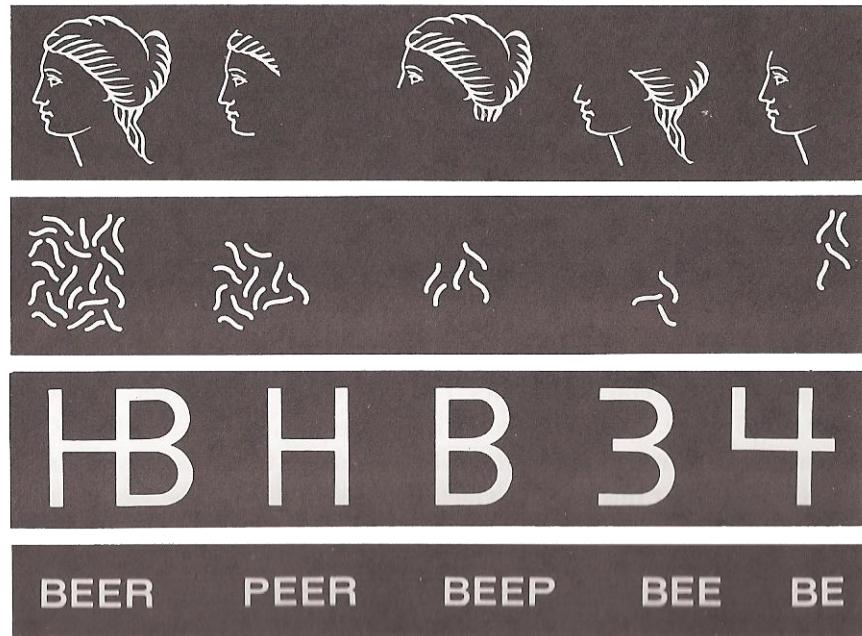


Physiology

Patterns



Segmental Image Loss



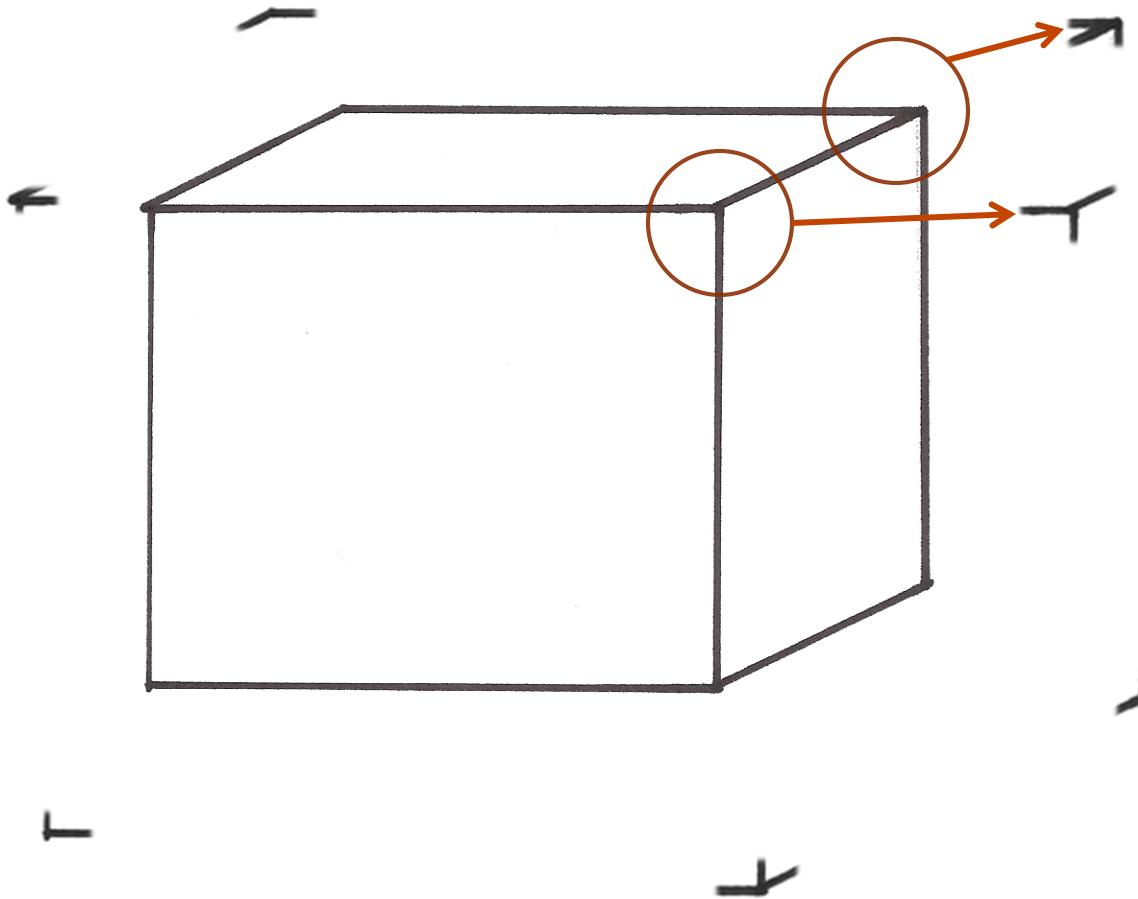
Physiology

Patterns

Features

(From R.M. Pritchard, *Scientific American*, 1961 in Lindsay & Norman 1977)

Object Segmentation into Features

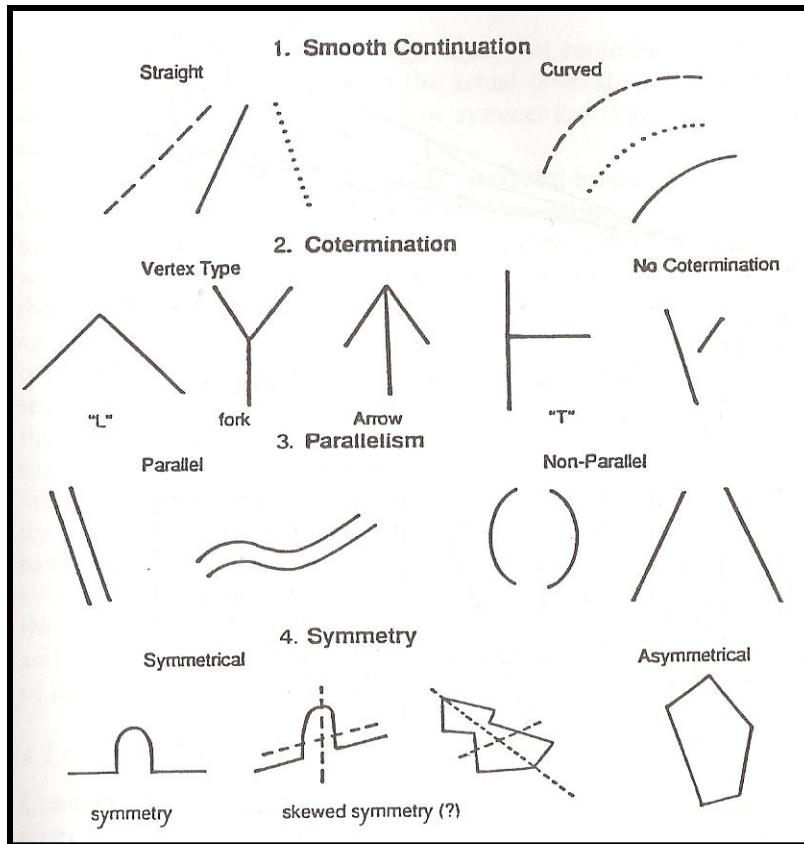


Physiology

Patterns



Feature Classes

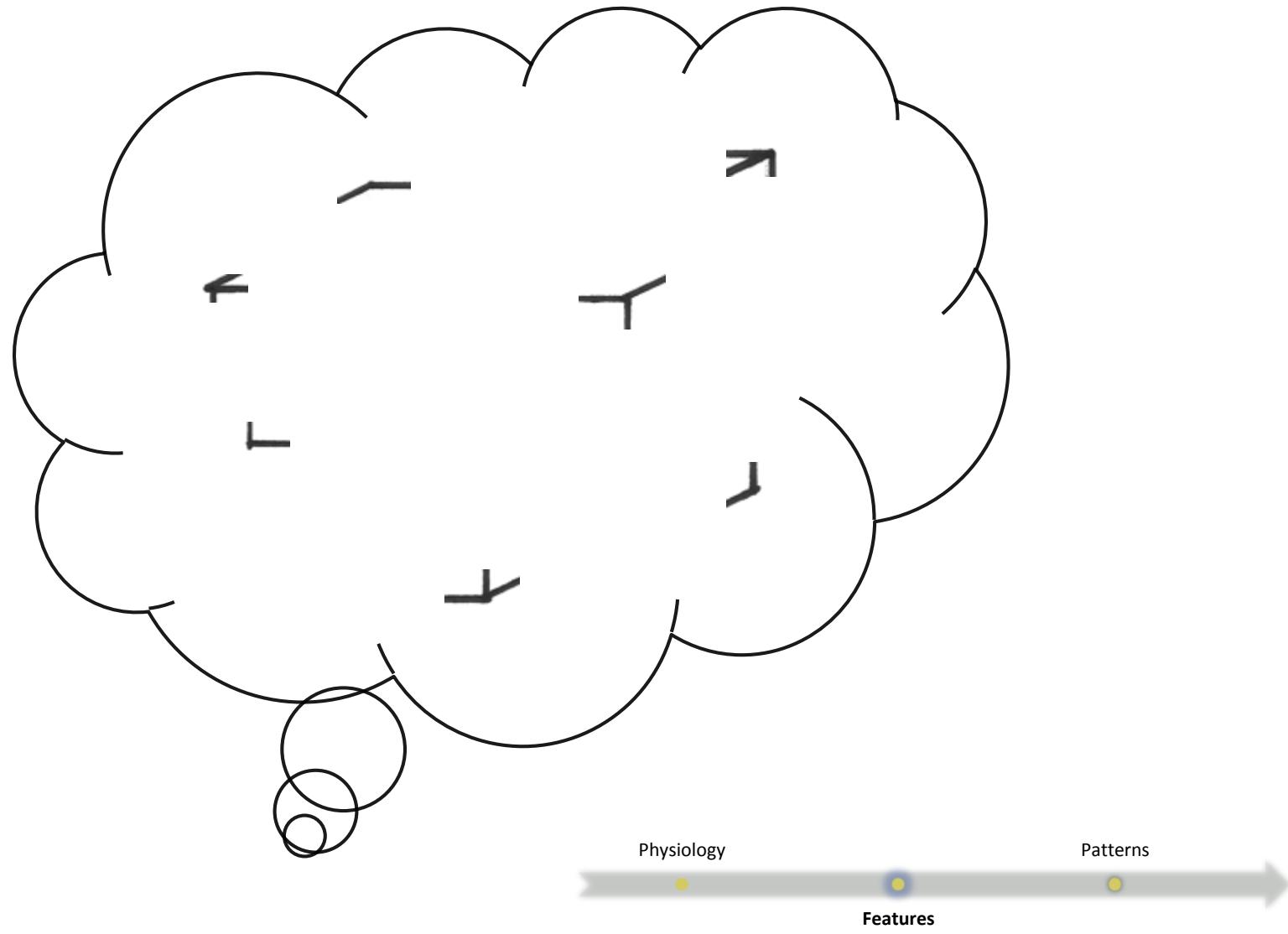


Physiology

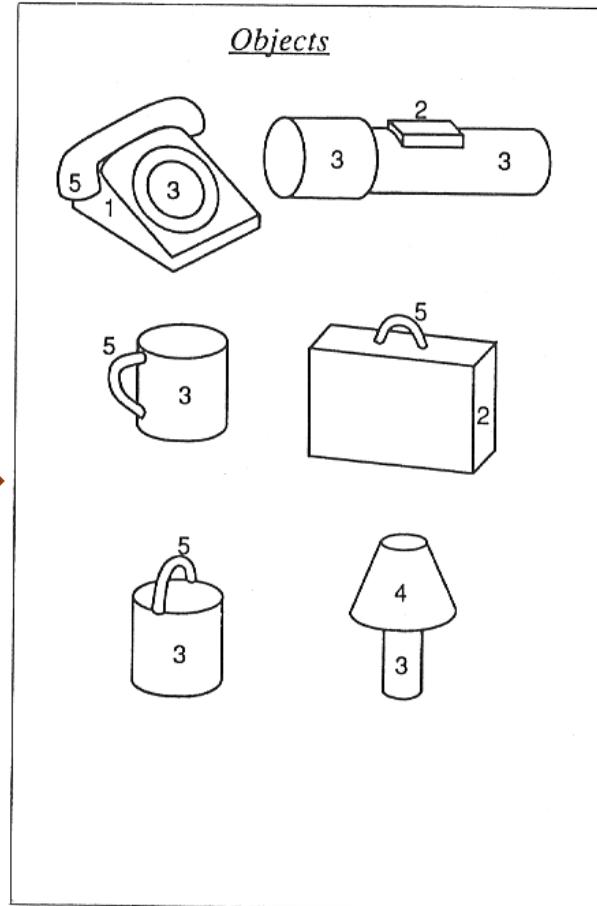
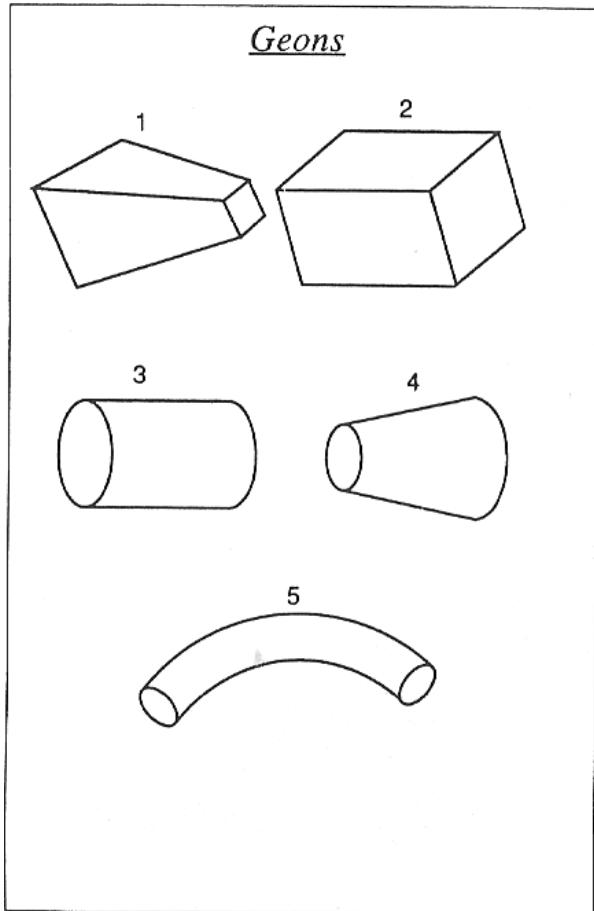
Patterns



Feature Relation



Geons



Physiology

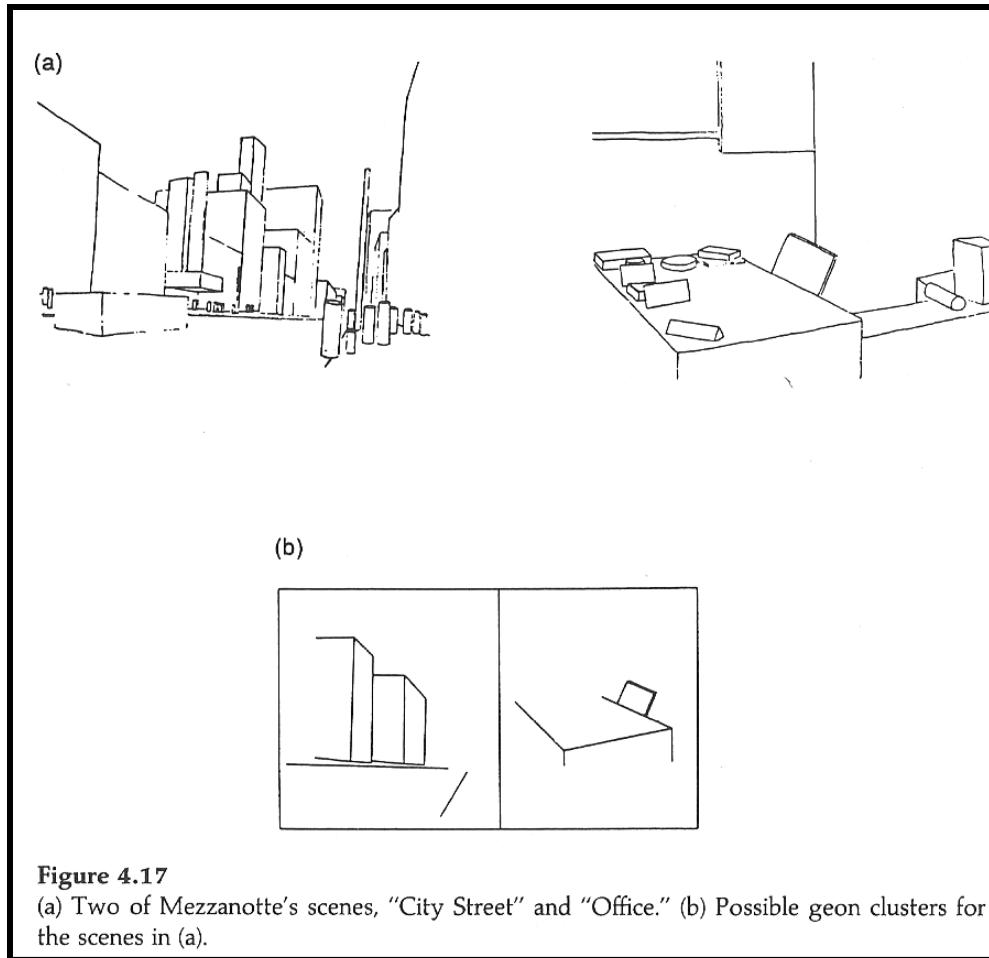
Patterns



Features



Geons to Scenes



Physiology

Patterns



Features

Features

Sensory Input

Physiological Features

Simple → Complex → Hypercomplex → Higher-Level

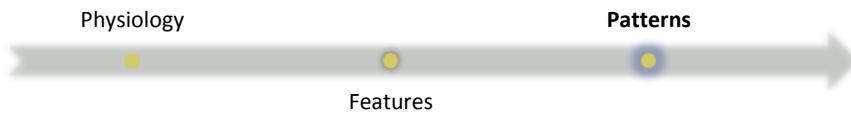
Feature Classes + Feature Relations

Object Segments

Objects

Pandemonium Revisited

PATTERN RECOGNITION



Words make sense.

SIZE *doesn't matter nor orientation*, missing information,
~~Intference~~, Variety In Pattern...
and even if orientation turns you on your head.



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