Sensation vs. Perception

Sensation

"The process by which our sensory receptors and nervous system receive and represent stimulus energies from our environment."

Perception

"The process of organizing and interpreting sensory information, enabling us to recognize meaningful objects and events."

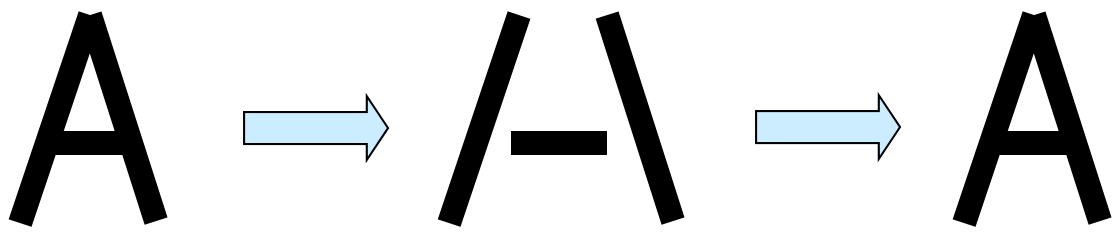
The brain receives input from the sensory organs.

The brain makes sense out of the input from sensory organs.

Transduction: the transformation of stimulus energy into neural impulses.

Bottom-up Processing

Analysis of the stimulus begins with the sense receptors and works up to the level of the brain and mind.



Letter "A" is really a black blotch broken down into features by the brain that we perceive as an "A."

Top-Down Processing

Information processing guided by higher-level mental processes as we construct perceptions, drawing on our experience and expectations.

Making sense of the world

What am I seeing?

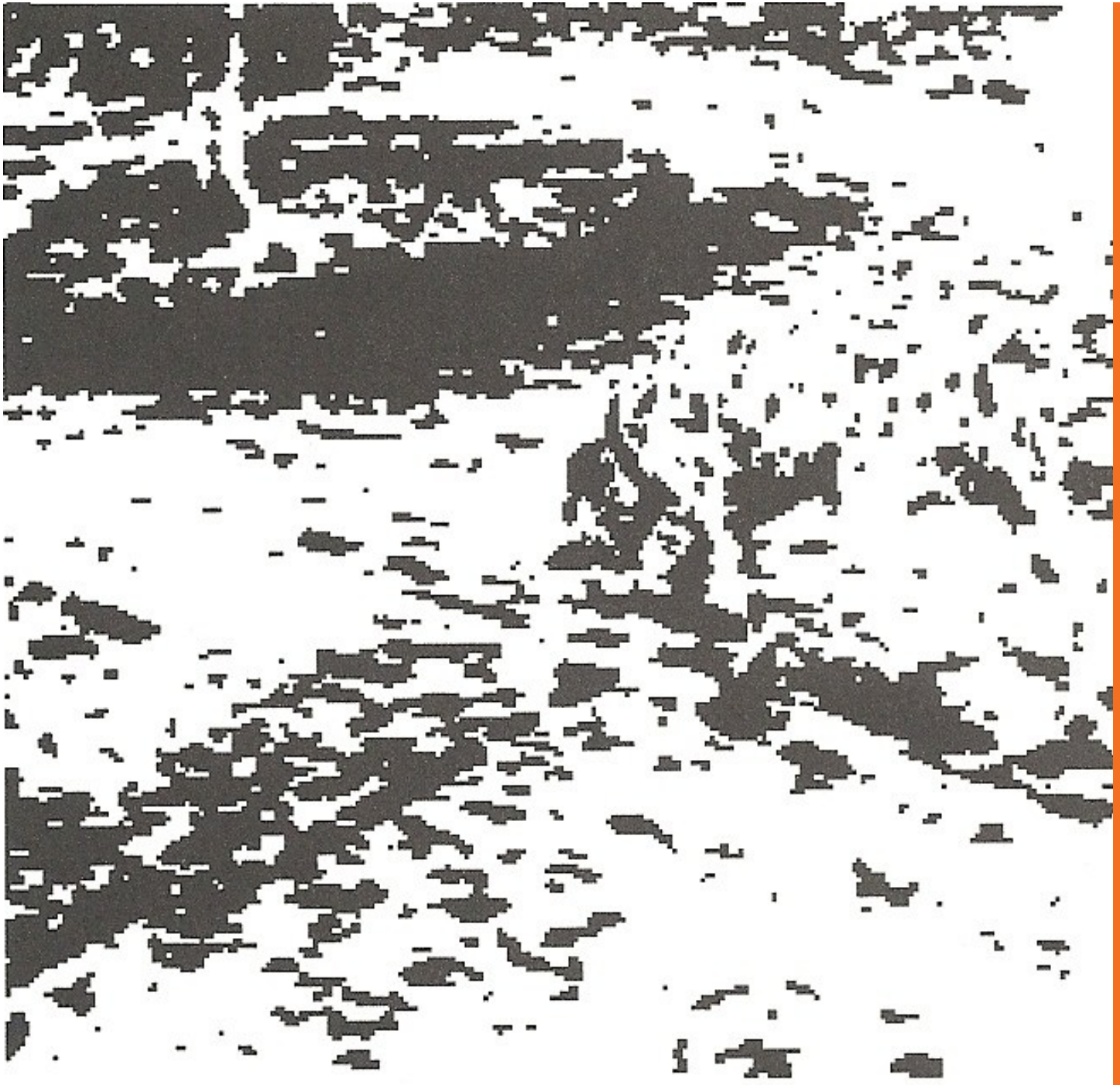
Bottom-up processing:

taking sensory information and then assembling and integrating it

Top-down processing:

using models, ideas, and expectations to interpret sensory information

Is that something I've seen before?



Top-down Processing

You may start to see something in this picture if we give your brain some concepts to apply:

"tree"

"sidewalk"

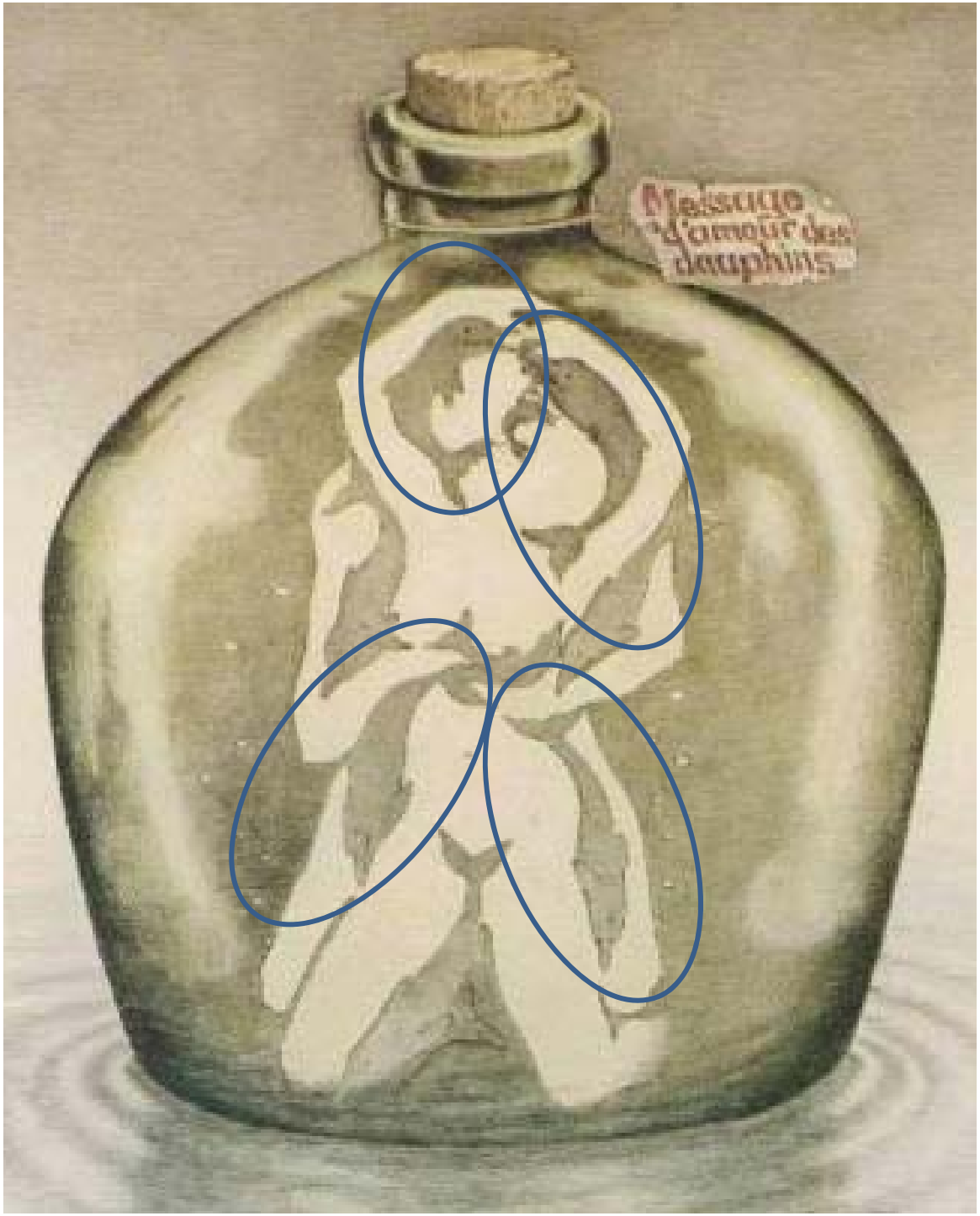
"dog"

"Dalmatian"

Making Sense of Complexity

Our sensory and perceptual processes work together to help us sort out complex images.

"The Forest Has Eyes," Bev Doolittle



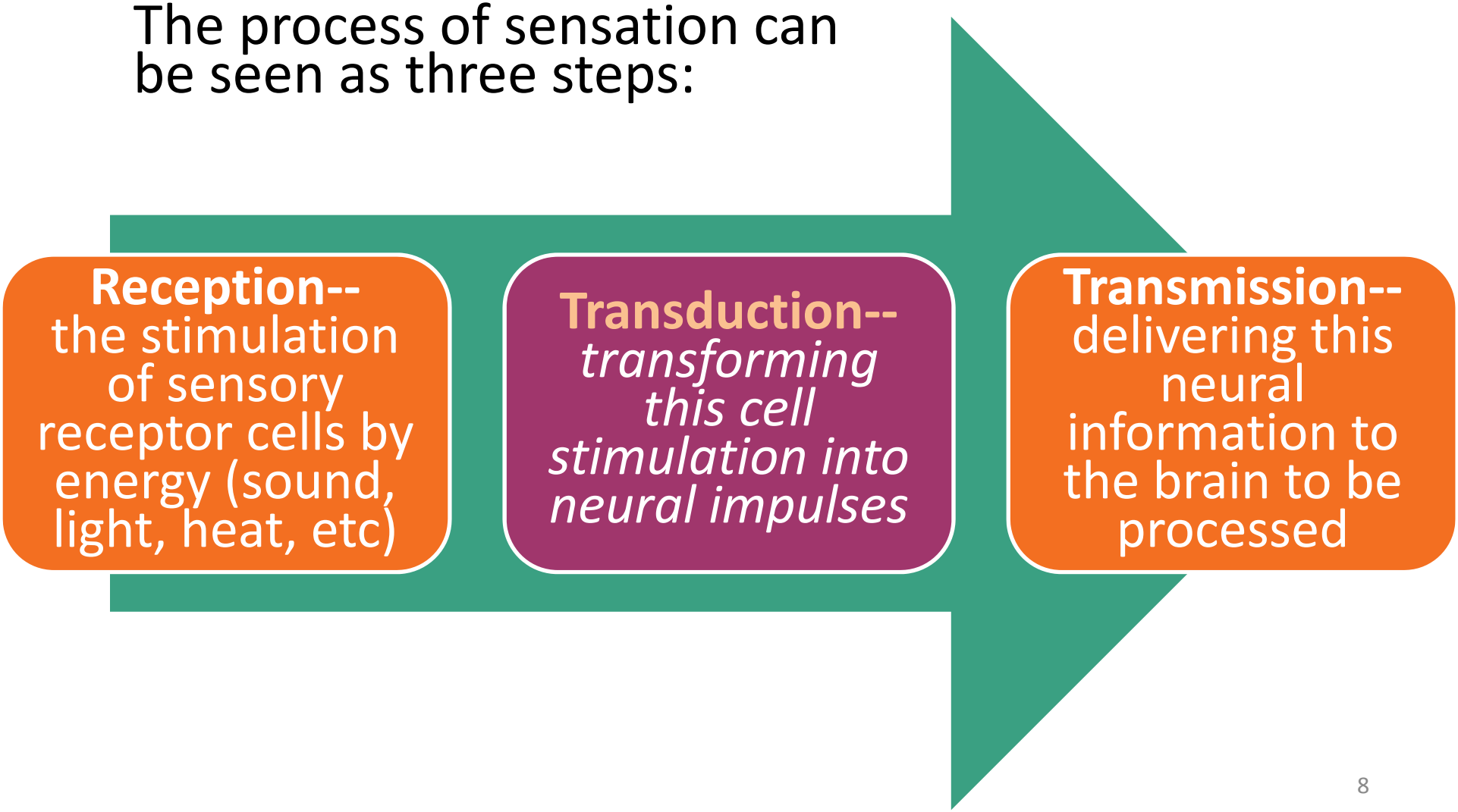
Do you see a painting or a 3D bottle?

What's on the bottle?

Why do you think kids see something different than adults?

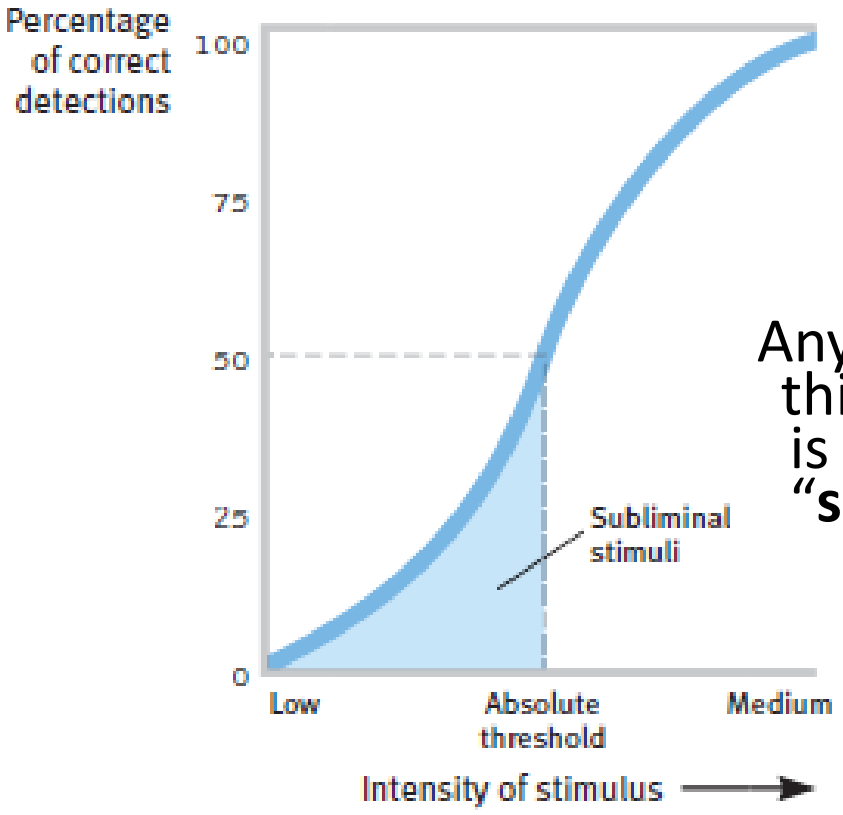
From Sensory Organs to the Brain

The process of sensation can be seen as three steps:



Thresholds

The **absolute threshold** refers to the minimum level of stimulus intensity needed to detect a stimulus half the time.



Anything below this threshold is considered "**subliminal**."

How far away can you see a candle flame at night?

30 miles away

-How far away can you hear a tick of a watch under quiet conditions

20 ft.

How much water can you still taste one teaspoon of sugar

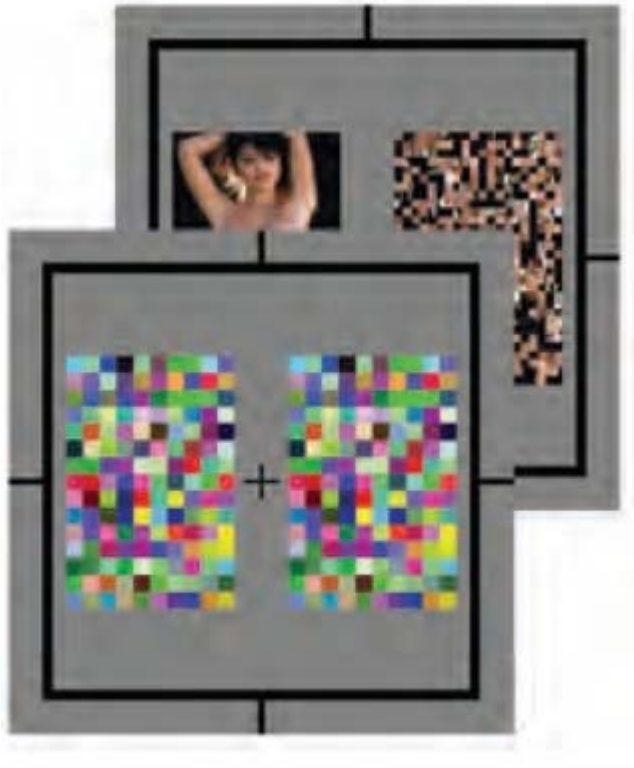
2 gal. of water

How much perfume has be diffused into the entire volume of air in a six-room apartment

One drop

Subliminal Detection

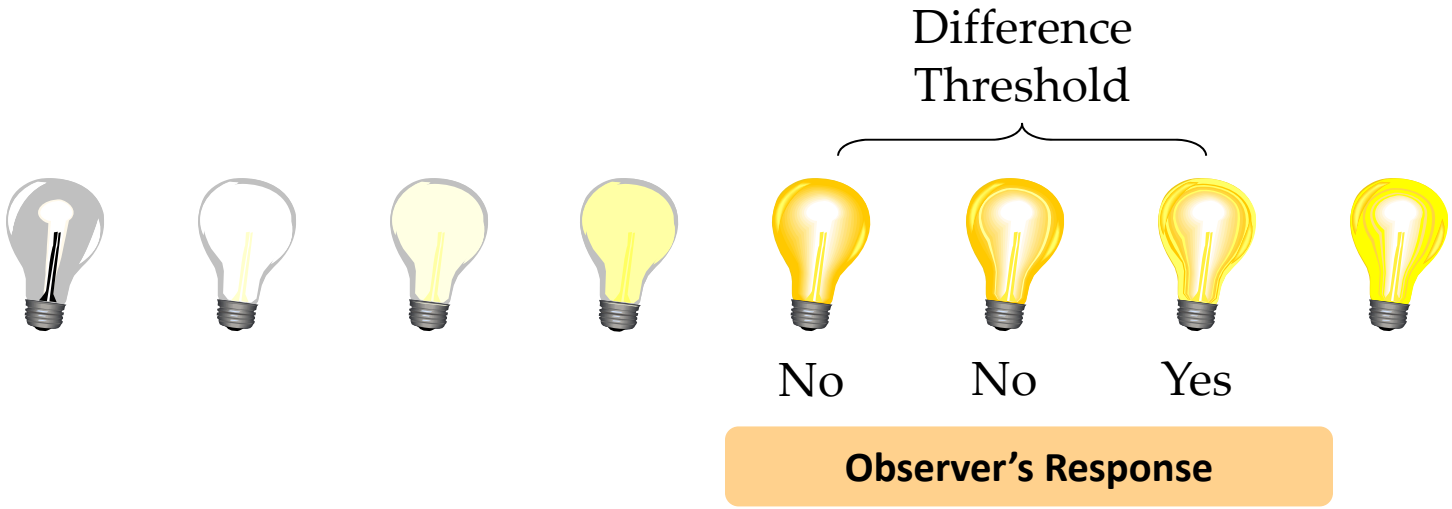
Subliminal:
below our threshold for being able to consciously detect a stimulus



- Although we cannot learn complex knowledge from subliminal stimuli, we can be **primed**, and this will affect our subsequent choices.
- We may look longer at the side of the paper which had just showed a nude image for an instant.

Difference Threshold

Difference Threshold: Minimum difference between two stimuli required for detection 50% of the time, also called just noticeable difference (JND).



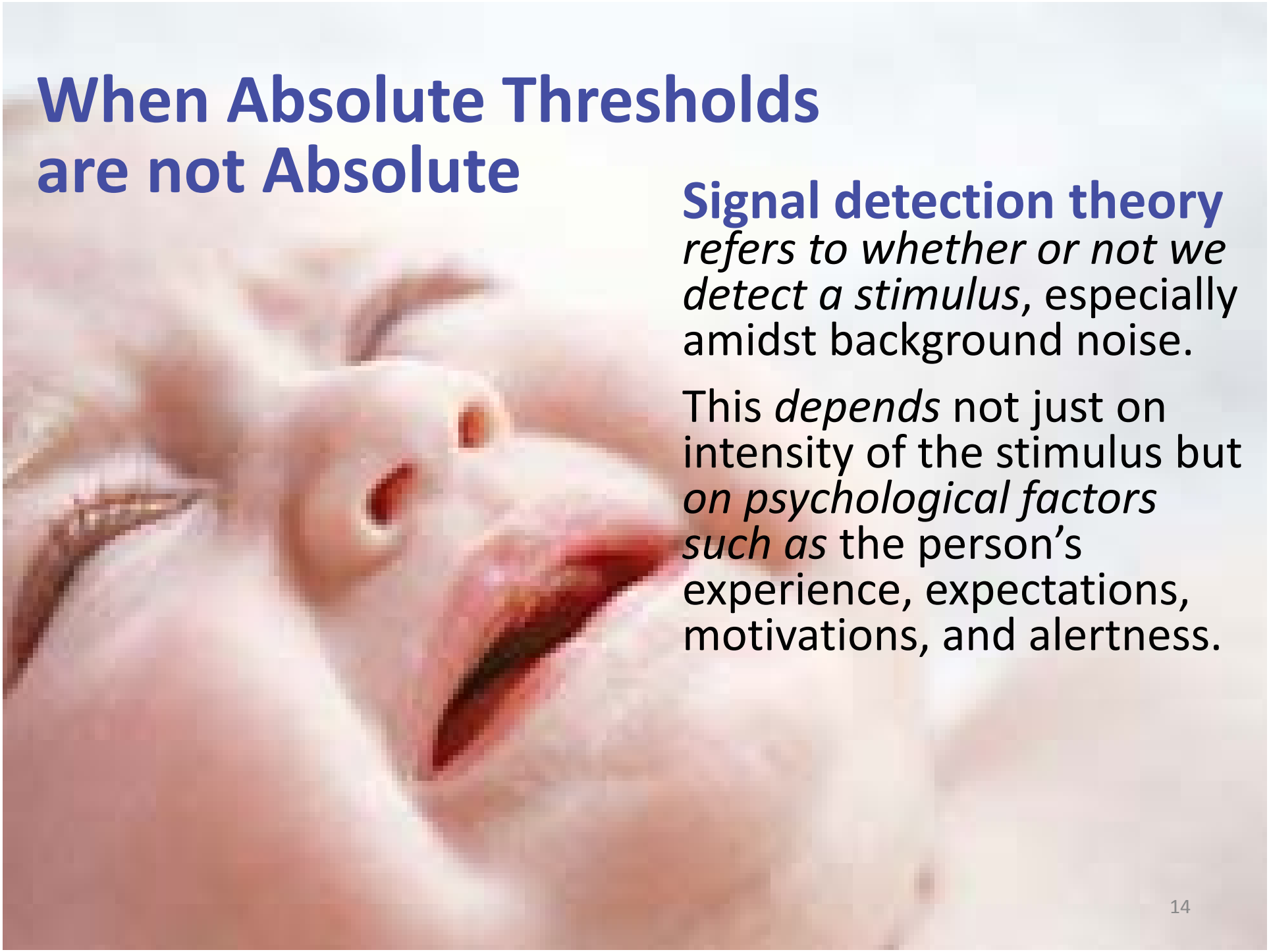
Tell when you (observer) detect a difference in the light.

Weber's Law

Two stimuli must differ by a constant minimum percentage (rather than a constant amount), to be perceived as different. Weber fraction: $k = \delta I/I$.

Stimulus	Constant (k)
Light	8%
Weight	2%
Tone	3%

When Absolute Thresholds are not Absolute



Signal detection theory *refers to whether or not we detect a stimulus*, especially amidst background noise.

This *depends* not just on intensity of the stimulus but *on psychological factors such as* the person's experience, expectations, motivations, and alertness.

SDT Matrix

The observer decides whether she hears the tone or not, based on the signal being present or not. This translates into four outcomes.

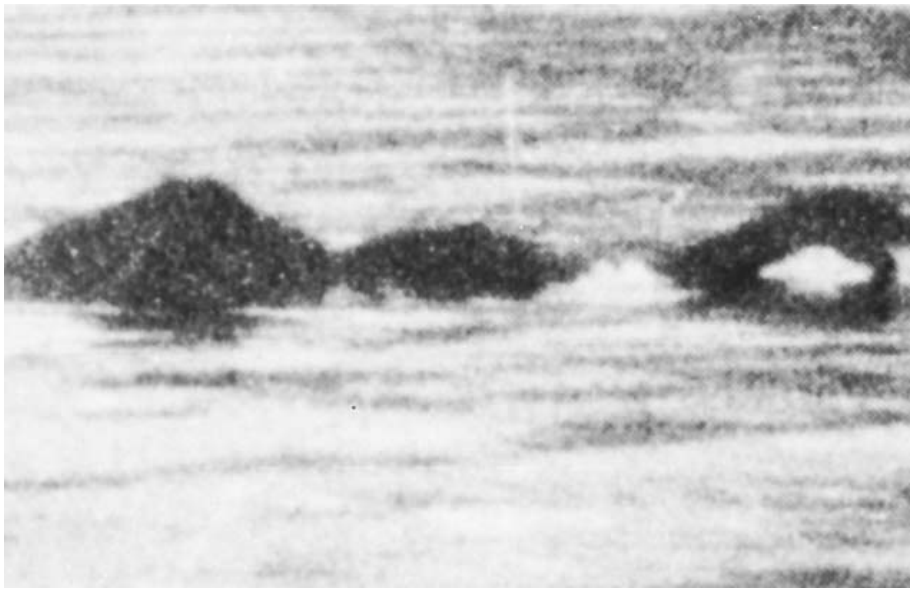
		Decision: Yes	Decision: No
Signal	Present	Hit	Miss
	Absent	False Alarm	Correct Rejection

Sensory Adaptation

- To detect novelty in our surroundings, our senses tune out a constant stimulus.
- The rock in your shoe or the ticking of a clock are more difficult to sense after a while.
- We don't notice this visually because normally our eyes are constantly moving.
- However, if you concentrate on keeping your eyes in one spot, you'll see the effects, as your eyes adjust to stimuli in the following slides.

Perceptual Set

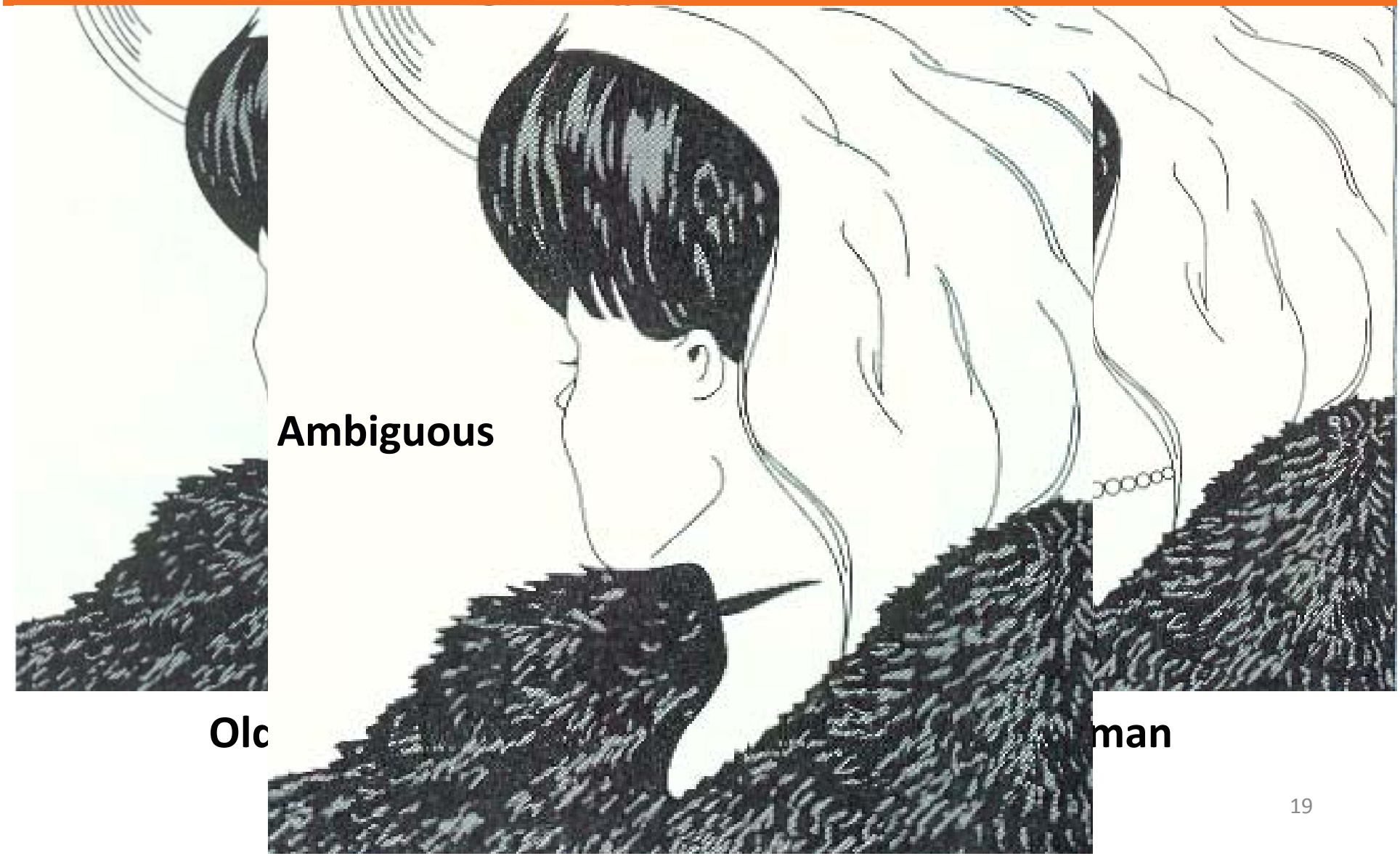
Perceptual set is *what we expect to see*, which influences what we **do** see. Perceptual set is an example of top-down processing .



Loch Ness monster or a tree branch?

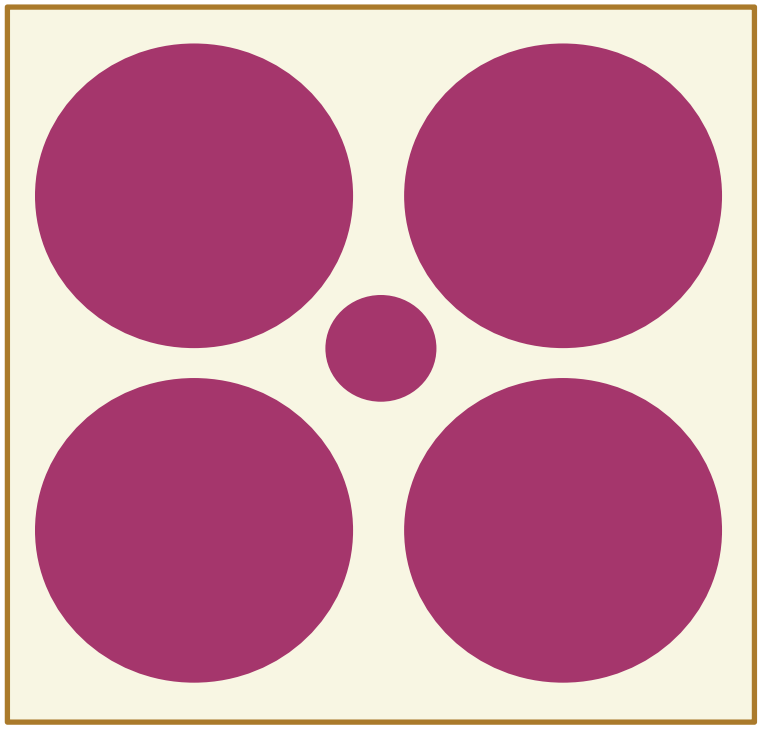
Flying saucers or clouds?

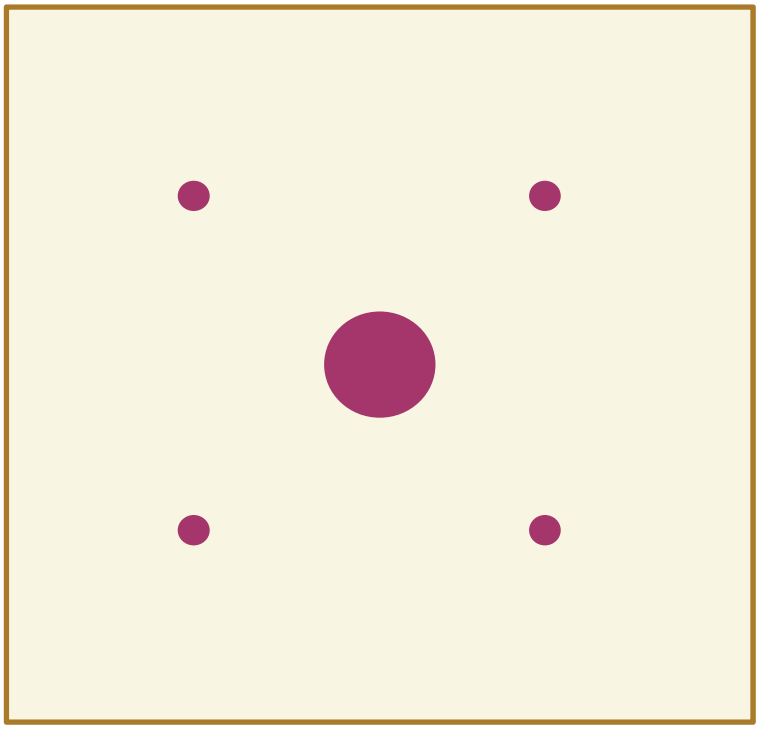
Perceptual set can be “primed.”



Context Effect on Perception

In which picture does the center dot look larger?
Perception of size depends on context.





Spelling test answers:

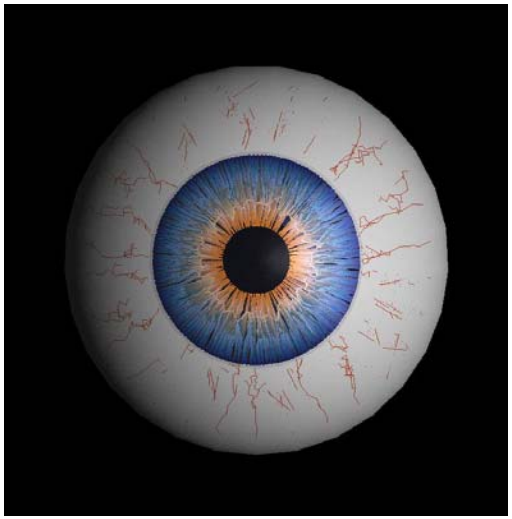
double pear apple payor payee pair

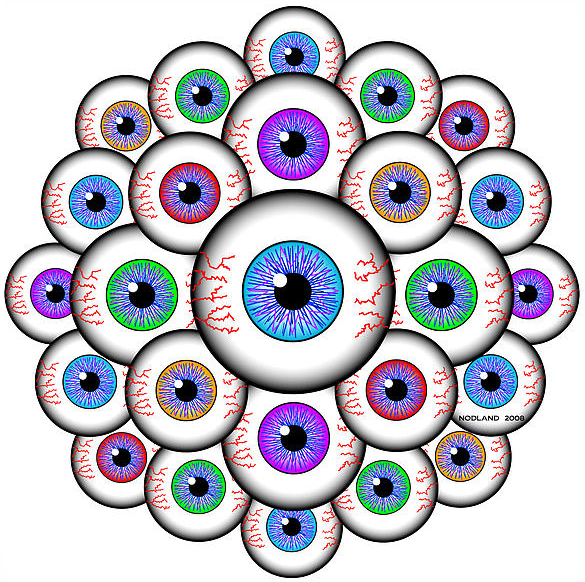
Did context affect which word you wrote?

Effect of Emotion, Physical State, and Motivation on Perception

Experiments show that:

- destinations seem farther when you're tired.
- a target looks farther when your crossbow is heavier.
- a hill looks steeper with a heavy backpack, or after sad music, or when walking alone.
- something you desire looks closer.





Vision

Vision:

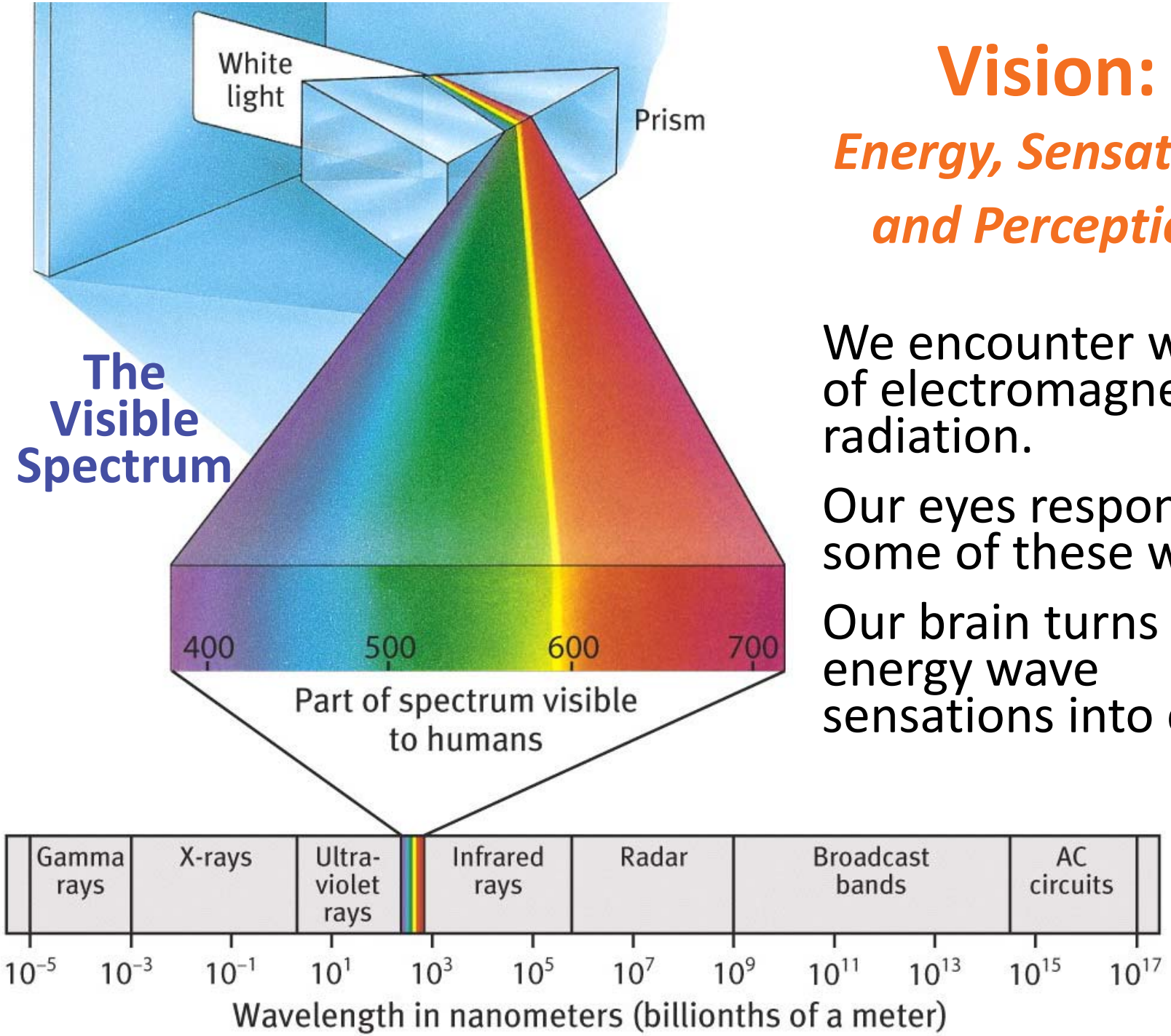
Energy, Sensation, and Perception

We encounter waves of electromagnetic radiation.

Our eyes respond to some of these waves.

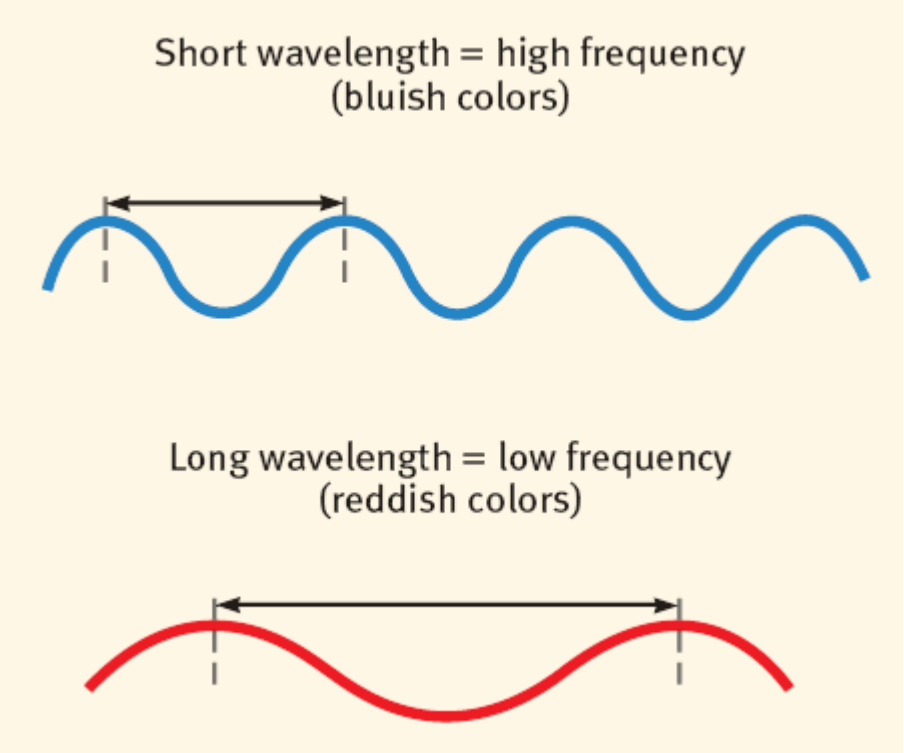
Our brain turns these energy wave sensations into colors.

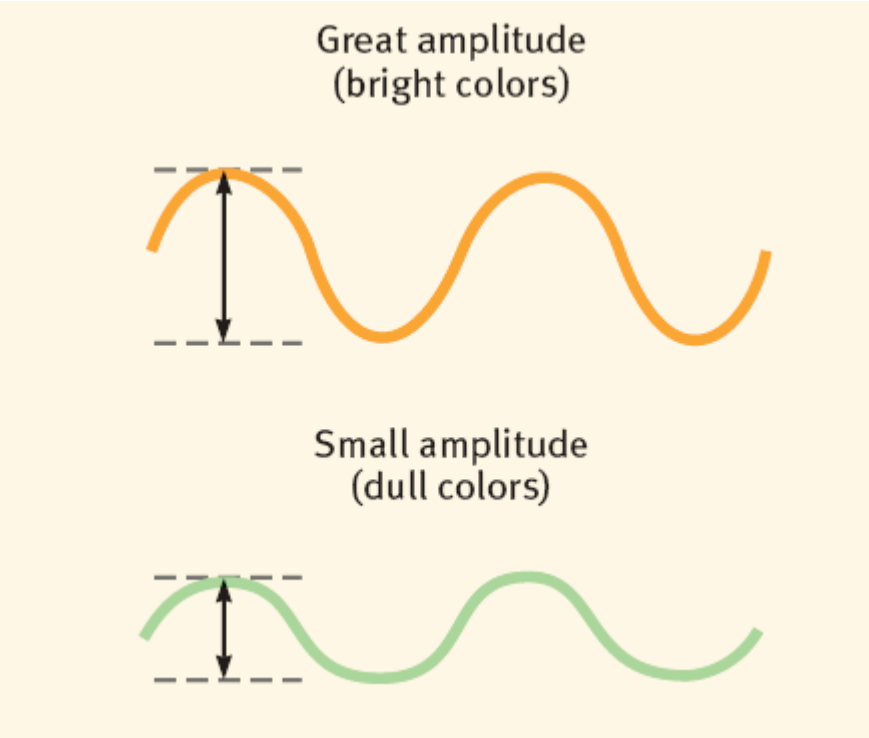
The Visible Spectrum



Color/Hue and Brightness

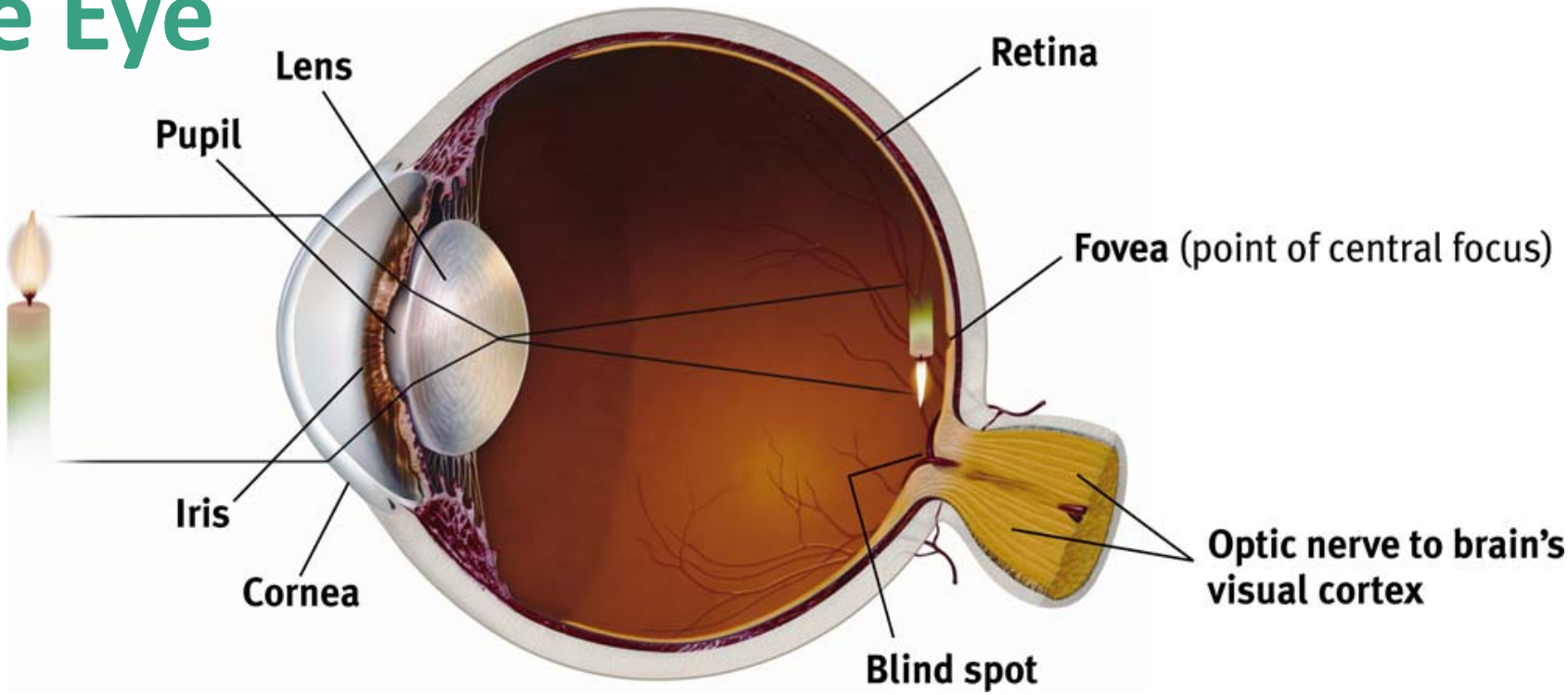
We perceive the wavelength/frequency of the electromagnetic waves as color, or hue.





We perceive the height/amplitude of these waves as intensity, or brightness.

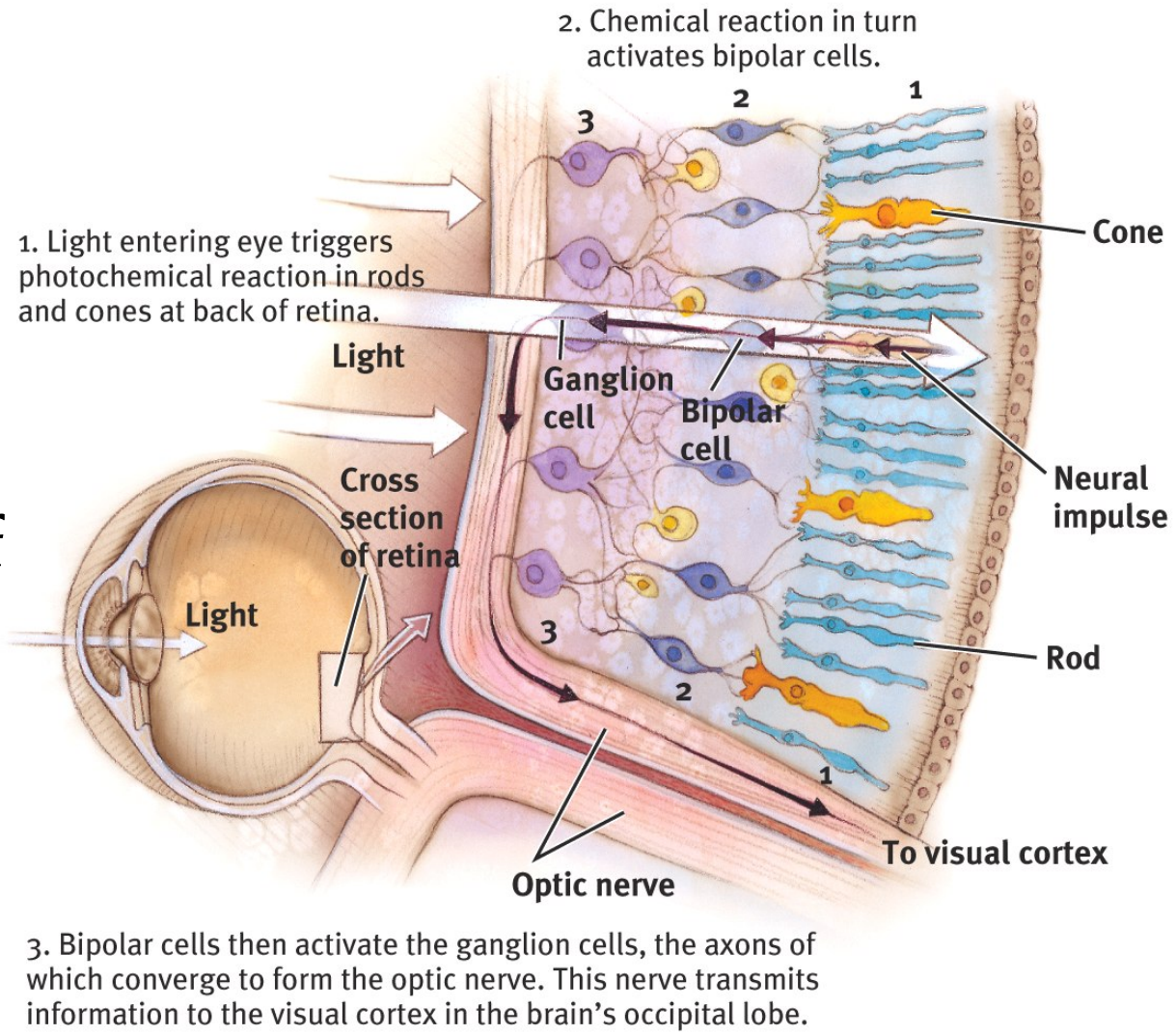
The Eye



- Light from the candle passes through the cornea and the pupil, and gets focused and inverted by the lens. The light then lands on the retina, where it begins the process of transduction into neural impulses to be sent out through the optic nerve.
- The lens is not rigid; it can perform **accommodation** by *changing shape to focus on near or far objects.*

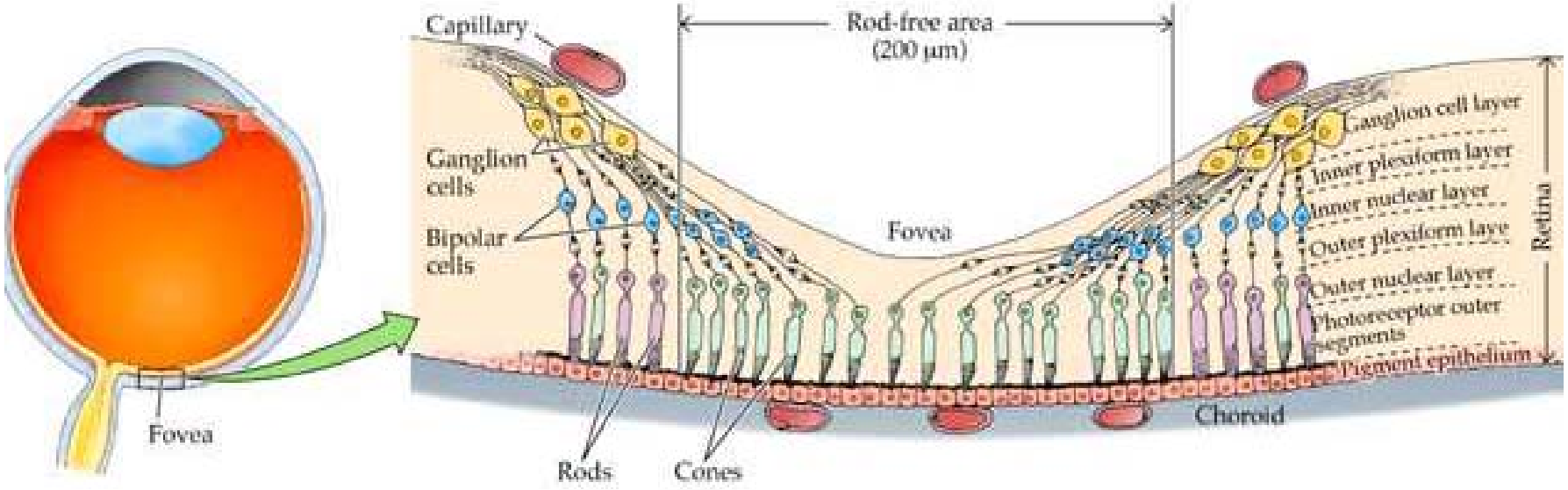
Retina

Retina: The light-sensitive inner surface of the eye, containing receptor rods and cones in addition to layers of other neurons (bipolar, ganglion cells) that process visual information.



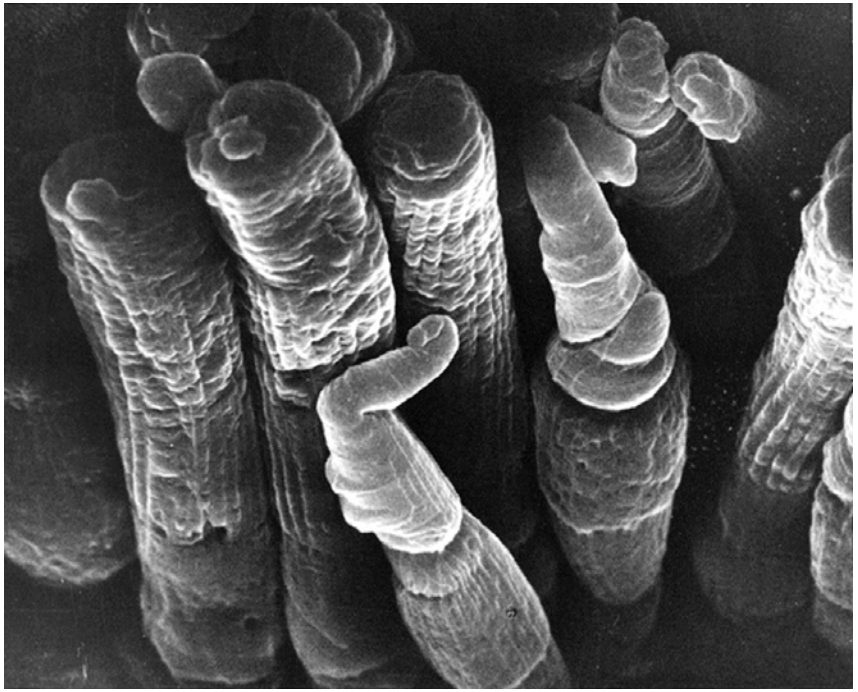
Optic Nerve, Blind Spot & Fovea

Optic nerve: Carries neural impulses from the eye to the brain. Blind Spot: Point where the optic nerve leaves the eye because there are no receptor cells located there. This creates a blind spot. Fovea: Central point in the retina around which the eye's cones cluster.



http://www.bergen.org

Photoreceptors



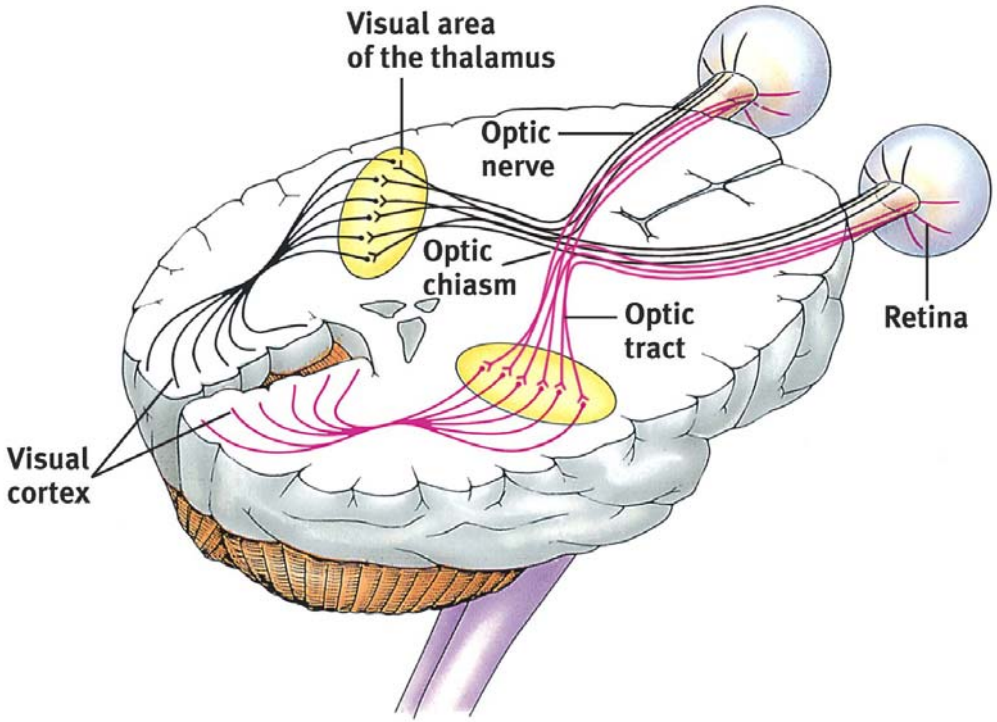
E.R. Lewis, Y.Y. Zeevi, F.S Werblin, 1969

RECEPTORS IN THE HUMAN EYE

	Cones	Rods
Number	6 million	120 million
Location in retina	Center	Periphery
Sensitivity in dim light	Low	High
Color sensitive?	Yes	No
Detail sensitive?	Yes	No

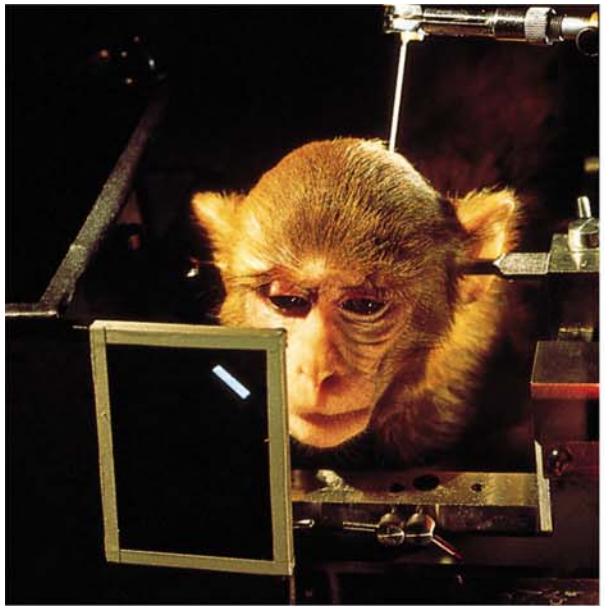
Visual Information Processing

Optic nerves connect to the thalamus in the middle of the brain, and the thalamus connects to the visual cortex.

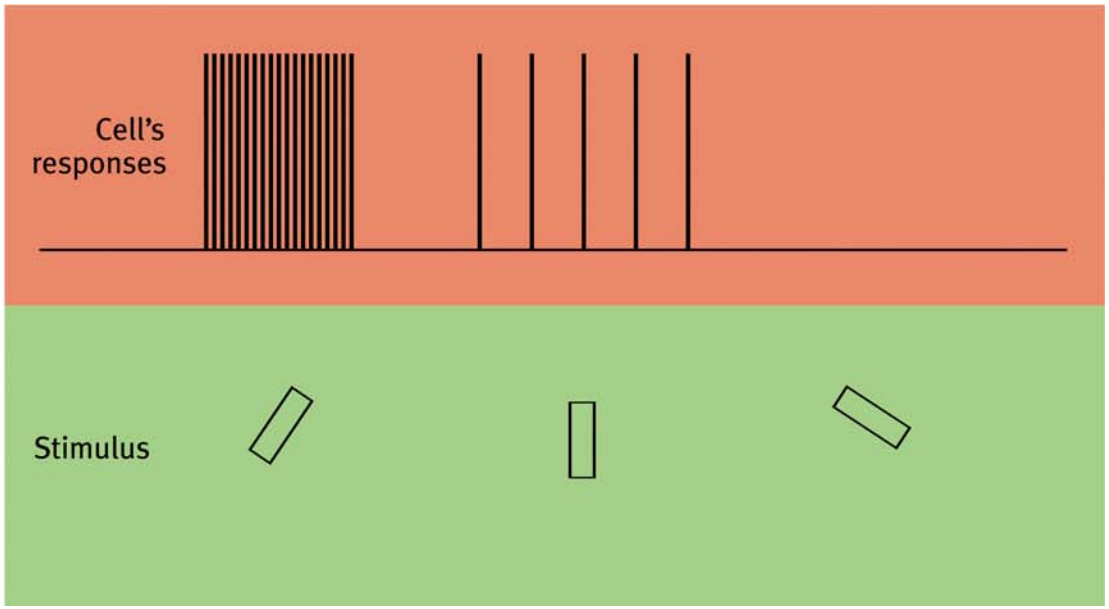


Feature Detection

Nerve cells in the visual cortex respond to specific features, such as edges, angles, and movement.

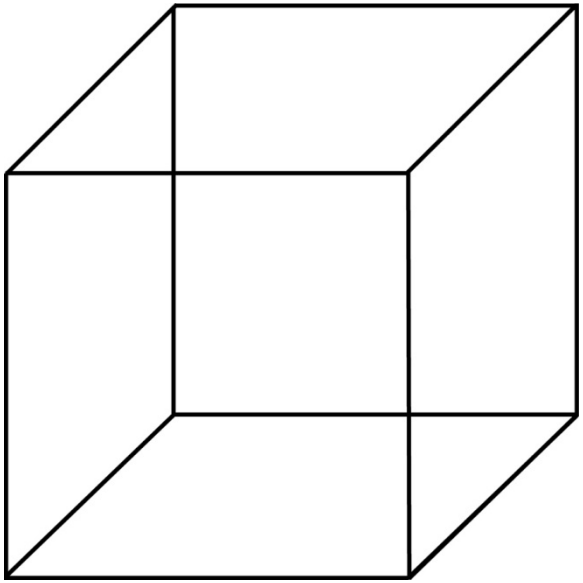


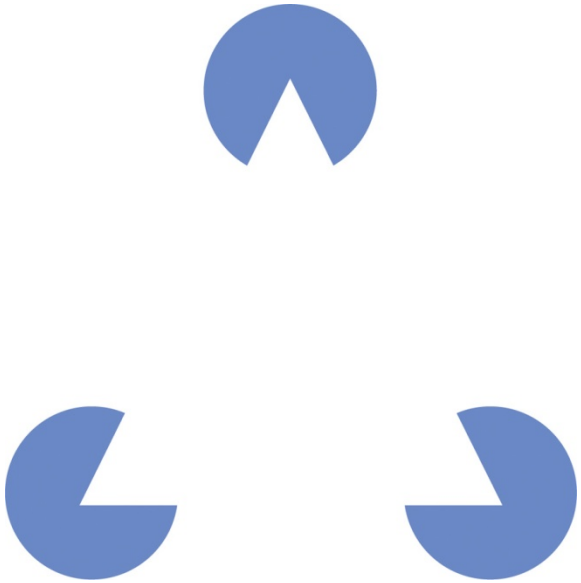
Ross Kinnaird/ Allsport/ Getty Images



Perception in Brain

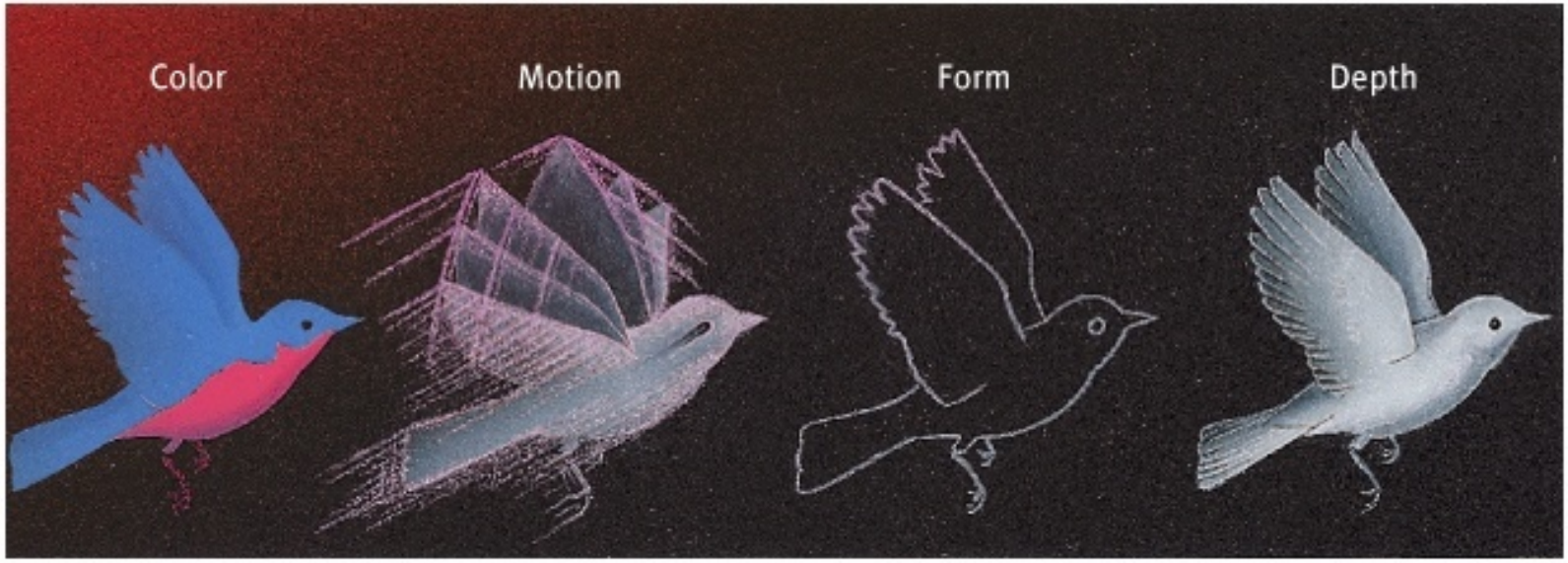
Our perceptions are a combination of sensory (bottom-up) and cognitive (top-down) processes.





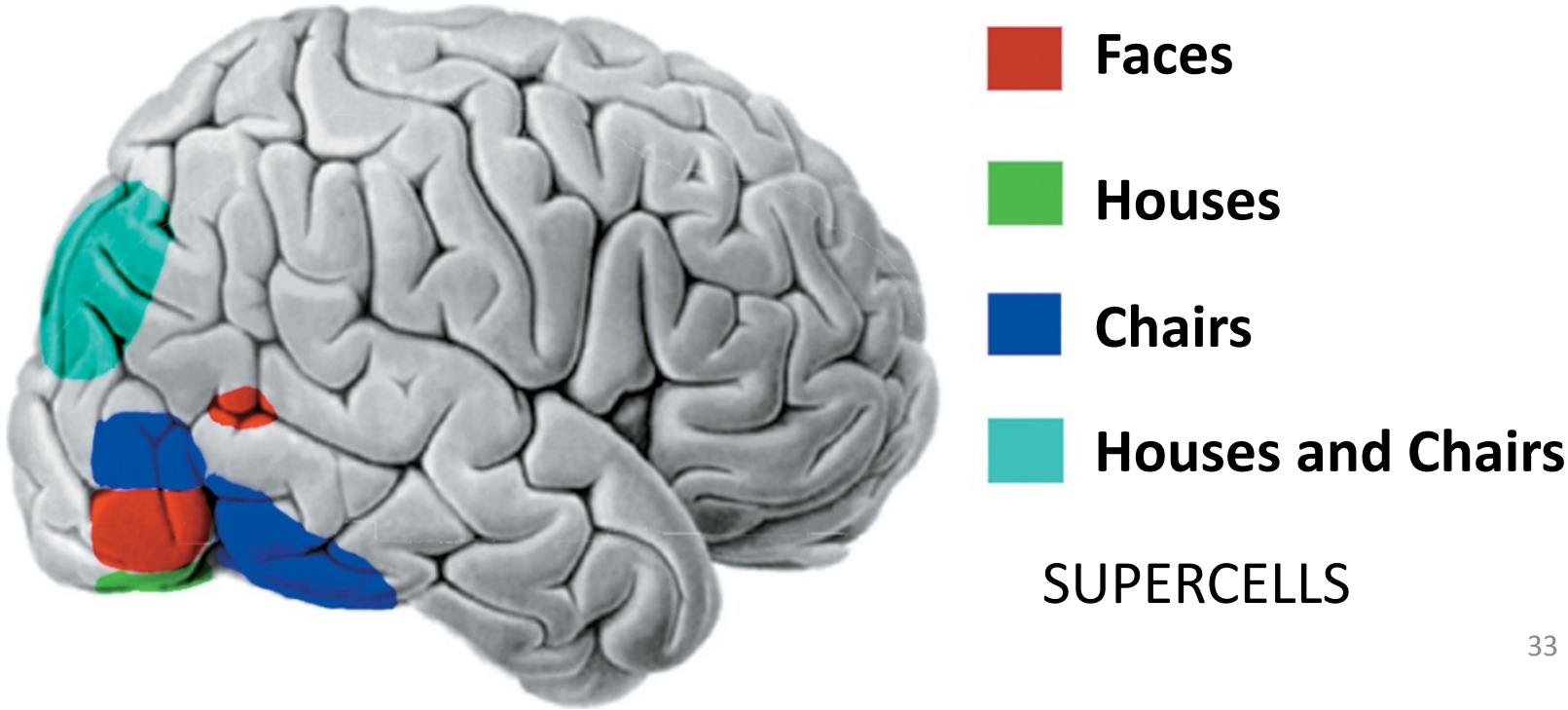
Visual Information Processing

Processing of several aspects of the stimulus simultaneously is called parallel processing. The brain divides a visual scene into subdivisions such as color, depth, form and movement etc.



Turning Neural Signals into Images

- Some ganglion cells in the eye send signals directly to the visual cortex in response to certain **features** such as visual patterns, certain edges, lines, or movements.
- In and around the visual cortex of the occipital lobe, **supercells** integrate these feature signals to recognize more complex forms such as faces.



SUPERCELLS

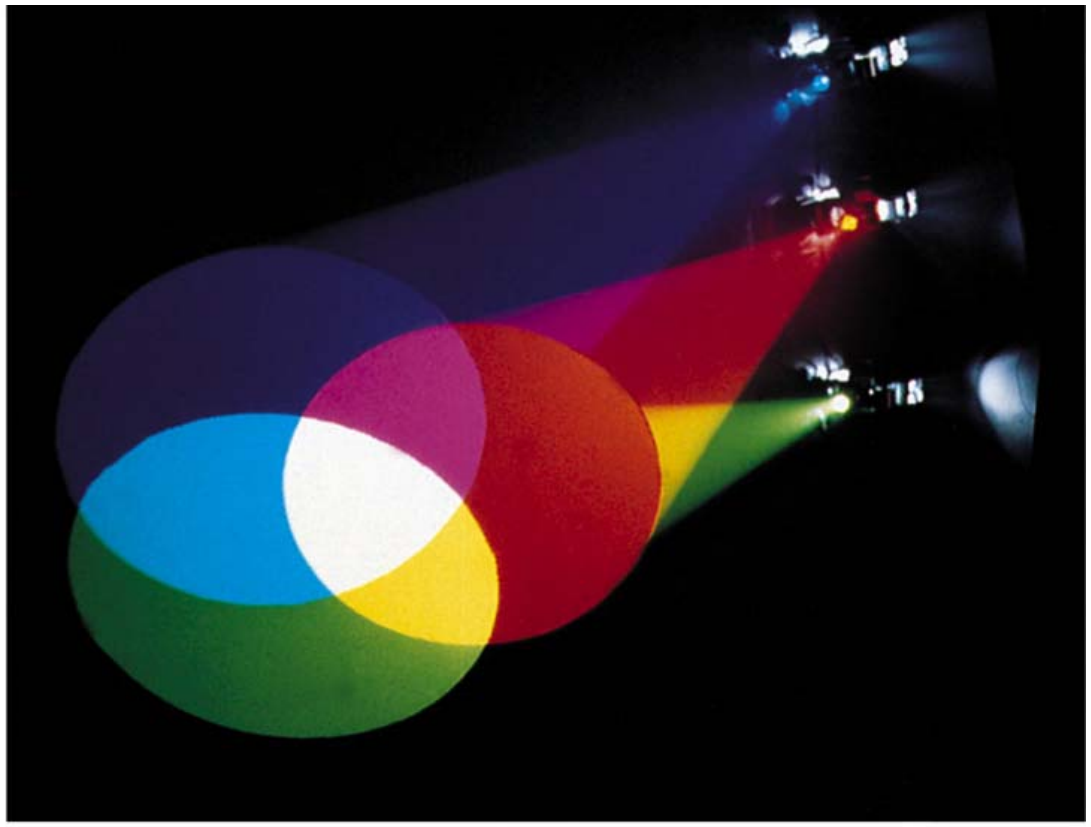
Subtraction of Colors

If three primary colors (pigments) are mixed, subtraction of all wavelengths occurs and the color black is the result.

Subtractive color mixing

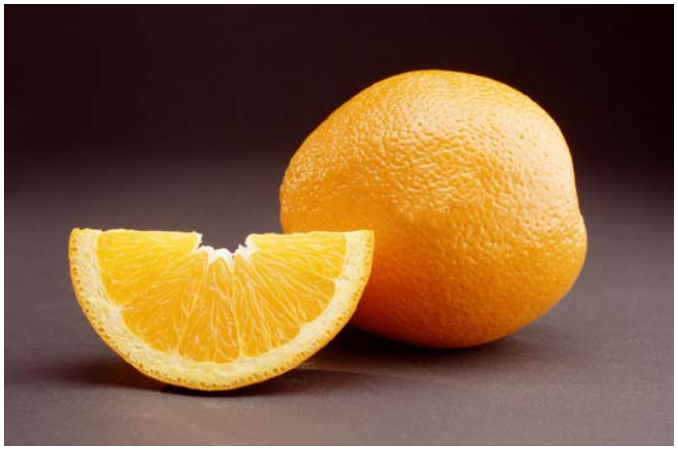
Addition of Colors

If three primary colors (lights) are mixed, the wavelengths are added and the color white is the result.



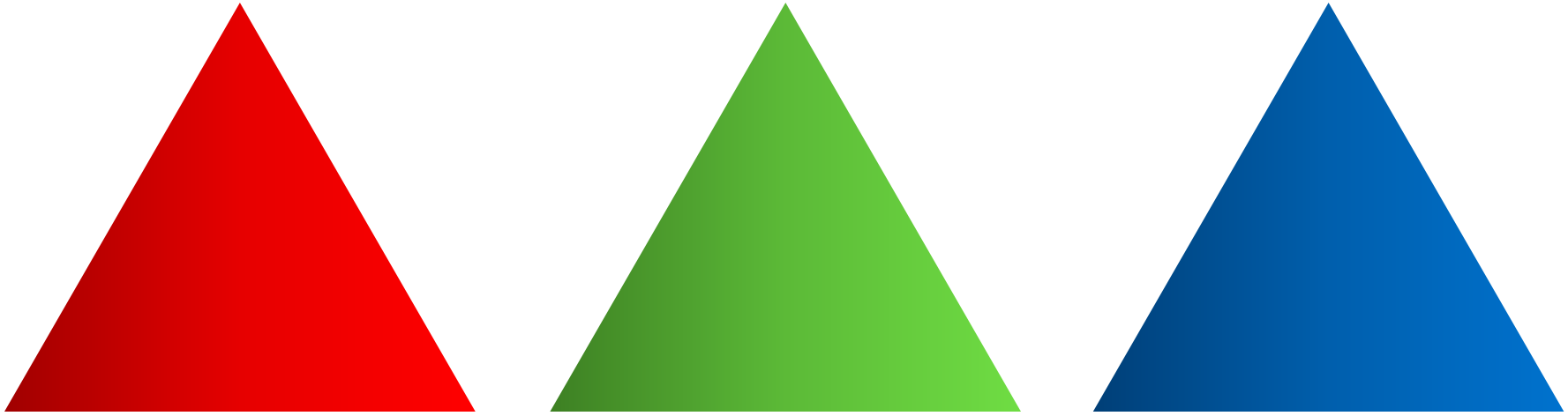
Additive color mixing

Color Vision



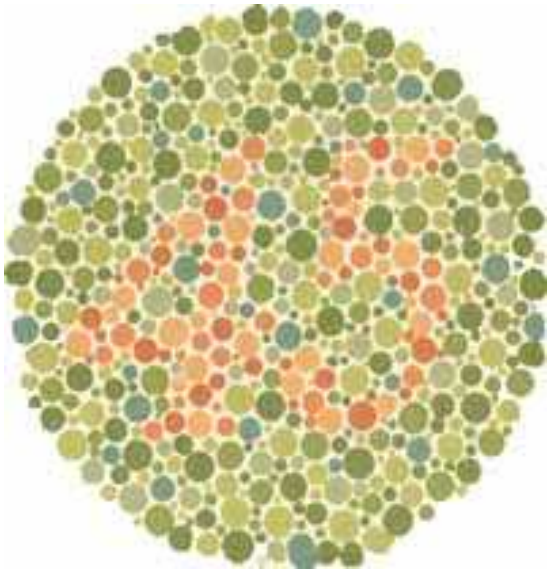
Young-Helmholtz Trichromatic (Three-Color) Theory

According to this theory, there are three ***types*** of color receptor cones--red, green, and blue. All the colors we perceive are created by light waves stimulating combinations of these cones.

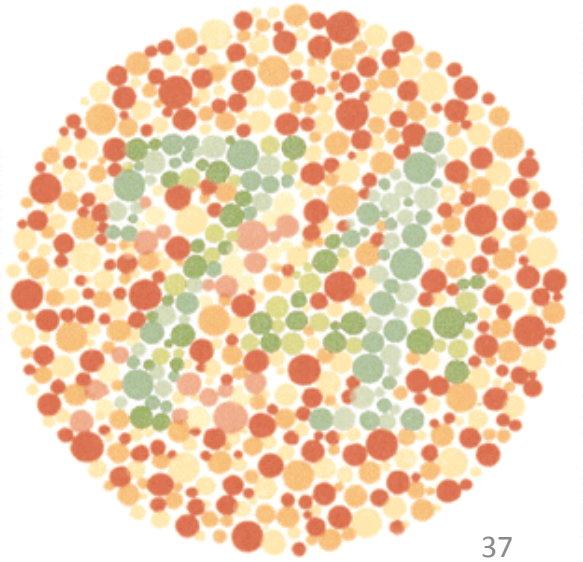


Color Blindness

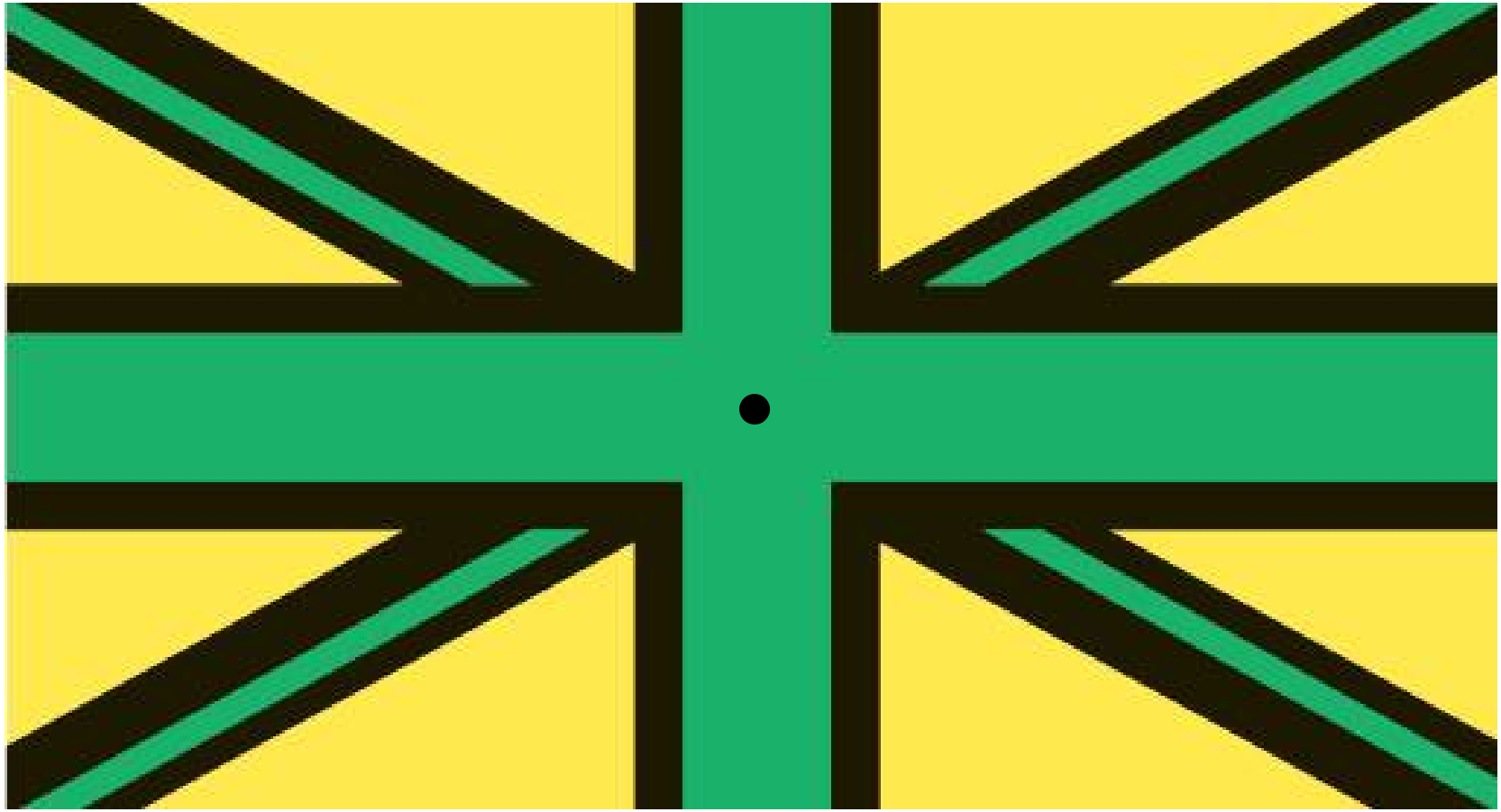
People missing red cones or green cones have trouble differentiating red from green, and thus have trouble reading the numbers to the right.



Opponent-process theory refers to the neural process of perceiving white as the opposite of perceiving black; similarly, yellow vs. blue, and red vs. green are opponent processes.



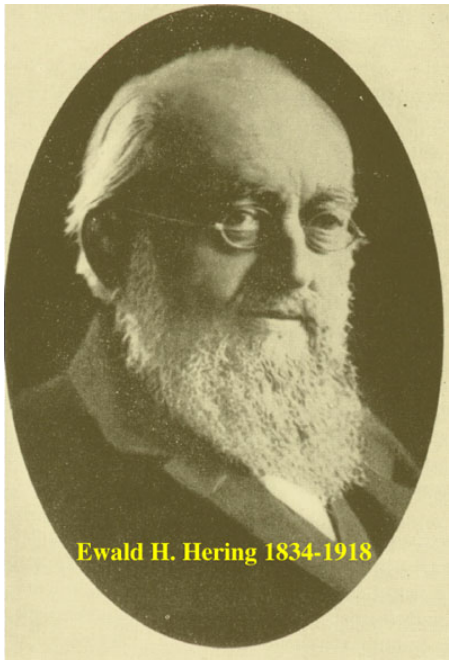
Opponent-Process Theory Test

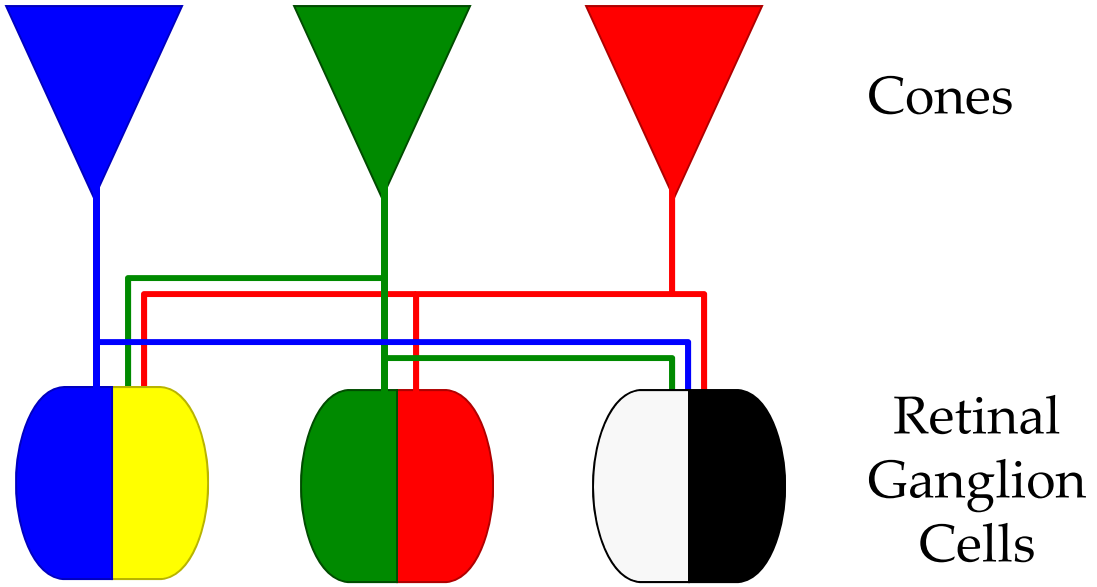


The dot, the dot, keep staring at the dot in the center…

Opponent Process Theory

Hering proposed that we process four primary colors combined in pairs of red-green, blue-yellow, and black-white.





Turning light waves into mental images/movies...

Perceptual Organization

We have perceptual processes for enabling us to organize perceived colors and lines into objects:

- grouping incomplete parts into **gestalt** wholes
- seeing **figures** standing out against **background**
- perceiving **form**, **motion**, and **depth**
- keeping a sense of **shape** and **color constancy** despite changes in visual information
- using **experience** to guide **visual interpretation**

Selective Attention

Perceptions about objects change from moment to moment. We can perceive different forms of the Necker cube; however, we can only pay attention to one aspect of the object at a time.

Necker Cube

Inattentional Blindness

Inattentional blindness refers to the inability to see an object or a person in our midst. Simmons & Chabris (1999) showed that half of the observers failed to see the gorilla-suited assistant in a ball passing game.

Change Blindness

Change blindness is a form of inattentional blindness in which two-thirds of individuals giving directions failed to notice a change in the individual asking for directions.



The Role of Perception

Our senses take in the blue information on the right. However, our perceptual processes turn this into:

1. a white paper with blue circle dots, with a cube floating in front.
2. a white paper with blue circle **holes**, through which you can see a cube.
3. a cube sticking out to the top left, or bottom right.
4. blue dots (what cube?) with angled lines inside.

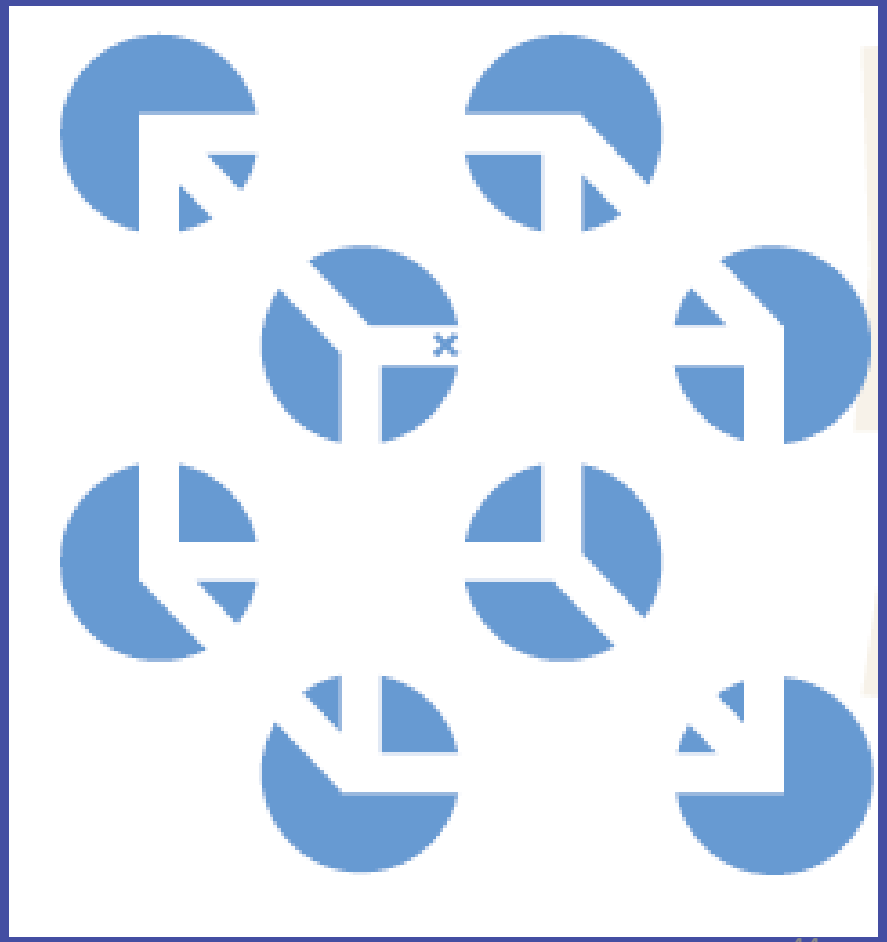


Figure-Ground Perception

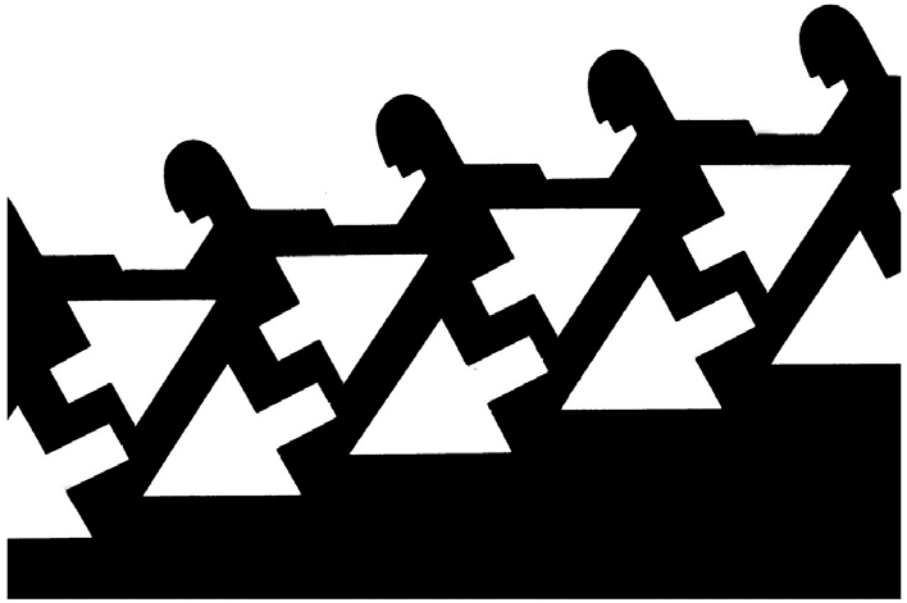
- In most visual scenes, we pick out objects and figures, standing out against a background.
- Some art muddles this ability by giving us two equal choices about what is figure and what is “ground”:

Goblet or two faces?

Stepping man, or arrows?

Form Perception – Figure-ground

Organization of the visual field into objects (figures) that stand out from their surroundings (ground).

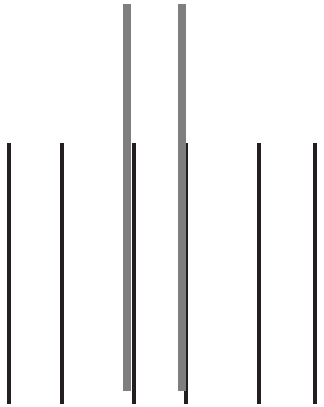


Gestalt and attention…

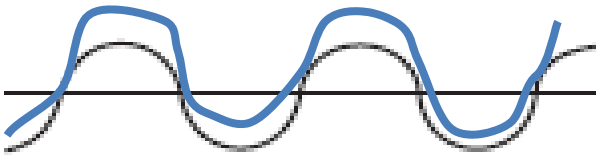
Aoccdrnig to a rscheearch at Cmabrigde Uinervtisy, it deosn’t mttaer in what oredr the ltteers in a word are, the olny iprmoetnt tihng is that the frist and lsat ltteer be at the rghit pclae. The rset can be a total mses and you can still raed it wouthit porbelm. This is bcuseae the huamn mnid deos not raed ervey lteter by istlef, but the word as a wlohe.

Grouping: How We Make Gestalts

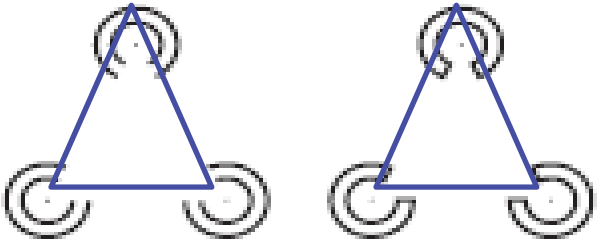
- "**Gestalt**" refers to a meaningful pattern/configuration, forming a "whole" that is more than the sum of its parts.
- Three of the ways we group visual information into "wholes" are proximity, continuity, and closure.



Proximity

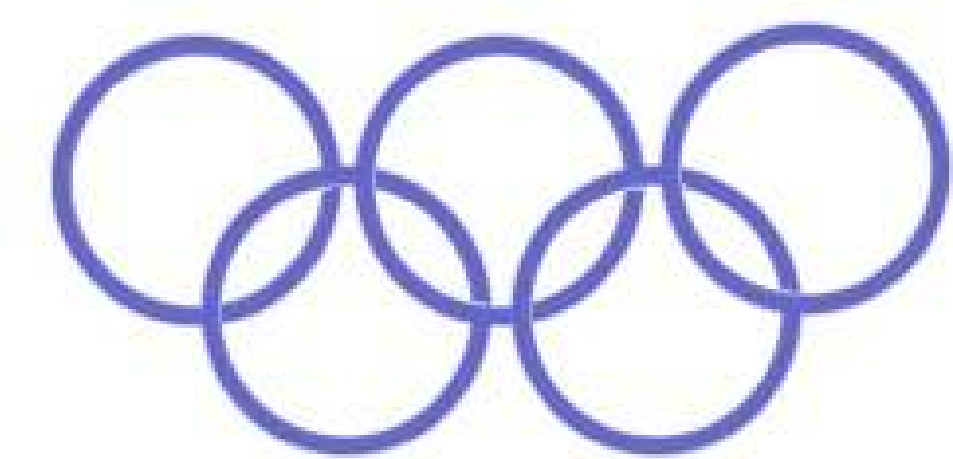


Continuity



Closure

Another name for the Gestalt principle of **Simplicity….**



Law of Pragnanz:

Reality is organized or reduced to the simplest form possible.

For example, we see the image above as a series of circles rather than as many much more complicated shapes.