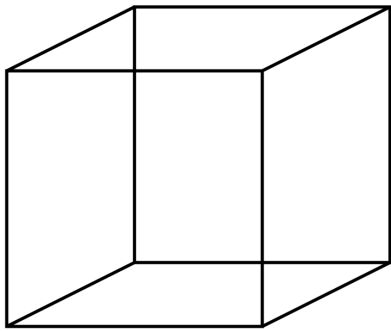# Visual Perception I

PSYC 313 - Lecture 4
Dr. J. Nicol

Perception involves making sense of the raw stimulation conveyed by our senses (Gregory, 1966)

Perception is a Mental Construction

- Perception is not just about becoming consciously are of the stimulus that is stimulating our sensory systems — the perceptual process is much more complex than that!

- When we consciously perceive a stimulus, our brain does not just process the sensory information, it also *interprets the information and gives it meaning*

Perception is a Mental Construction

- When we consciously perceive a stimulus, our brain does not just process the sensory information, it also interprets the information and gives it meaning

- Perception involves going "beyond the information given" (Bruner, 1973)

- You see what you see because your mind produces a mental representation — perception is a construction of the mind

Approaches to Perception

- **Bottom-up approaches** focus on the perceptual processes that are directly shaped by the stimulus itself

- Sometimes referred to as stimulus-driven or data-driven perception

- Emphasize how perception happens in a feedforward fashion from the retina up — parts are identified, put together, and then recognition occurs

- Sensation drives perception

Approaches to Perception

- **Top-down approaches** focus on the perceptual processes that are directly shaped by context, expectations, and experience

- Sometimes referred to as concept-driven perception

- Emphasize how perception happens from the high-level cognitive processes downward

- Cognition drives perception

*Perception is determined by information coming from stimulation of the receptors (**bottom-up**), and information such as the context in which an object appears, and the knowledge or expectations of the perceiver (**top-down**)*
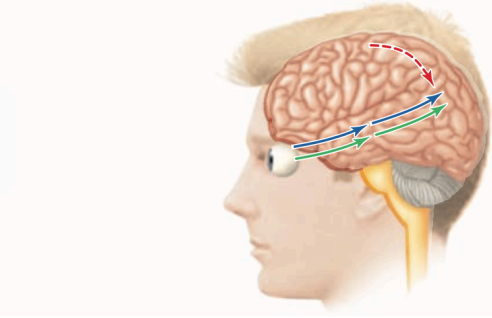
Objects can be created from simple features which activate feature detectors in the cortex that respond to specific stimuli. This occurs at the earliest stages of cortical processing
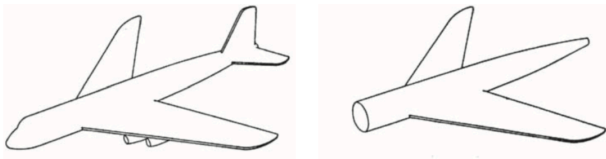
Cortical neurons that respond to specific features such as line orientation are referred to as "feature detectors"
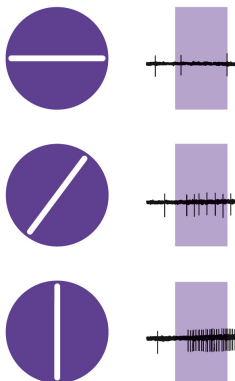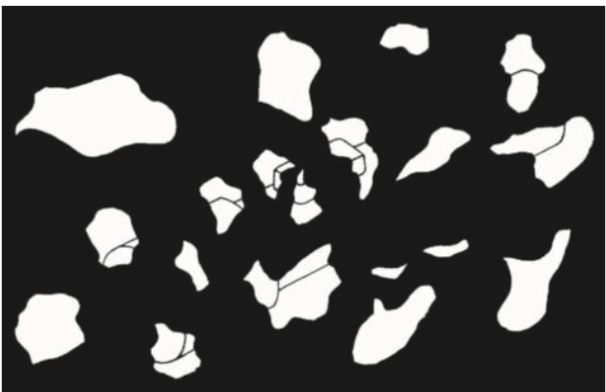
Recognition-by-components theory states that we form 3-D mental representations of objects using simple geometric shapes called **geons**
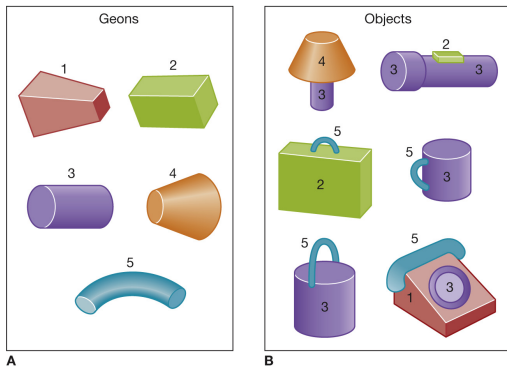
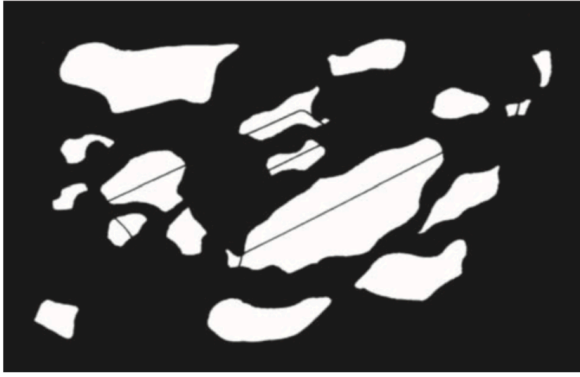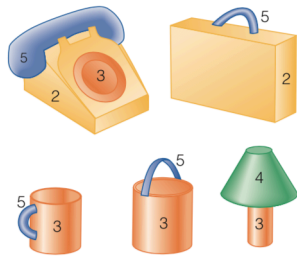Geons

Objects

Biederman (1987)

Biederman (1985)

Although the geons that make up these objects may be determined by bottom-up processing, additional processing is involved when they are combined to create objects

We are able to recognize these different objects based on the arrangement of their geons, and to give these objects names because of the knowledge we bring to the situation

blob

(a)

(b)

(c)

(d)

Oliva & Torralba (2007)

| meiz | it | oaz | n | doaz | eet | oaz | n | litl | laamz | eet | ievee |
| mice | eat | oats | and | does | eat | oats | and | little | lambs | eat | ivy |

Time 0 sec   0.5   1.0   1.5   2.0   2.5

Johnson & McClelland (1973)
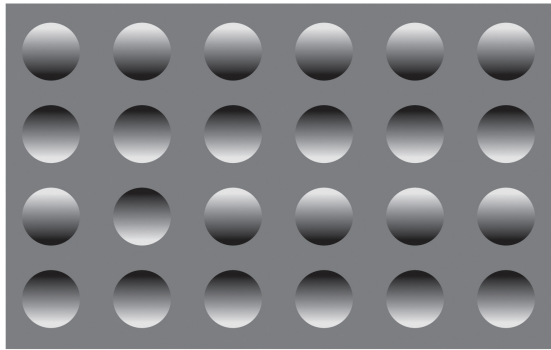
COGNITION 1e, Figure 3.4
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Kleffner & Ramachandran, 1992)

Congruent Colour   *Incongruent Colour*

Tanaka & Presnell (1999)

Tanaka & Presnell (1999)

Perception feels effortless but it is actually a complex cognitive process because the environment is filled with ambiguous stimuli that we have to make sense of

THE CAT

Perception depends on information in addition to that falling on the sensory receptors, including the knowledge that a person brings to the situation

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COGNITION 1e, See for Yourself 3.4 (2)
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(a)   (b)   (c)

(a)   (b)   (c)

32   29   5   4   31   30   28

Quiroga et al. (2005)

A fundamental challenge for visual perception is **object segmentation** — the assignment of elements of a scene to separate objects and backgrounds
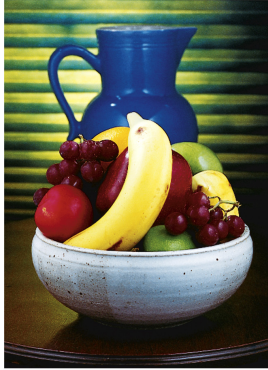
We take for granted that objects look distinct from each other, but such bottom-up cues are in sufficient for a computer

From Y. Ostrovsky et al, 2009. *Psychol Sci* 20: 1484–1491

COGNITION 1e, Figure 3.8
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To recognize objects and their locations you need to separate them from the background

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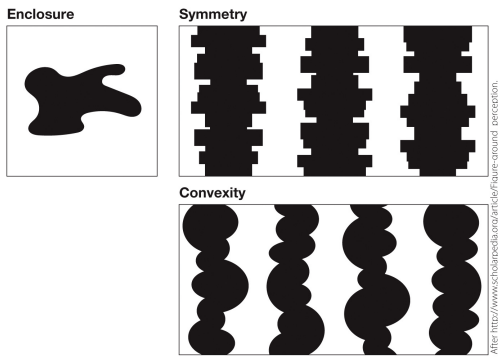*COGNITION 1e*, Figure 3.9
© 2022 Oxford University Press

In the real world, objects often do not have clear boundaries outlining their shape, a fact that animals exploit to camouflage themselves from predators
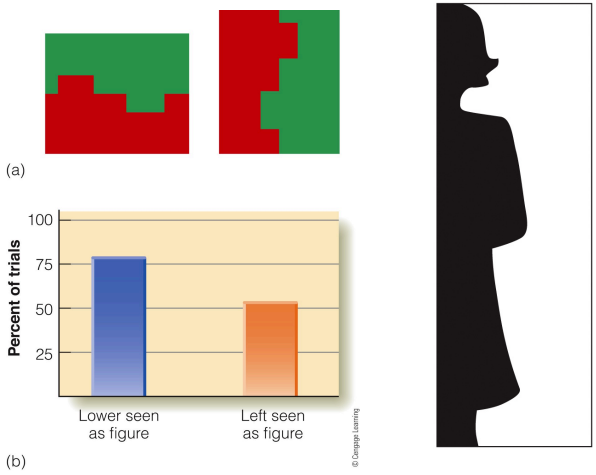
*The problem of **figure-ground organization**
is one aspect of object segmentation*

*Even when the boundary between an object and its
background are clear, it's not always evident which
side of the boundary belongs to the figure and which
side of the boundary belongs to the ground*

---

*The mind follows "rules" in order to determine
which region is figure and which is ground*

Enclosure

Symmetry

Convexity

(a)

Percent of trials

100

75

50

25

Lower seen
as figure

Left seen
as figure

(b)

Helmholtz's (1867) **theory of unconscious inference** states that some of our perceptions are the result of unconscious assumptions that we make about the environment

(a)　　　(b)　　　(c)