

Lecture 3: Perceptual Organisation

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Reading:

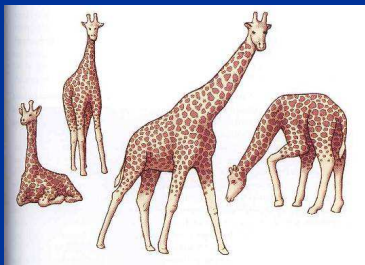
UoA text, Chapter 5, Sensation and Perception,
(especially pp. 138-141)

The puzzle of visual perception

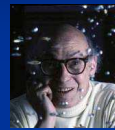
- Last week – sensory processing of brightness & colour
- Perception of meaningful *objects* - effortless recognition of ...
 - Giraffes & gin bottles, chairs & chihuahuas, post-boxes & police-men ... *ad infinitum*
 - Luckily, we almost never get these mixed up

Form perception

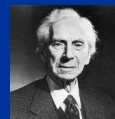
- Every one of previous examples can present an essentially *infinite* variety of patterns to the retina



Vision and 'the computational paradox'



- Artificial Intelligence (AI)
 - Born in 1950's amid great optimism
 - Marvin Minsky - intelligent robots by 1980's ??



- An early AI program (*Logic Theorist*) out-performed Bertrand Russell !!

Vision and 'the computational paradox'

- Walking about, conversing and *seeing* turn out to be extremely complex
- By comparison, chess & theorems in logic are a walk in the park!
- Neuroscience - a *lot* of brain power is devoted to vision

So how is it done ??

- A first step is to separate figure from ground



Perceptually ambiguous:
a vase or two faces?

Feature analysis

- Physiological studies suggest that visual system *analyses* scene into primitive features
- Primitive features – the building blocks of perception
- Feature extraction in visual cortex
 - Hubel & Wiesel: edges, colour, movement

Perception & visual features

- Perhaps we extract a list of features
- Compare features to a checklist in memory
- A century ago, Gestalt psychologists realised that feature lists alone would not be enough

Gestalt approach to form perception

- Gestalt – ‘form’ or ‘entire figure’
- The whole is more than the sum of its parts
- Holistic approach – emphasises *perceptual organisation*

Gestalt Approach

Few or no features in common

But **ALL** of these are triangles

Emphasis on overall organisation, rather than individual elements



Perceptual grouping

- Different parts of objects must be grouped together if the object is to be seen as a whole
- Gestalt psychologists established laws governing this grouping

Some Gestalt laws

Proximity—objects closest together are grouped together

Good continuation
—grouped by smooth contours

Similarity—grouping by rows on the left, columns on the right

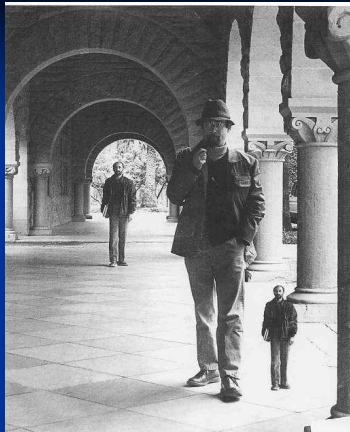
Perceptual segregation is a form of parsing

- Analogous to parsing a string of words.
- Some ambiguous examples:
 - J.Hendrix
 - *Please excuse me while I kiss the sky*
 - *Please excuse me while I kiss this guy*
 - *They are eating apples*
 - *I saw Mount Ruapehu flying to Wellington*

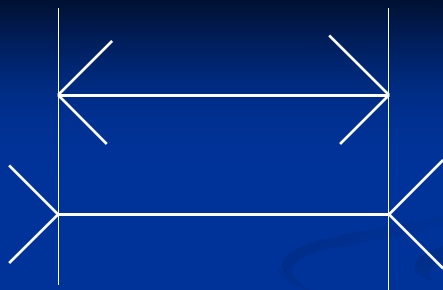
Perceiving Constancy

- Size constancy
- Shape constancy
- Brightness & colour constancy

Size Constancy

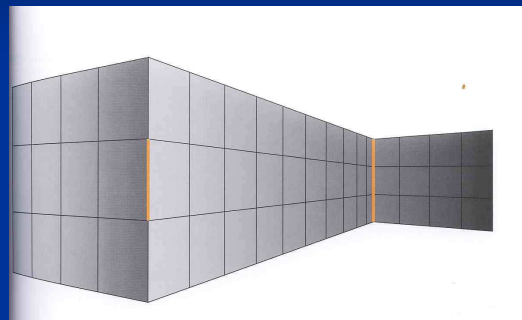


The Muller-Lyer illusion:
which line seems longer?

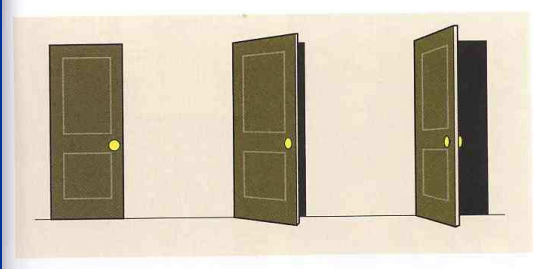


And now?

A possible explanation in terms of
constancy scaling



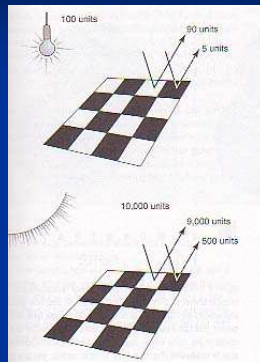
Shape Constancy: *perceiving different shapes as the same*



Shape Constancy



Brightness constancy



Perception as unconscious inference

- Hermann von Helmholtz (19C)
- Richard Gregory (1970's)
- Perception often goes beyond the available information
- Influence of background knowledge and context

Perception as miracle (??)

- *"We are given tiny distorted upside-down images in the eyes and we see separate solid objects in surrounding space. From the patterns of stimulation on the retina we perceive the world of objects, and this is nothing short of a miracle."*

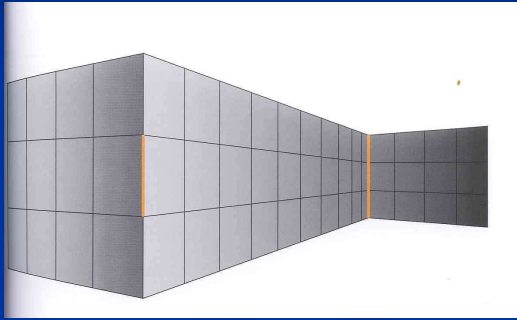
Gregory 1978

Perception as unconscious inference

- Analogy with scientific discovery – evidence & hypothesis

PERCEPTION 15 HYPOTHESIS

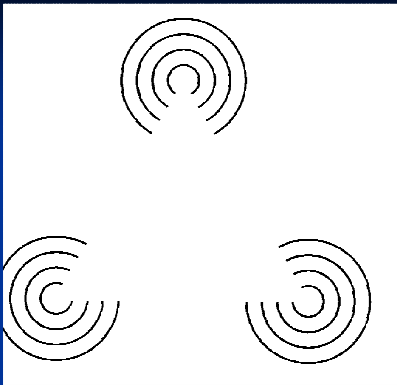
Visual Illusions



Visual illusions

- Ambiguous figures
- Illusions involving paradox

Illusions
involving
probable
inference:
Kanizsa
triangle



Summing Up

- The puzzle of perception
 - Physiological and psychological approaches
 - Feature detectors in visual cortex
 - Figure-ground segregation
 - Gestalt laws of perceptual organisation
- Perception as unconscious inference