

2a - Perception & Attention

16th January 2012



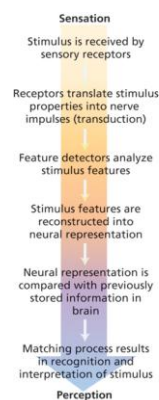
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Learning objectives

- Differentiate between sensation and perception.
- Contrast bottom-up and top-down processing of sensory information.
- Define Weber's Law
- Define Attention and contrast focussed (selective) and divided attention
- Describe the Gestalt principles of perceptual organization.
- Describe the roles of perceptual schemas, perceptual sets, and perceptual constancies in stimulus detection.
- Describe the factors that account for shape, brightness, and size constancy in vision.
- Describe the biological development of perceptual skills, and explain how they are affected by cross-cultural factors, critical periods, and experience.
- Describe the stages in Humphreys & Riddoch's hierarchical model of object recognition
- Define Apperceptive and Associative Visual Agnosia

Sensation and perception

- Sensation: the stimulus-detection process by which our sense organs respond to and translate environmental stimuli into nerve impulses that are sent to the brain
- *"Is there anything out there?"*
- Perception: making "sense" of what our senses tell us
 - This is the active process of organizing the stimulus output and giving it meaning
 - *"What is it, where is it, what is doing?"*



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Absolute thresholds

Absolute threshold = the lowest intensity at which a stimulus can be detected 50% of the time

Sensory modality	Absolute Threshold
Vision	Candle flame at a distance of 30 miles on a clear, dark night
Hearing	The tick of a watch under quiet conditions at 20 feet
Taste	1 teaspoon of sugar dissolved in 7.5 litres of water
Smell	1 drop of perfume diffused into the entire volume of a 2 room apartment
Touch	The wing of a fly falling on a person's cheek at a distance from a distance of 1 metre

But we're not that all that impressive

- A falcon can see a 10 cm object from a distance of 1.5 km. Visual acuity is 2.6 times better than human. Can see sharp images even when diving at 100 miles/hr
- A rabbit's tongue contains 17,000 taste buds (about twice as many as a human)
- Silkworm Moth can detect pheromones up to 11 km. distant. This moth can detect pheromones in concentrations as low as 1 molecule of pheromone per 10^{17} molecules of air.
- A fly has 3,000 lenses in each eye and has a flicker fusion rate (FFR) of 300/sec. Humans FFR = 60/sec in bright light and 24/sec in dim light.

Ernst Weber (1795-1878)

Spent his career working at the University of Leipzig worked on the problem of how we judge whether a stimulus, such as loud music, has increased or decreased in intensity.



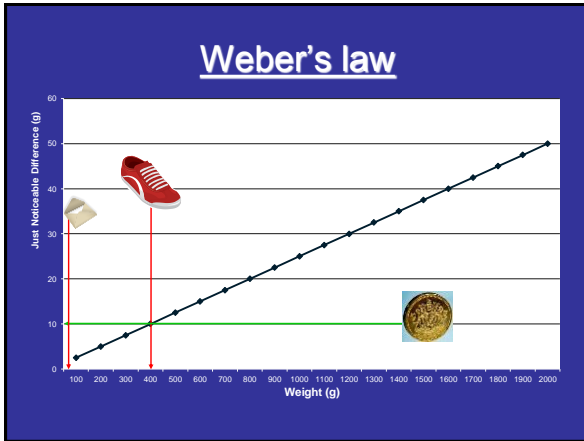
Concept of **(just noticeable difference JND)** which refers to the smallest increase or decrease in the intensity of a stimulus that a person is able to detect

- Weber (1835) suggests the perceived difference between the two experimentally presented sensory stimuli is dependent not upon the "absolute" size of the difference but upon the "relative" ratio of difference of the "constant standard" for that particular sensory modality

Weber's law

The increase in intensity of a stimulus needed to produce a just noticeable difference grows in proportion to the intensity of the initial stimulus.

- $dR/R = k$, which means simply that the proportion of the minimum detectable change (dR) to the strength (size) of the stimulus (R) is a constant (k) across varying levels of intensity (with R standing for "Reiz" in German, meaning stimulus)



Some human-sense JNDs

- Pitch: 1/333
- Brightness: 1/60
- Lifted weights: 1/40
- Loudness: 1/10
- Pressure on skin: 1/7
- Taste: 1/5

Sensory adaptation

- Sensory neurons respond to a constant stimulus by decreasing activity, and the diminishing sensitivity to an unchanging stimulus is called sensory adaptation.
- Sensory adaptation occurs across all sensory modalities.
- Examples, feeling cold for first few minutes after diving into a swimming pool, don't notice the loud noise a computer makes until switch it off

Attention

- Refers to the process of focusing conscious awareness, providing heightened sensitivity to a limited range of experience requiring more intensive processing.

Components of attention

- **Orientating** – affected by intensity, novelty, movement, contrast and repetition also internal factors e.g. when hungry more likely to notice food-related stimuli, threat
- **Focused attention** - The ability to respond discretely to specific visual, auditory or tactile stimuli.
- **Sustained attention (vigilance)** -The ability to maintain a consistent behavioral response during continuous and repetitive activity.
- **Selective attention**: The ability to maintain a behavioral or cognitive set in the face of distracting or competing stimuli. Therefore it incorporates the notion of "freedom from distractibility."
- **Alternating attention**: The ability of mental flexibility that allows individuals to shift their focus of attention and move between tasks having different cognitive requirements.
- **Divided attention** - The highest level of attention and it refers to the ability to respond simultaneously to multiple tasks or multiple task demands

• **Stimulus characteristics that affect attention:**

- Intensity
- Novelty
- Movement
- Contrast
- Repetition

• **Personal factors that affect attention:**

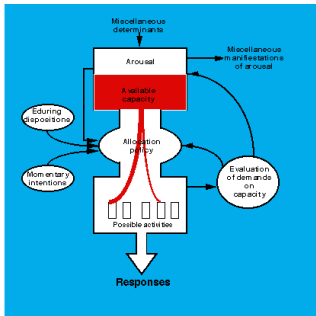
- Motives
- Interests
- Threats to well-being

e.g. Participants are faster at finding a single angry face in a happy crowd than a single happy face in an angry crowd

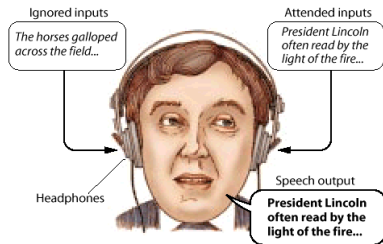
The Cocktail party effect (Cherry 1953)



Attentional capacity model Kahneman (1973)



Dichotic Listening Task



Context Effects

- Attended ear:
 - “They were standing near the bank”
- Unattended ear:
 - One of the following was presented
 - “river”
 - “money”
- Participants interpreted “bank” as
 - a riverbank if they heard “river”
 - a financial bank if they heard “money”

Perception

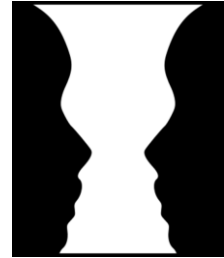
- Individual elements of the stimulus are combined to produce a coherent, unified perception.
- What are the key principles the brain uses in constructing our perception of the world?

Gestalt principles

- The word *Gestalt* in German literally means "shape" or "figure."
- The **Gestalt effect** refers to the form-forming capability of our senses, particularly with respect to the visual recognition of figures and whole forms instead of just a collection of simple lines and curves.

Figure-Ground perception

- It seems that our visual system simplifies the visual scene into a **figure** that we look at and a **ground** which is everything else and forms the background.



Gestalt principles

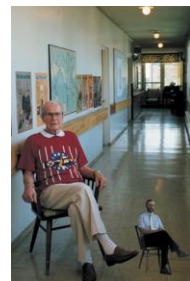


(a) Similarity (b) Proximity (c) Closure (d) Continuity

- Similarity** – we tend to group similar elements together to form a distinct percept.
- Proximity** – The brain tends to group together objects that are close to one another.
- Closure** – If part of a familiar pattern or shape is missing, our brains will “fill in the gap” to create the perception of a complete object
- Continuity** – If possible the brain organizes stimuli into a continuous perception.

Perceptual constancy

The visual system compensates for the fact that the same object casts a different image on the retina in different light conditions, from different perspectives and at different distances.



What do you see?

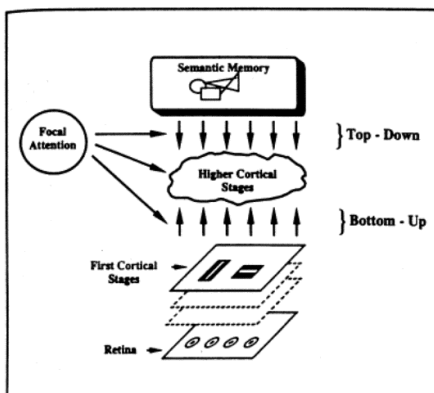
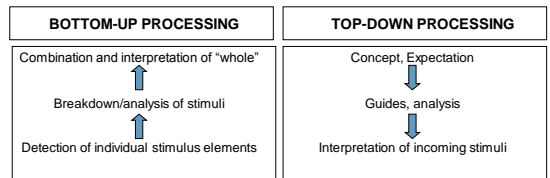


Factors Affecting Perception:

Bottom-up processing

Perception that consists of the progression of recognizing and processing information from individual components of a stimuli and moving to the perception of the whole.

•Top-down and bottom-up processing occur simultaneously and interact with each other in our perception of the world around us.



Top-down processing

- **Perceptual Schema:** a mental representation or image containing the critical and distinctive features of a person, object, event, or other perceptual phenomenon

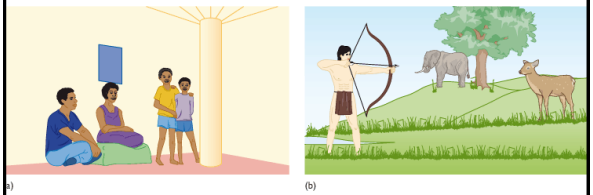
- Schemas provide mental templates that allow us to identify and classify sensory input
- Each of our perceptions is essentially a hypothesis about the meaning of the sensory information

Bottom-up vs top-down processing

- iesaly ziss centanss uoww cuhd reid
- Cuhd uoww reid ziss centanss iesaly?

Cross-cultural differences in perception

- What is the object above the woman's head?
- Which animal is the hunter about to shoot?
- Different answers depending on culture



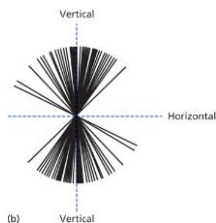
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Critical Periods

- Certain kinds of experiences must occur if perceptual abilities and the brain mechanisms that underlie them are to develop normally
 - Kittens raised in completely vertical environments were unable to see horizontal objects, and vice-versa (Blakemore & Cooper, 1970)



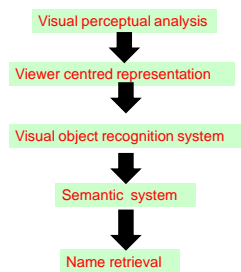
(a)



(b)

Object recognition

(after Humphreys & Riddoch)



Visual Agnosia (literally “not knowing”)

- **Apperceptive visual agnosia** is characterised by intact visual ability on a basic sensory level, but a defect in early stage visual processing that prevents a correct percept of the stimulus being formed. The patient is unable to access the structure or spatial properties of a visual stimuli and the object is not seen as a whole or in a meaningful way.

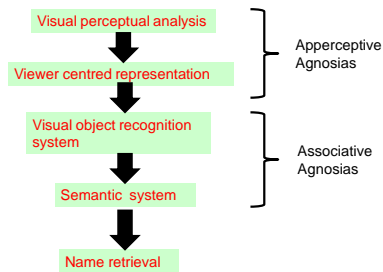
In **Associative visual agnosia**, primary sensory and early visual processing systems are preserved. The patient can perceive objects presented visually but cannot interpret, understand or assign meaning to the object, face or word.

CK (Behrmann, Winocur & Moscovitch) is severely agnostic, but produces accurate drawings... and cannot later recognize the identity of his own drawings.



Object recognition

(after Humphreys & Riddoch)



Perception and attention

- Sensation
- Attention – vigilance, orienting, selective attention.
- Absolute and difference thresholds
- Gestalt principles
- Perceptual constancy
- Depth perception
- Top-down vs bottom-up processing
- Cultural differences in perception
- Development of perception
- Object recognition and agnosia