SYDE 543 (Fall 2016)
Cognitive Ergonomics

Senses and Perception II

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Traffic lights

Review questions

- What's the difference between sensation and perception?
- Which type of cells on the retina is related to color vision?
- What does STSS stand for?
- What's the difference between accommodation and convergence?

Check previous lecture slides to find the answers.

Overview of today's lecture

- Some other senses
- Characteristics of senses
- Perception and its characteristics
- How to use these in systems design?

Taste/gustation

- Sense of chemical substances
- Seasoning applications
  - MSG—monosodium glutamate
  - Artificial sweetener

bitter, salty, sweet, sour, and umami (savory)

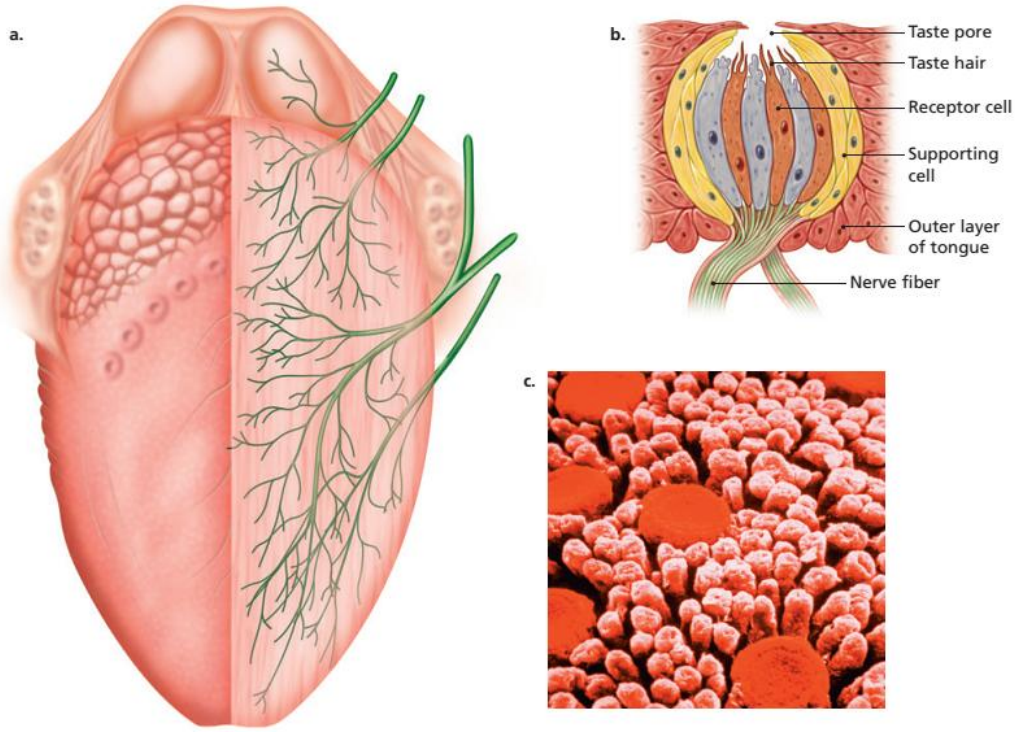


Figure 3.10 The Tongue and Taste Buds—A Crosscut View of the Tongue

Smell/olfaction

- Food “tasting”, more sensation from smell

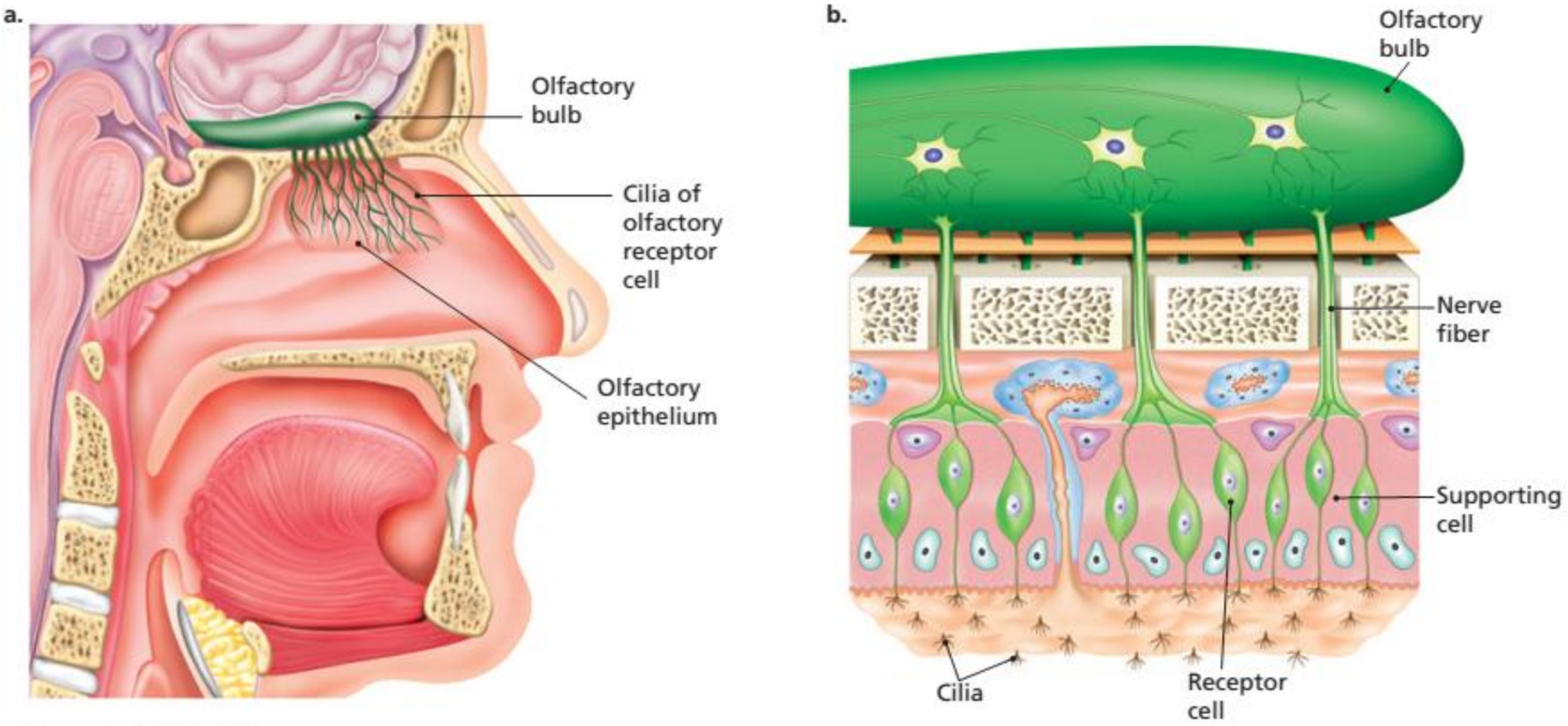
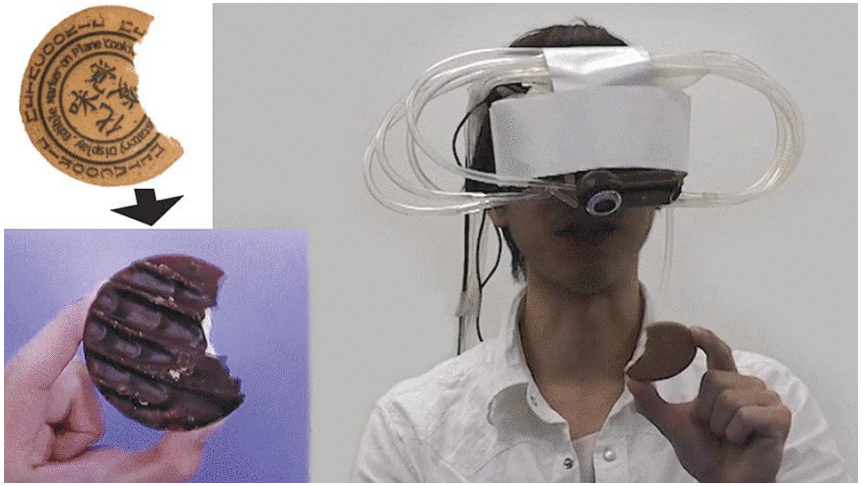


Figure 3.11 The Olfactory Receptors

Smell/olfaction

- Smell presentation devices



"Meta Cookie“ changes perceived taste of a cookie.
http://www.cyber.t.u-tokyo.ac.jp/projects/

Machine olfaction, custom 14 scents
http://www.sigmacom.fr/permanent-installations.html

http://www.techinsider.io/cyrano-lets-you-send-messages-that-smell-2016-5

https://www.yahoo.com/tech/your-iphone-can-now-wake-you-up-with-the-smell-of-bacon-78670253114.html

Design applications of taste and smell

- As warning signals for toxic substances
  - E.g., herbicide
  - Carbon monoxide (CO)

- Issues with using smell to convey extra information.
  - Smells could be difficulty to remove from the air.
  - Adaptation

Somesthetic senses

- Soma - “body,” esthetic - “feeling”
  - Skin senses (touch, pressure, temperature, and pain)
  - Kinesthetic sense (the location of body parts in relation to each other; sensory receptors for joint movement or the muscles stretching or contracting)
  - Vestibular senses (balance, movement and body position)

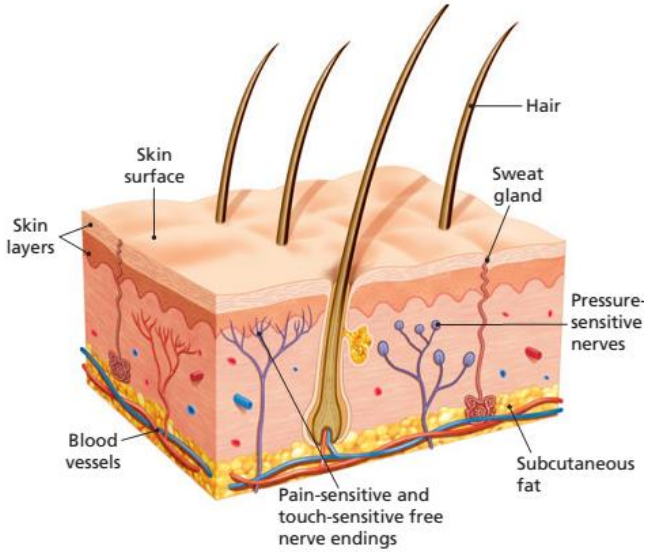
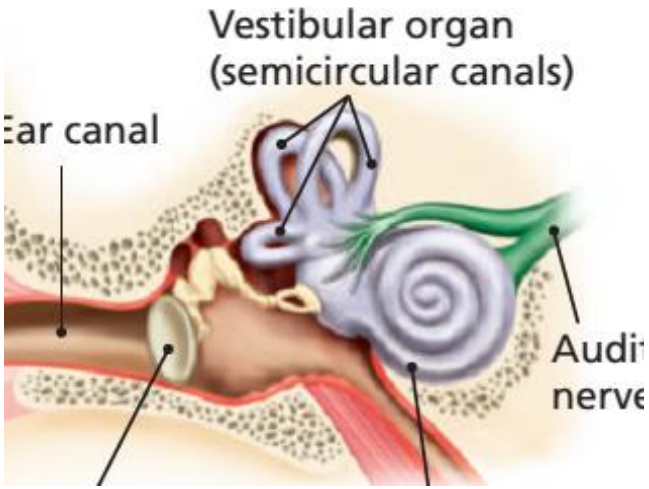
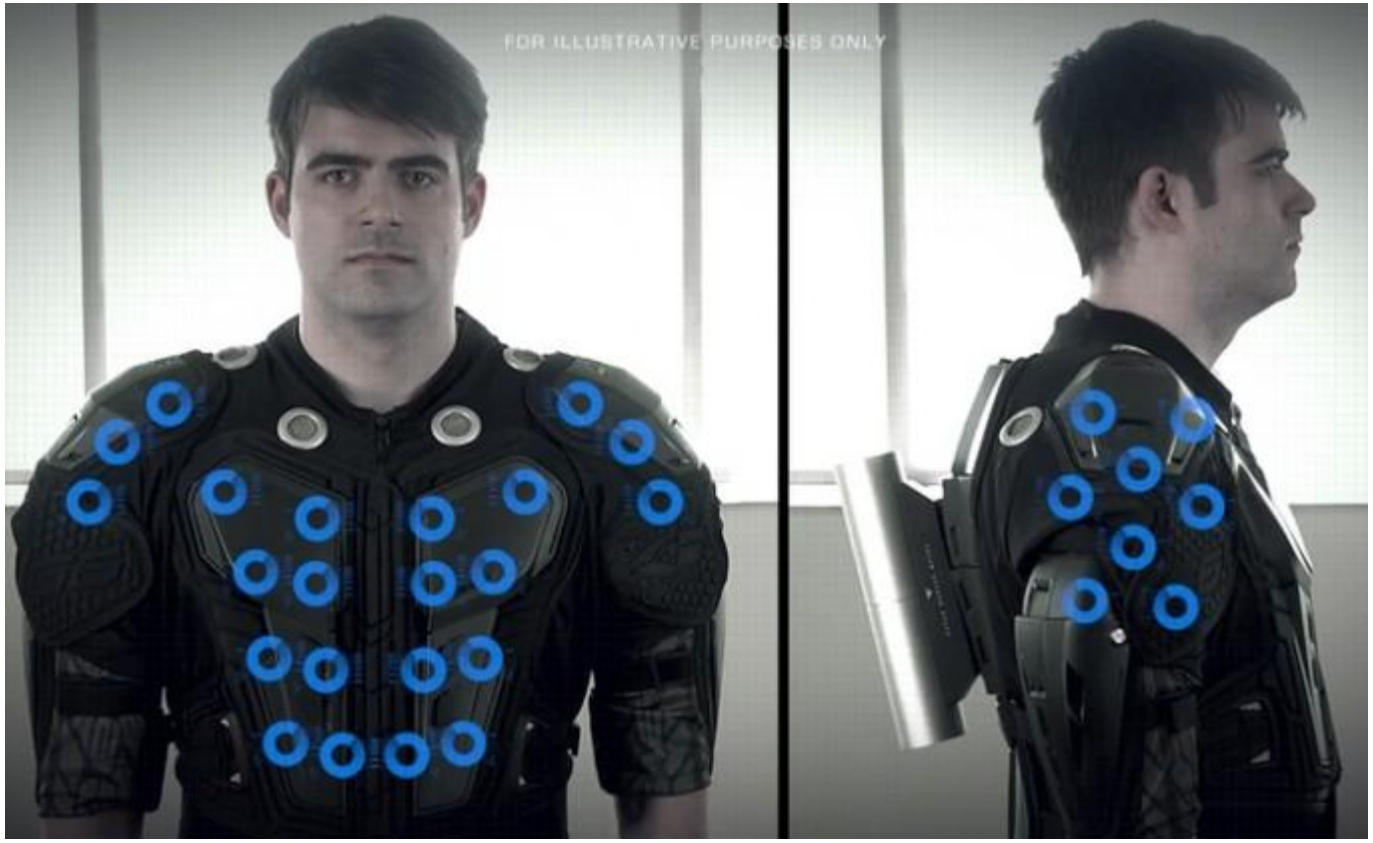


Figure 3.12 Cross Section of the Skin and Its Receptors





http://www.roadtovr.com/araig-kickstarter-gaming-impact-vest-virtual-reality/

http://www.ecouterre.com/vibrating-eyeronman-vest-could-help-the-visually-impaired-avoid-obstacles/eyeronman-vest-blind-3/?extend=1

Research questions if you want to use tactile cues

- How many different **patterns** of tactile cues can people distinguish?
- How many different **locations** of tactile cues can people distinguish?
- Will **adaptation** affect the perception of information?
- Can people learn and **remember** the tactile cues?

Characteristics of sensation

1. **Adaptation**

Adaptation of sensation

Adaptation

- Dark adaptation: from brighter to darker place
- Light adaptation: from darker to brighter place

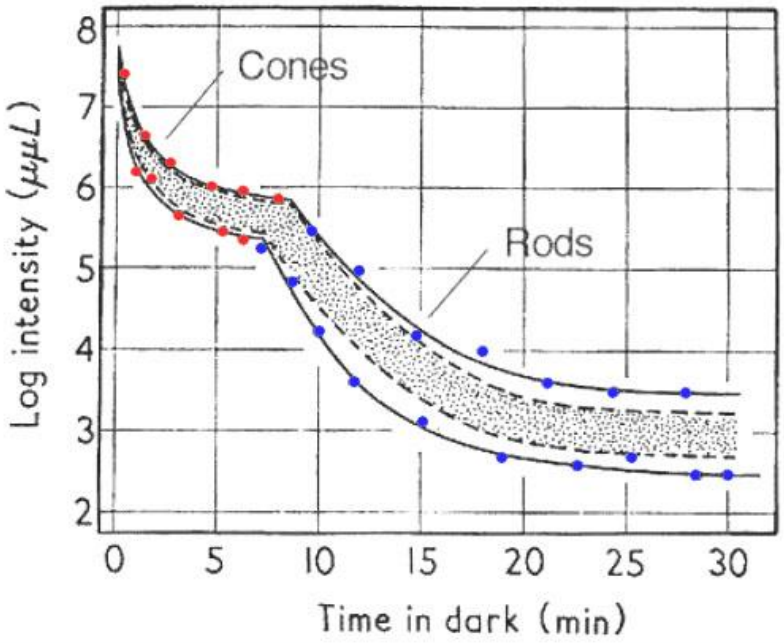


Figure 1. Dark adaptation curve. The shaded area represents 80% of the group of subjects. Hecht and Mandelbaum's data from From Pirenne M. H., Dark Adaptation and Night Vision. Chapter 5. In: Davson, H. (ed), The Eye, vol 2. London, Academic Press, 1962.

http://www.lifeafterdeathexperiences.org/description-of-heaven/

Adaptation of sensation

Consider Adaptation in design

- Give time for people to adapt. This means to gradually change brightness, sound intensity, etc.

- After adaptation, the stimulus will not be perceived as strong as before.

http://www.lifeafterdeathexperiences.org/description-of-heaven/

Characteristics of sensation

2. **People are better at telling the difference rather than the absolute value**

- Can you think any examples?
  - Weight, when you shop for groceries
  - Brightness, when you compare displays
  - Temperature, when you feel the cold wind

Characteristics of sensation

2. **People are better at telling the difference rather than the absolute value**

- **Design considerations:**
  - If the perception of absolute values is needed, provide graph legends.
  - If you want to rank multiple options, compare two at a time.
  - Use machines to enhance sensation.

Use machines to enhance sensation

- Bring non-sensible stimuli into the sensible range
- Night vision

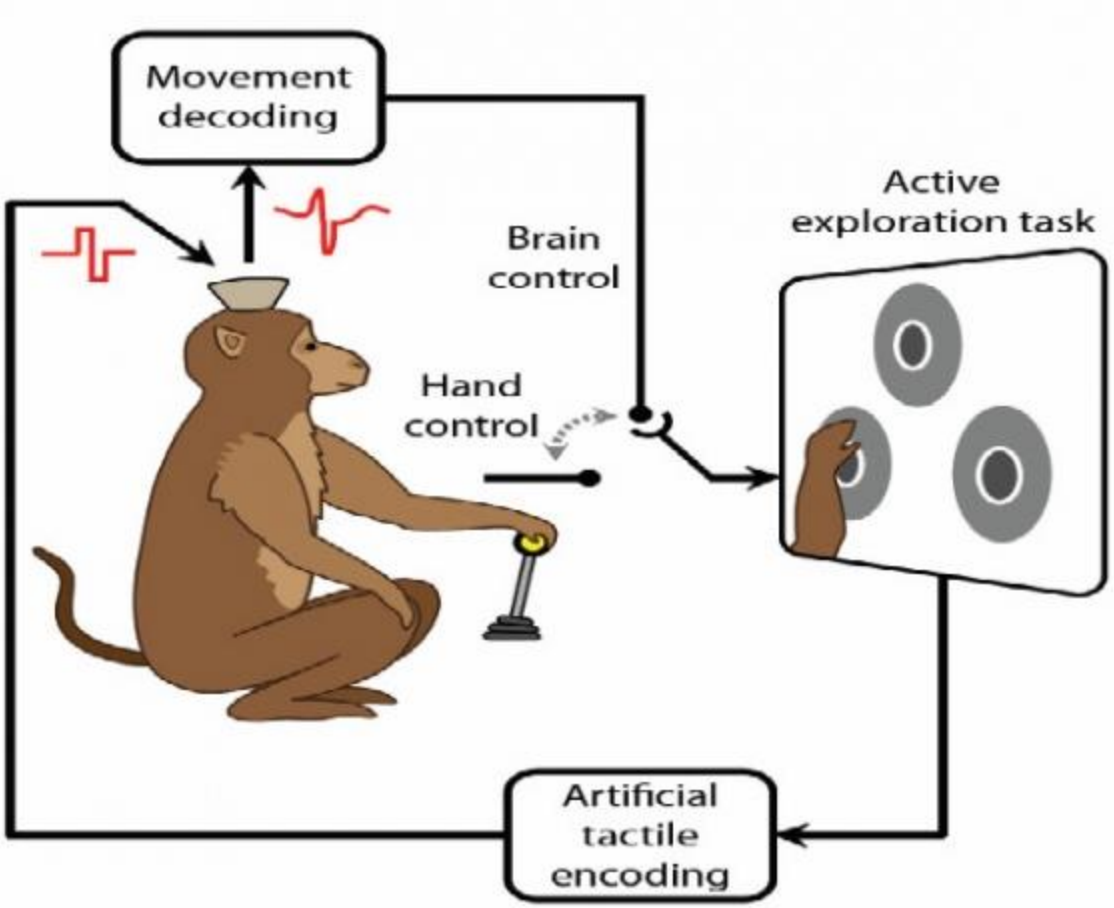
http://www.hownightvisionworks.com/

Use machines to enhance sensation

- Transfer information from one sense to another other
- Blind people drive
- http://www.ted.com/talks/dennis_hong_making_a_car_for_blind_drivers?language=en

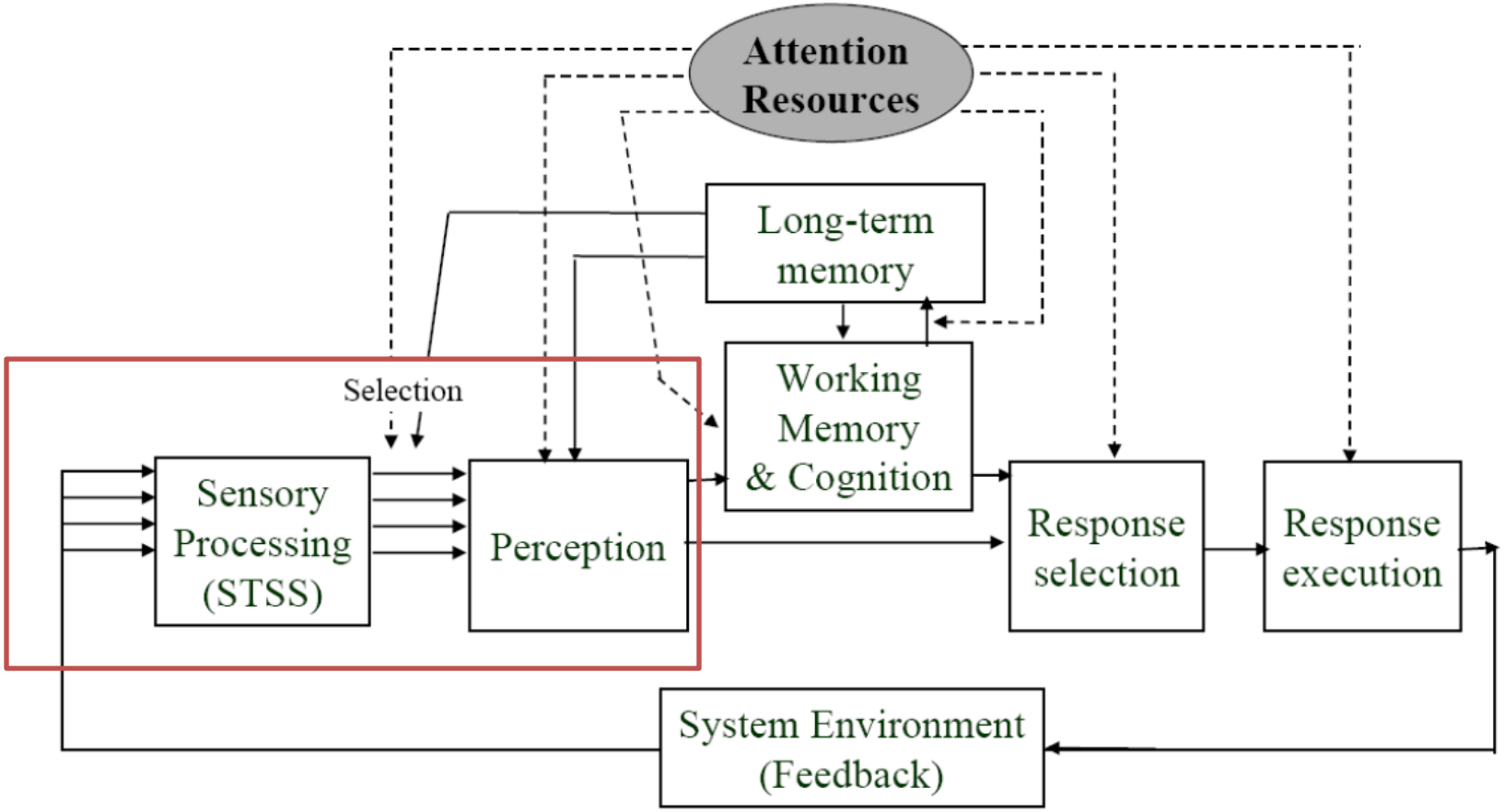
Use machines to enhance sensation

- New senses via brain-machine interfaces
- Learn a new sense by direct electric signal to the brain (https://www.ted.com/talks/miguel_nicolelis_a_monkey_that_controls_a_robot_with_its_thoughts_no_really)



Theme: Descriptive model of human information processing

- Senses and perception in the cognitive model



Characteristics of perception

- **"Bottom-up meets top-down"**
- It is determined by both
  - what we sense from the physical **world**, and
  - how our **mind** interprets the senses.

Perception: Bottom-up meets top-down

- Bottom – senses, neural signals
- Top – mind, knowledge, psychological meanings

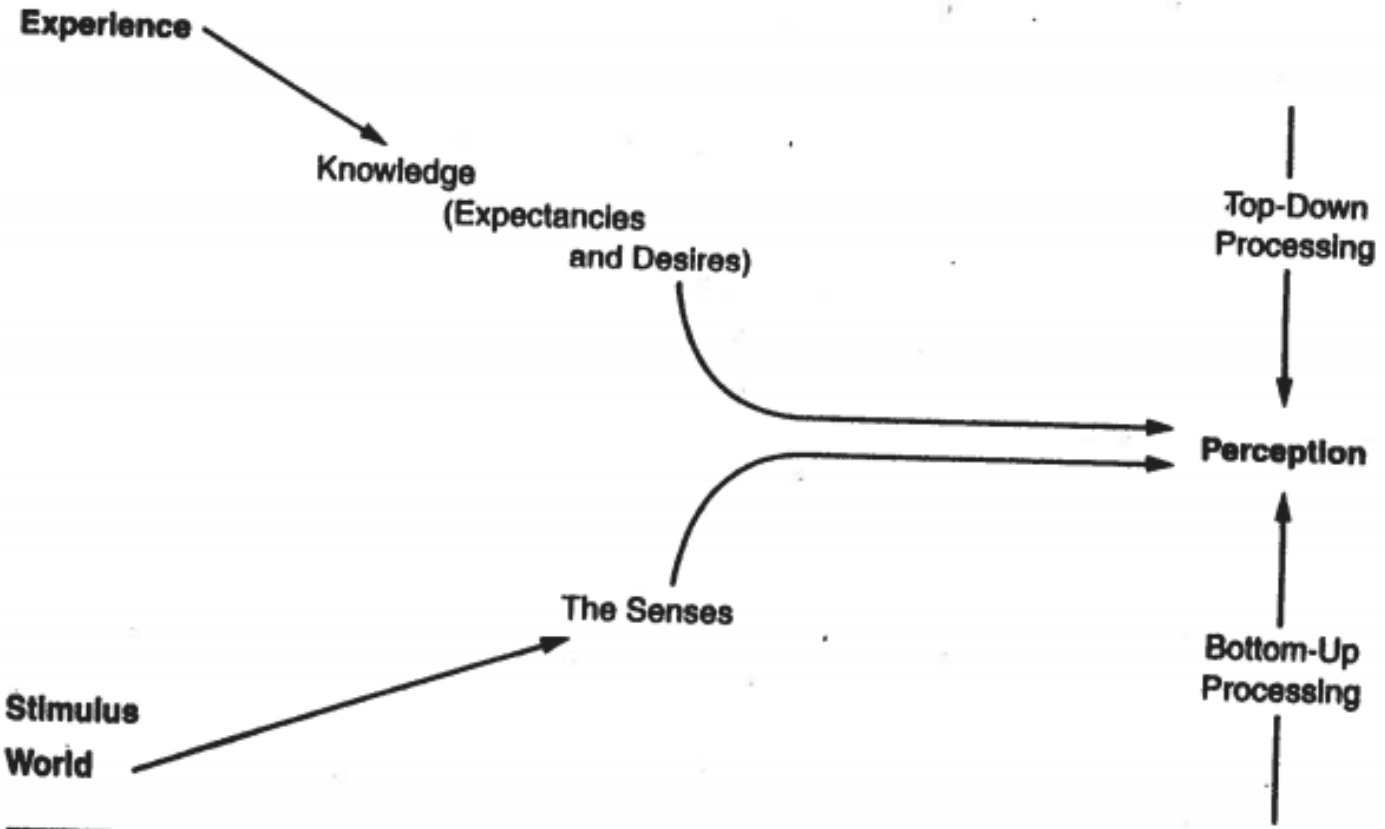


FIGURE 4.6
The relation between bottom-up and top-down processing.

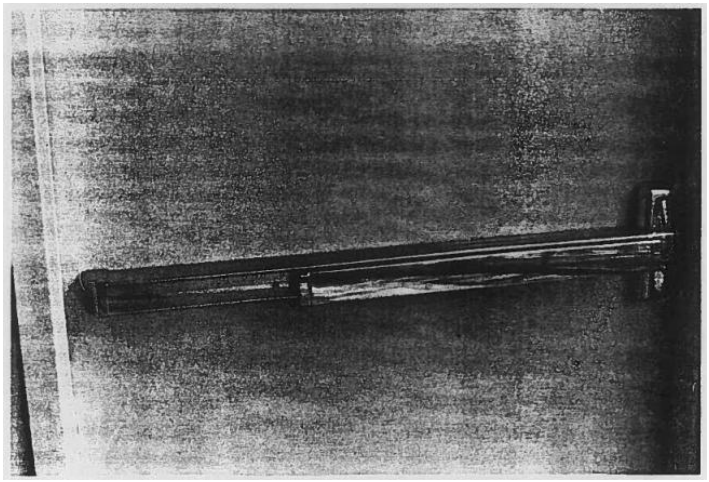
Perception: Bottom-up meets top-down

The brain applies experience (about numbers and English) and expectancies (context) in making sense of the stimulus.

Affordance and design implications

- Affordance
  - Perceived functions of an object (based on object appearance, personal experience and expectancies)
  - Inform the opportunity to perform an action

Poor design



Good design

Perception: Bottom-up meets top-down

Can you raed tihs? Olny srmat poelpe can.

I cdnuolt blveiee taht I cluod aulaclty uesdnatnrd waht I was rdanieg. The phaonmneal pweor of the hmuan mnid, aoccdrnig to a rscheearch at Cmabrigde Uinervtisy, syas it deosn't mttaer in waht oredr the ltteers in a wrod are, the olny iprmoatnt tihng is taht the frist and lsat ltteer be in the rghit pclae. The rset can be a taotl mses and you can sitll raed it wouthit a porbelm. This is bcuseae the huamn mnid deos not raed ervey lteter by istlef, but the wrod as a wlohe. Amzanig huh? yaeh and I awlyas tghuhot slpeling was ipmorantt!

Drinks or cleaning products?

Bix Deng
#20413850

Appearance (not showing anything delicious)
Shape (not for pouring into mouth)

Perception in design

- Form correct perception, meet expectation

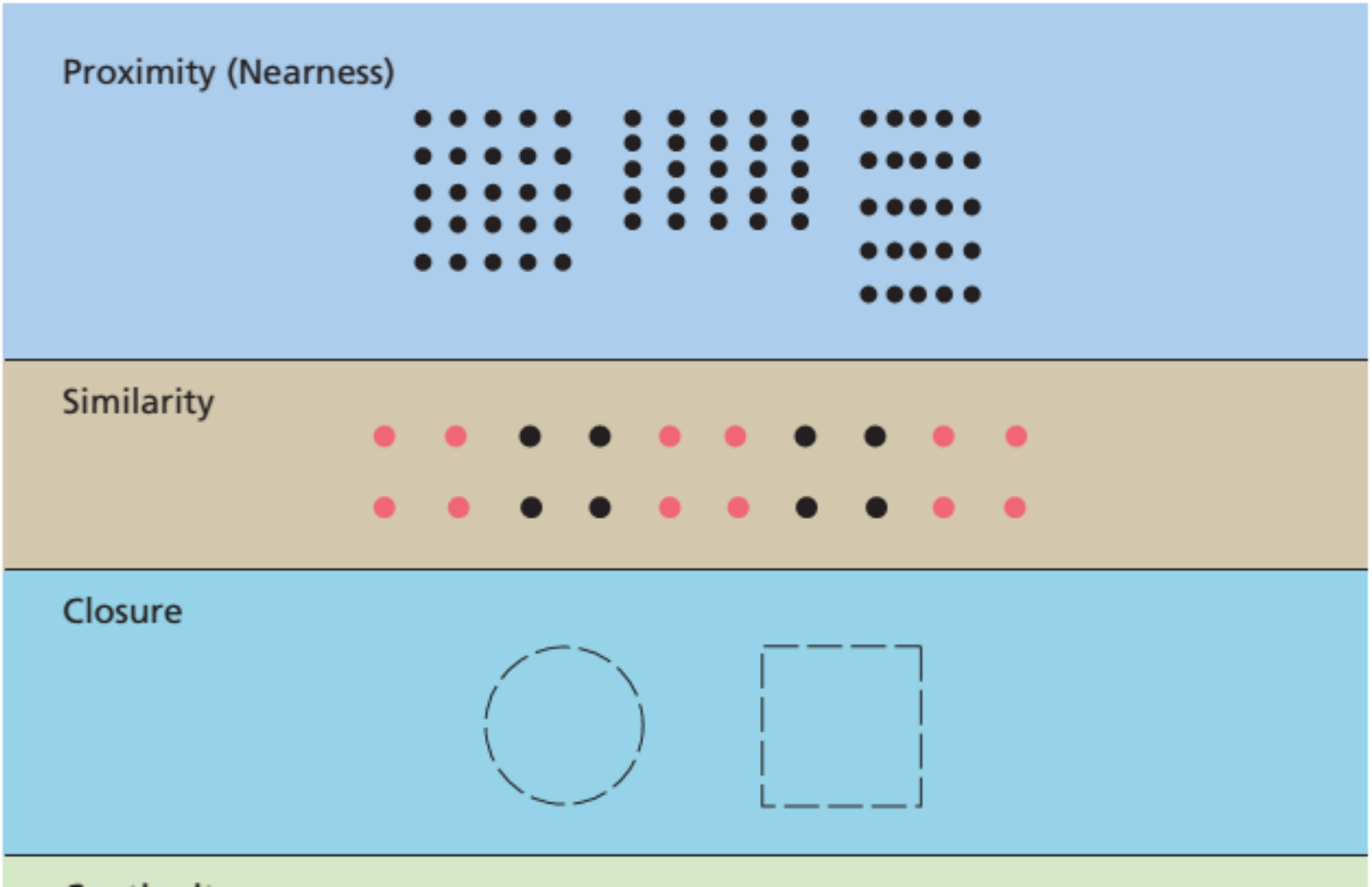
- Make the object only affordable to be used for the designed purpose.

Characteristics of perception

- **“Bottom-up meets top-down”**
- **Gestalt principles**

Gestalt Principles of Perception

- **Gestalt** (German: *Gestalt* "shape, form"). The mind forms a global whole with **self-organizing tendencies**.



Gestalt Principles of Perception

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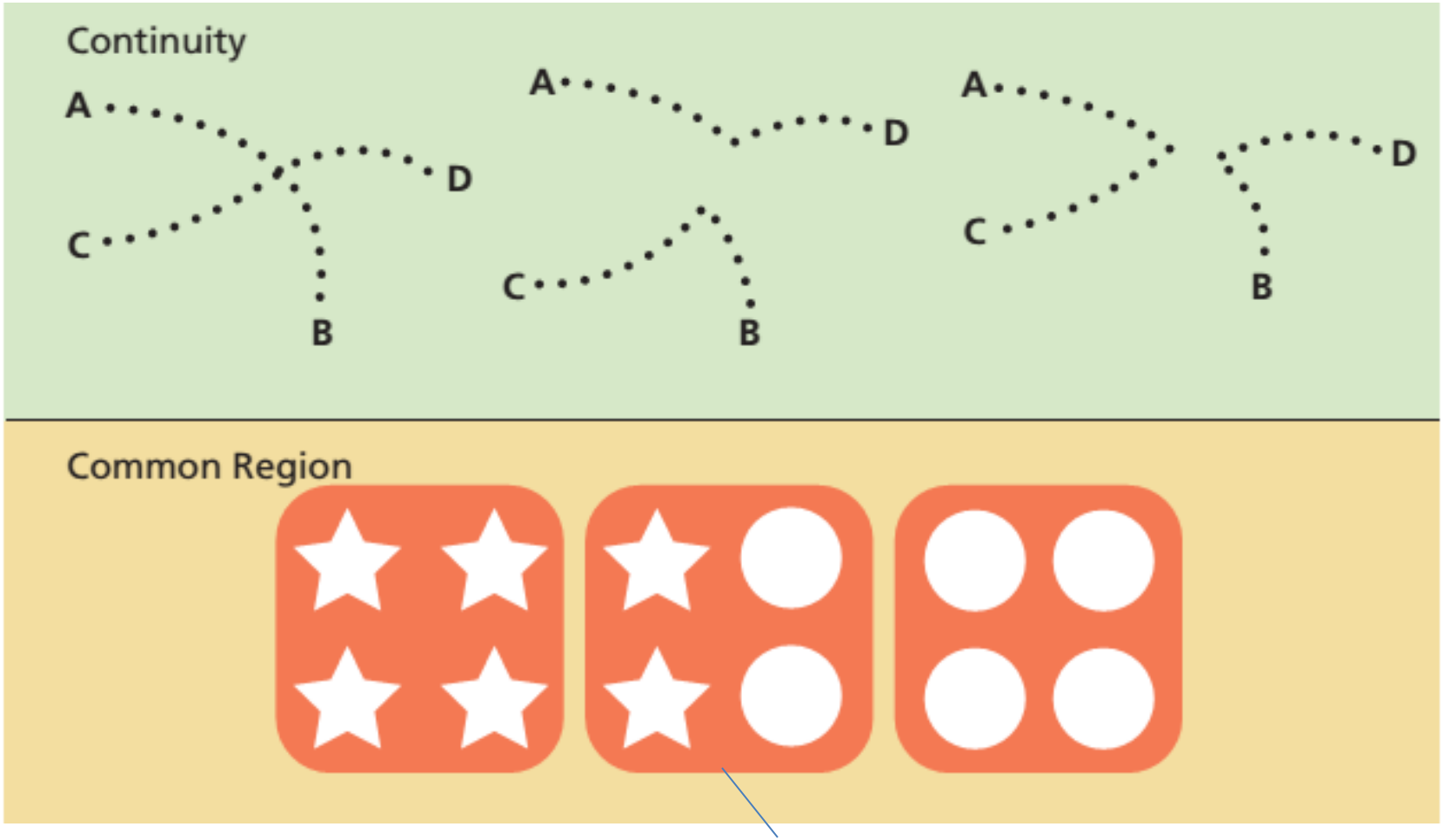


Two levels hierarchy

Gestalt in design

- Control panel design

Less organized

Gestalt in design

Proximity
(nearness, need space)

Similarity
(different shapes)

Common Region

More organized

Gestalt in design

- Logo design
  - **Proximity** (emerging contour)
  - A large concept consists of small concepts.

Gestalt in design

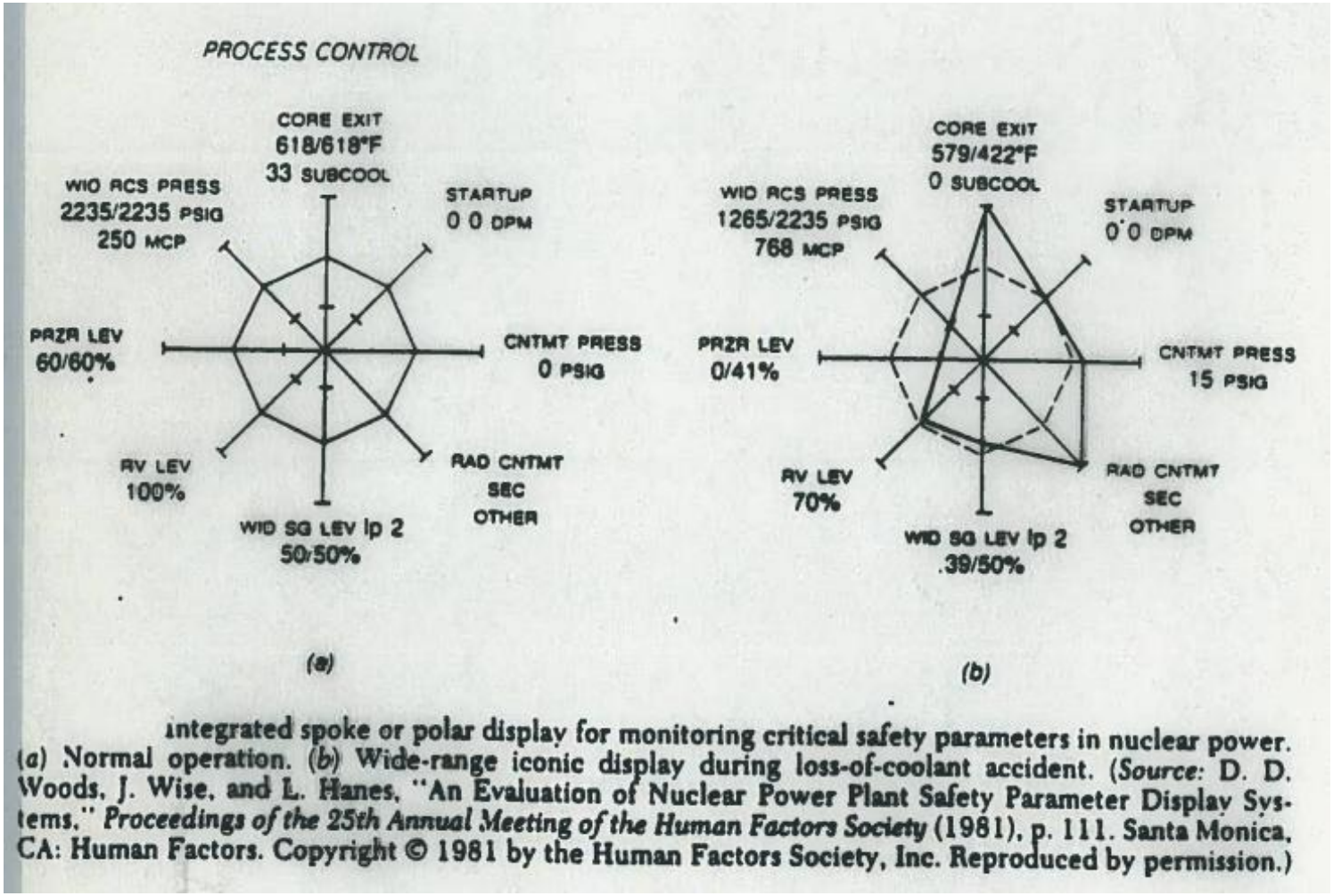
- Logo design
  - **Closure**
  - Simple, intelligent (viewers must fill in the blank part in their brain)

Gestalt in design

- Logo design
  - **Continuity** (eyes follow curves)
  - Feeling of connection, continuation

Perception: Emerging Features

- **Emerging features** formed by individuals
- Application in **integrated polar display**



integrated spoke or polar display for monitoring critical safety parameters in nuclear power. (*a*) Normal operation. (*b*) Wide-range iconic display during loss-of-coolant accident. (*Source:* D. D. Woods, J. Wise, and L. Hanes, "An Evaluation of Nuclear Power Plant Safety Parameter Display Systems," *Proceedings of the 25th Annual Meeting of the Human Factors Society* (1981), p. 111. Santa Monica, CA: Human Factors. Copyright © 1981 by the Human Factors Society, Inc. Reproduced by permission.)

Characteristics of perception

- **“Bottom-up meets top-down”**
- **Gestalt principles**
- **Constancy**

Perception: Constancy

- The perception of an object or quality as **constant** even though our sensation of the object changes.

- **Size**
- Shape
- Brightness
- Color

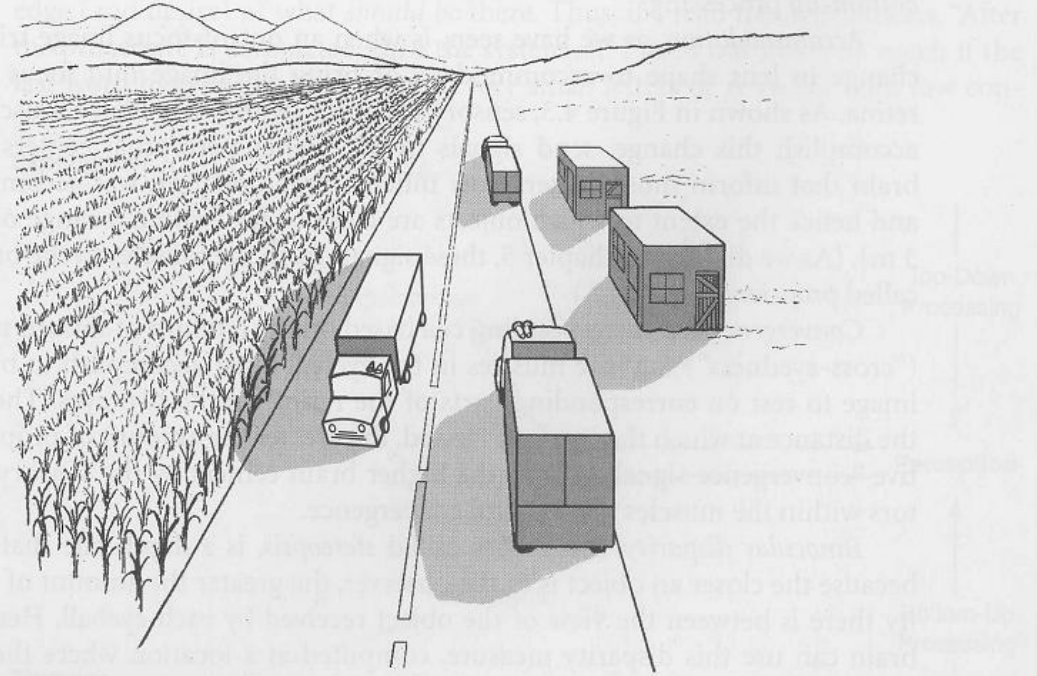


FIGURE 4.7
Some pictorial depth cues. (*Source:* Wickens, C. D., 1992. *Engineering Psychology and human performance.* New York: HarperCollins. Reprinted by permission of Addison-Wesley Educational Publishers, Inc.)

Perception: Constancy

- The perception of an object or quality as **constant** even though our sensation of the object changes.

- Size
- **Shape**
- Brightness
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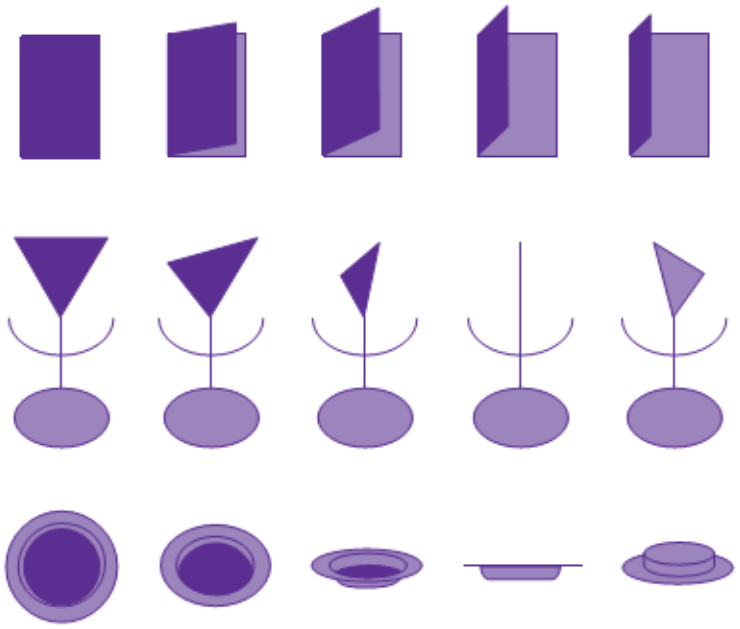
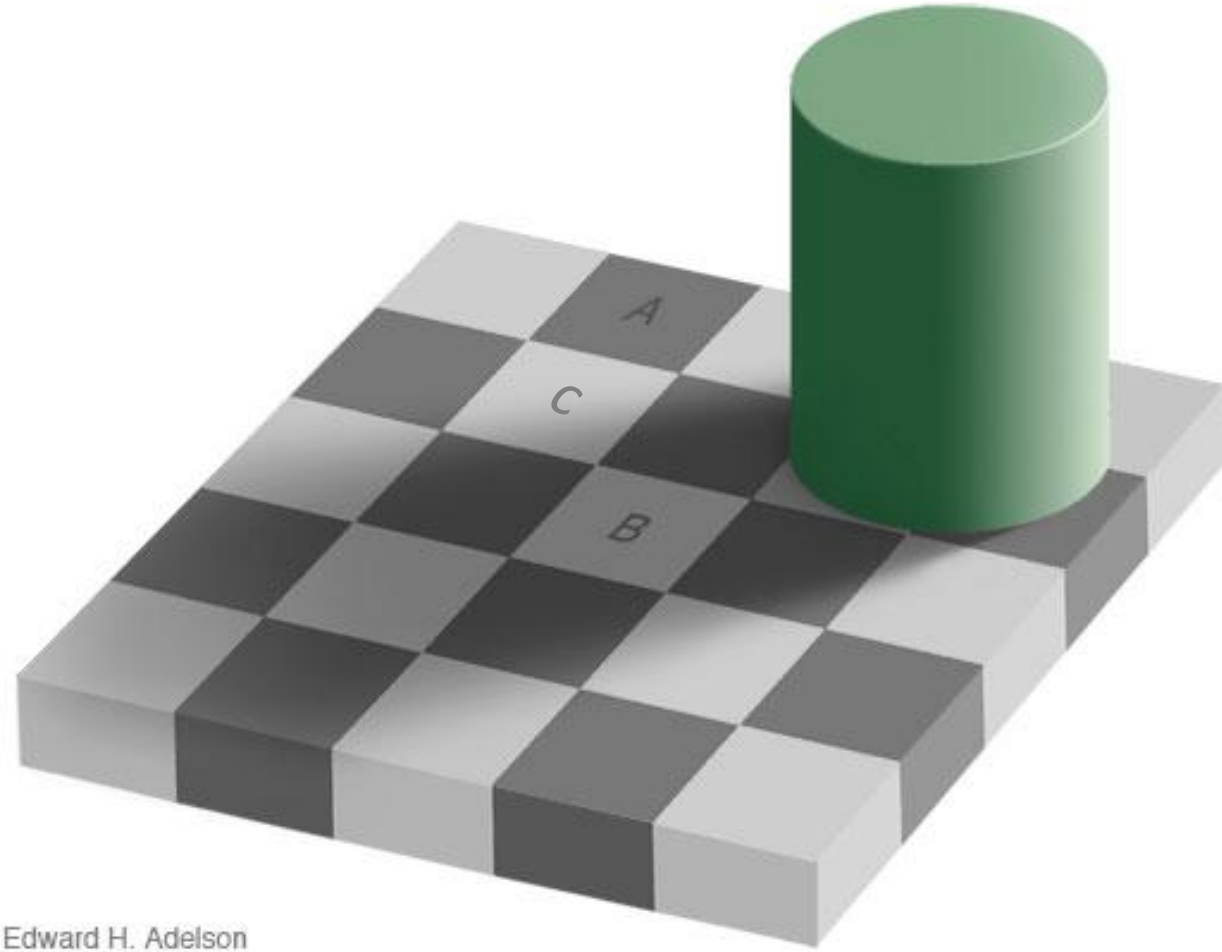


Figure 3.13 Shape Constancy

Perception: Constancy

- The perception of an object or quality as **constant** even though our sensation of the object changes.

- Size
- Shape
- **Brightness**
- Color

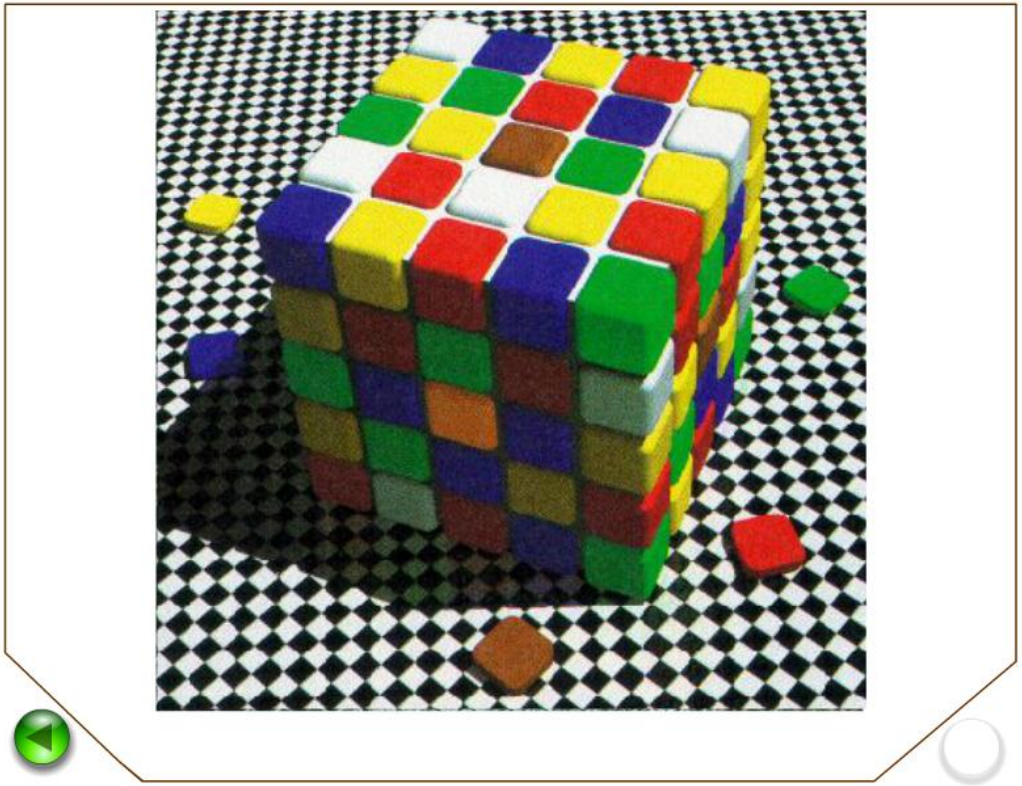


Edward H. Adelson

Perception: Constancy

- The perception of an object or quality as **constant** even though our sensation of the object changes.

- Size
- Shape
- Brightness
- **Color**



http://wadsworth.cengage.com/psychology_d/templates/stripped_features/try_online/TIY/kalat_intro_02.html

Overview of today's lecture

- Some other senses
  - Taste, smell, touch
- Characteristics of senses
  - Adaptation
  - Better at judging difference than absolute values
- Perception and its characteristics
  - "Bottom-up meets top-down"
  - Gestalt principles
  - Constancy

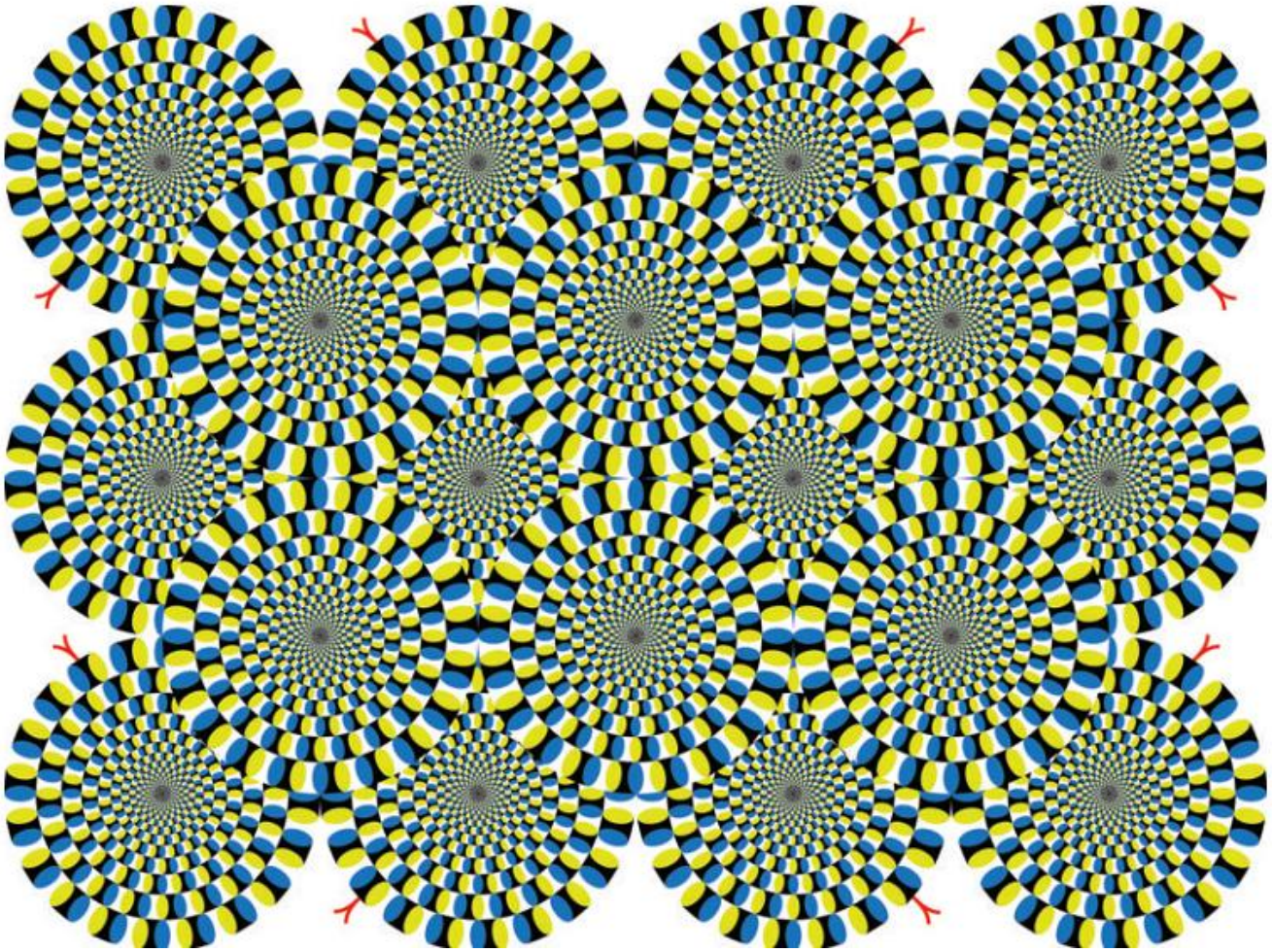
- How to use these in systems design? (Tutorial)

Tutorial

- Illusion

- 3 Design practices

Illusion



The brain still tries to make sense of what the eyes are telling it. But this time, it does not correctly interpret the truth.

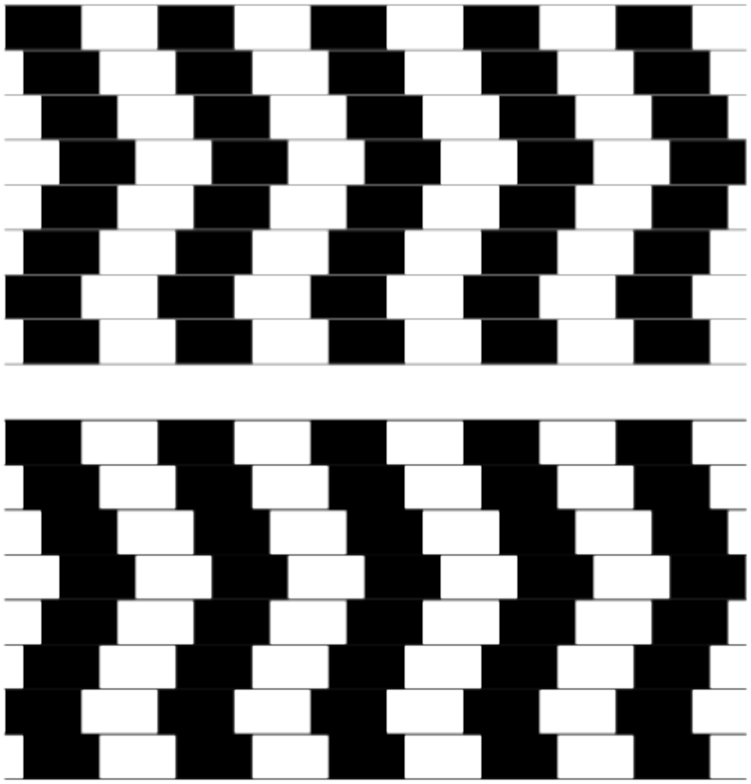
Figure 3.21 "Rotating Snakes"

Notice anything as you move your eyes over this image? The image is not moving; seeing the "snakes" rotate is due at least in part to movements of your eyes.

Created by and courtesy of Dr. Akiyoshi Kitaoka, Ritsumeikan University.

Visual illusion, application (Art)

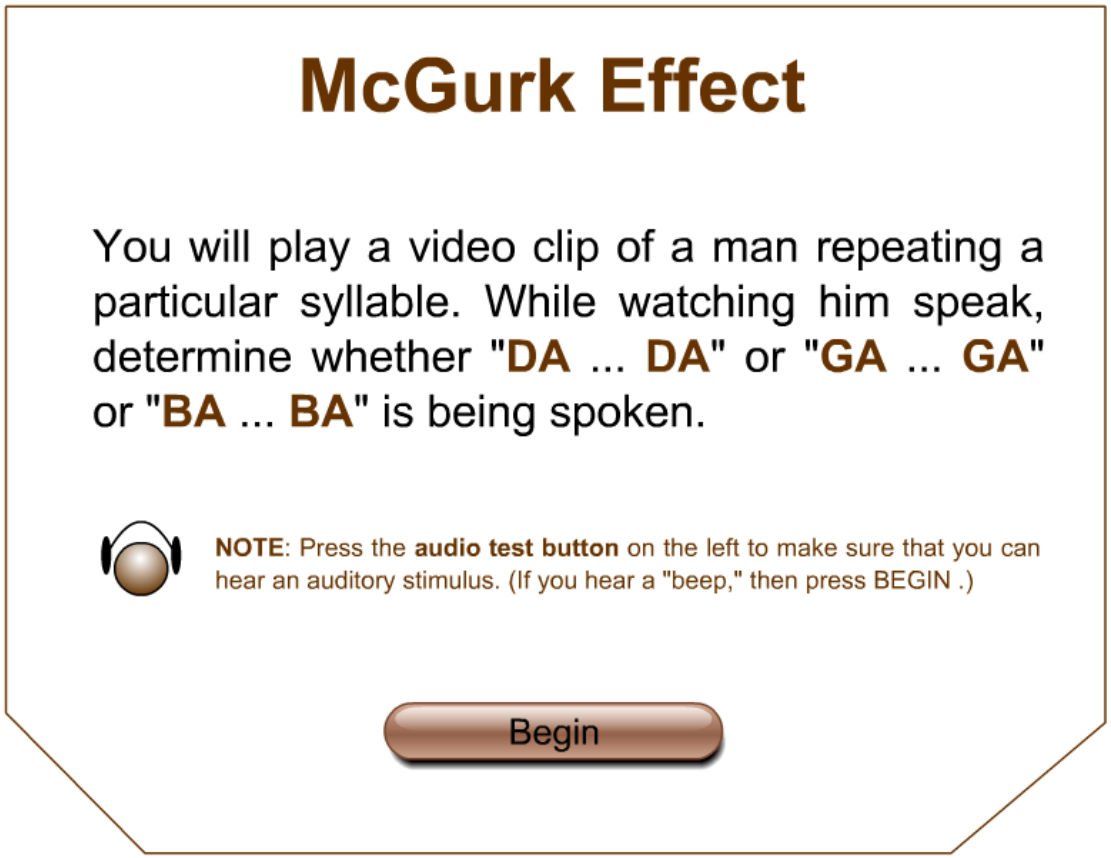
- A building in Melbourne, Australia designed to exhibit this illusion (C. L. Taylor, pers. comm., Aug. 5, 2006). The building, completed in 2006, is part of Melbourne's Digital Harbour Port 1010 and houses the Australian Customs Service (Ashton Raggatt McDougall 2006).



http://mathworld.wolfram.com/CafeWallIllusion.html

McGurk Effect

- A perceptual phenomenon that demonstrates an interaction **between hearing and vision in speech perception**.
  http://wadsworth.cengage.com/psychology_d/templates/stripped_features/try_online/TIY/kalat_intro_13.html



Design application practice #1

- Can you design something on the road to make drivers feel that the are speeding up, although the truth is that they are not?

Visual illusion, application (driving speed control)

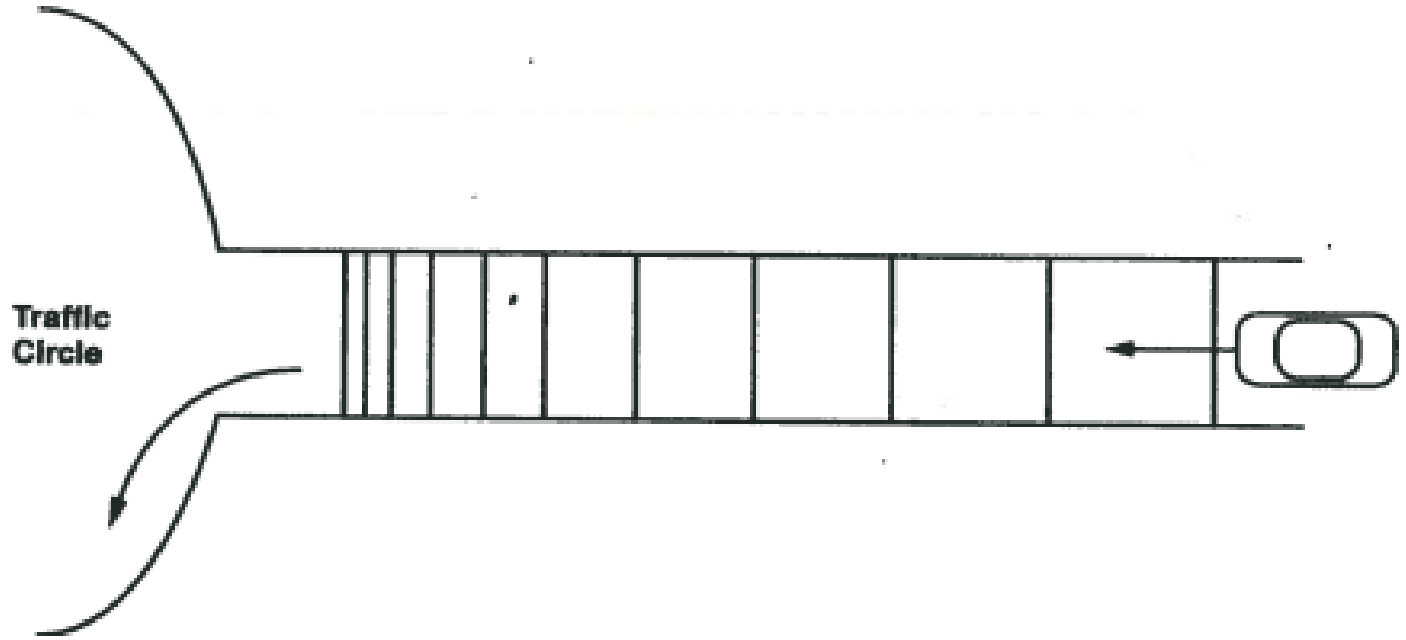
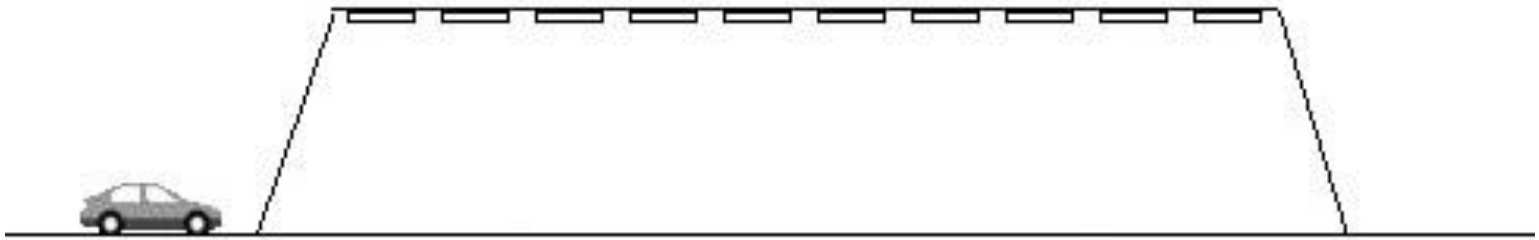


FIGURE 4.8

Technique used by Denton (1980) to slow down vehicles approaching the traffic circle (driving from right to left in the figure).

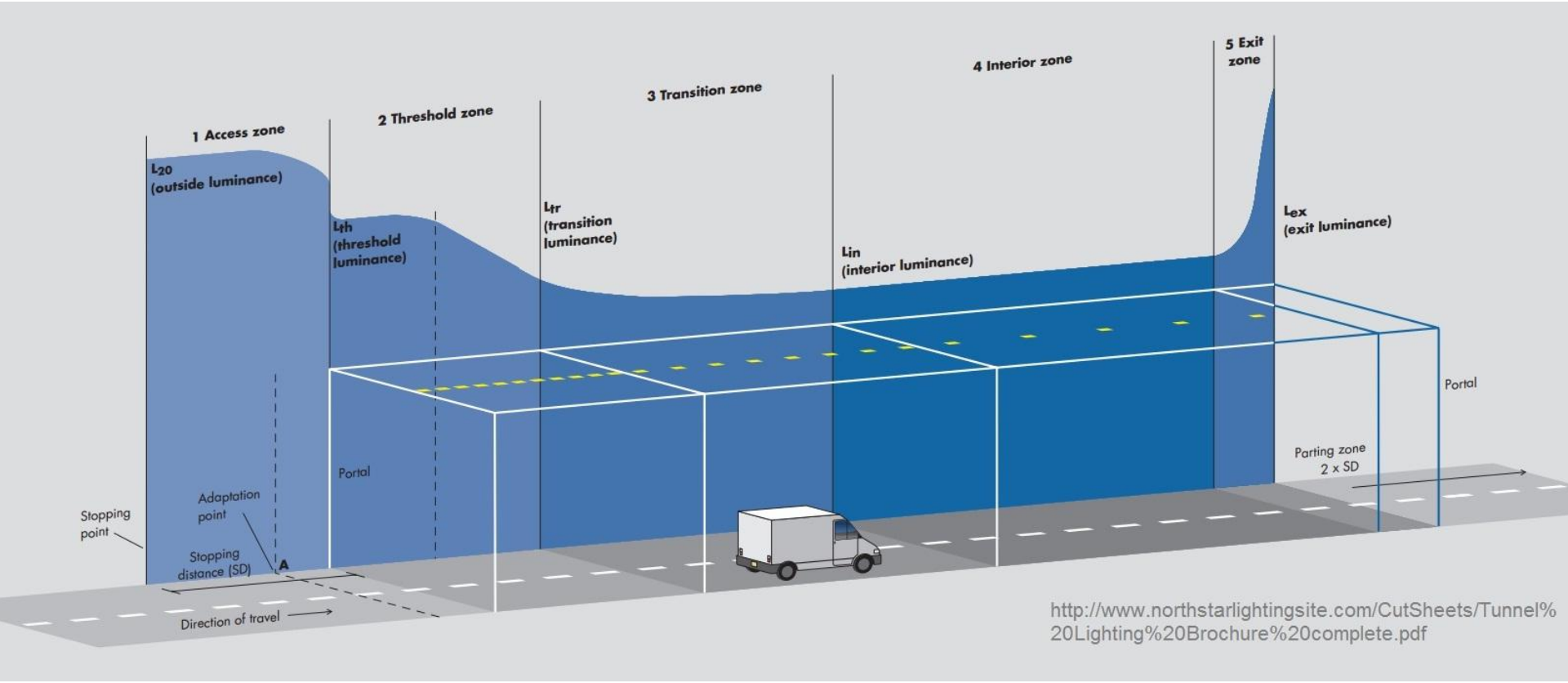
Design application practice #2

- How to design tunnel lighting?
- Consider dark adaptation and light adaptation
- At day time, and night time



Design applications

- How to design tunnel lighting?
- Consider dark adaptation, light adaptation
- Note the gradual change of illuminance (the picture below is for day time condition)



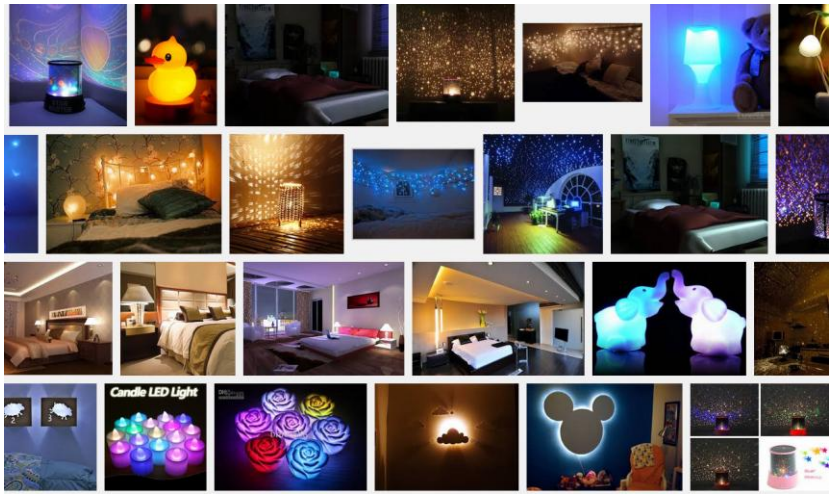
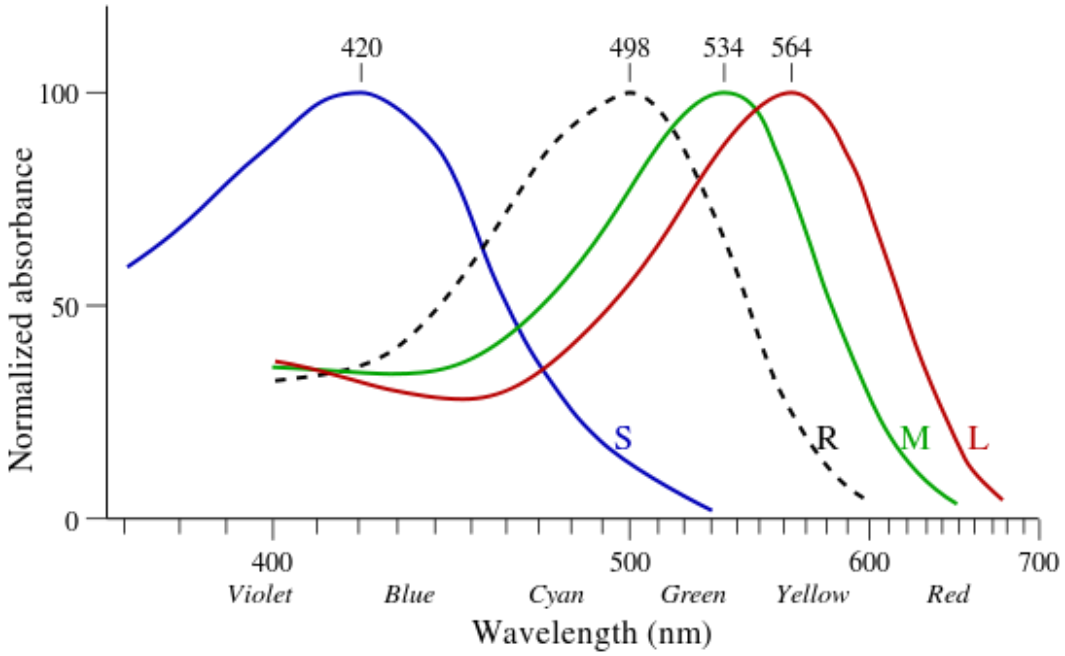
Design applications

- At night time condition, since it is darker outside, the lighting should gradually become brighter near the entrance of the tunnel; and gradually become darker near the exit of the tunnel.
- The idea is to allow eyes to gradually adapt to the new lighting environment, and avoid temporary blindness due to sudden brightness change.

http://mentalfloss.com/article/52493/why-did-pirates-wear-eye-patches

- FAA also recommend

- One eye for dark
- The other eye for light

Design application practice #3

- Ergonomically speaking, which color should be used for bedroom night lighting?
- To protect night vision.