CHAPTE R 3
PERCEPTION

CHAPTER OUTLINE

Perception attaches meaning to sensations, making them understandable experiences. Perception relies on sensory inputs but also uses expectations, motivations, and previous knowledge.

I. THREE VIEWS OF PERCEPTION

A. ECOLOGICAL VIEW

The ecological view says that the environment contains most of the information needed to form perceptions. Stimuli directly give most of the cues you need to make sense of the world. People then perform supporting actions, such as turning their head or walking around, to tune in the most important stimuli.

B. CONSTRUCTIONIST VIEW

The constructionist view says that perception relies on previous knowledge to infer reality from fragments of sensory information. This view sees perception as based on expectations and inferences based on past experience and not just on a passive reception of sensory inputs.

C. COMPUTATIONAL VIEW

The computational view focuses on how perception occurs. It tries to identify and explain the series of computations that the brain must perform to transform sensory inputs into meaningful experiences.

II. PSYCHOPHYSICS

Psychophysics focuses on the relationship between the physical characteristics of environmental stimuli and the psychological experiences those stimuli produce.

A. ABSOLUTE THRESHOLDS: IS SOMETHING OUT THERE?

1. The absolute threshold is the minimum detectable amount of environmental energy a sensory system can detect.

    a. Psychophysics has redefined absolute threshold as the minimum amount of energy that a sensory system can detect 50 percent of the time.

2. The absolute threshold varies over time and between people according to two factors.

    a. Internal noise, the spontaneous random firing of neurons, gives a background “noise” in sensory systems against which the brain must extract the sensory “signaL”
    b. Response criterion is a person’s willingness or reluctance (bias) to respond to a stimulus. It is the amount of energy needed for a person to justify saying that a signal has occurred. It reflects both motivation and expectancies.

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B. OVERCOMING THE THRESHOLD PROBLEM: SIGNAL-DETECTION THEORY

1. The signal-detection theory is a mathematical model that describes whether or not a person will decide that a near-threshold stimulus has occurred. In this model, subjects detect a target sensation (signal) by distinguishing it from a background of otherwise meaningless sensations (noise).
2. Detection of a faint signal depends on a person's sensitivity (ability to detect a stimulus) and response criterion.
3. To analyze signal-detection theory, researchers compare instances of true signals that occur against background noise versus instances of noise alone.

    a. When a signal occurs and the subject detects it, the response is called a hit.
    b. When a signal occurs but the subject does not detect it, the error is called a miss.
    c. When no signal is presented, but the subject decides that there was a signal anyway, the error is called a false alarm.
    d. Reporting no signal when none was given is called a correct rejection.

Example: A bank has been robbed. Sue, a detective, is trying to find the criminal. She investigates Bob (who was the robber) and Max (who was not the robber). When looking at Bob, if she decides that he is the robber, she has a hit; if she decides that he was not the robber, she has a miss. When looking at Max, if she decides that he is the robber, she has a false alarm; if she decides that he was not the robber she has a correct rejection.

4. Lowering .the response criterion (increasing bias) raises the hit rate and the false alarm rate, and lowers the number of misses as well as correct rejections.

    a. As the response criterion drops, people with greater sensitivity will show a hit rate that increases faster than the false alarm rate.

C. JUDGING DIFFERENCES BETWEEN STIMULI

1. According to Weber's law, the smallest detectable difference in stimulus energy (the difference threshold, or the just-noticeable difference, JND) is a constant fraction of the intensity of the stimulus.

    a. There are separate JNDs for different types of sensory input.

    b. Weber's law does not hold when stimuli are very intense or very weak. It does hold for very simple and very complex stimuli.

2. Fechner's law says that constant increases in physical energy will produce smaller increases in perceived magnitude, thus it will take greater and greater absolute energy increases to create equal perceived increases in intensity. This assumption applies to many, but not all, stimuli.
3. Stevens's power law is a more complex but more inclusive explanation for the perceived magnitude in all senses. It permits the observation that for electric shock, it takes less and less increases in stimulus magnitude to create the same perceived increases in intensity.

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D. THINKING CRITICALLY: CAN PEOPLE PERCEIVE WHAT CANNOT NORMALLY BE SENSED?

Parapsychology, a field that "goes beyond" psychology, studies claims of extrasensory perception (ESP), alleged abilities to perceive stimuli without using traditional senses. Such purported abilities include clairvoyance, perceiving concealed stimuli, and telepathy, communicating with others by extrasensory means. Psychokinesis, not actually a perceptual ability, is the alleged use of mental powers alone to move or control objects. Various people have claimed to possess each of these abilities.

1. What am I being asked to believe or accept? The purported ESP abilities cannot be accounted for by current knowledge of human sensory processes and are not a trick or a quirk.

2. What evidence is available to support the assertion? Laboratory experiments have sometimes shown clairvoyance, telepathy, and psychokinesis. Some blindfolded subjects are above chance in guessing the color shown on a card.

3. Are there alternative ways of interpreting the evidence? Most experiments do not support ESP phenomena, and the few experiments that suggest ESP abilities are seldom replicated. Studies that seem to support ESP claims often do have traditional sensory explanations, and some studies have been shown to be fraudulent.

4. What additional evidence would help to evaluate the alternatives? Repetition of experiments by psychologists who are neutral or skeptical about extrasensory perception would be useful.

5. What conclusions are most reasonable? Parapsychology must be based on scientific principles if it is to be a science, but data do not yet convincingly support the existence of ESP.

III. ORGANIZING THE PERCEPTUAL WORLD

A. PRINCIPLES OF PERCEPTUAL ORGANIZATION

1. When faced with complex stimuli, perceptual systems automatically divide on the figures (features to be emphasized) and ground (less meaningful background).

   a. The fact that people tend to place sensory information into either figure or ground shows the categorical nature of perception.

2. Grouping occurs as inherent properties of stimuli lead you to group some stimuli into a functional unit. The result is a Gestalt, a unified whole, qualitatively more than just the sum of its parts.

   a. Proximity: Objects that are close to each other tend to be perceived as belonging together.
   b. Similarity: Similar things are perceived to belong to a group.
   c. Continuity: Sensations that appear to create a continuous form are perceived as belonging together.
   d. Closure: People tend to fill in missing information to complete an object.

e. Texture: Stimuli that have the same texture (e.g., oriented along the same directions) tend to be grouped together.
f. Simplicity: People group stimuli to provide the simplest interpretation of the world.
g. Common fate: Objects that are moving in the same direction and speed are perceived as a group.
h. Common region: Elements located within the same boundaries tend to be perceived as belonging together.

3. Auditory science analysis shows many of the Gestalt principles described for vision. First, sounds are sensed and their constituent elements (frequency, intensity, and so on) identified. Then, sounds of similar characteristics are grouped into Gestalt-like wholes, auditory streams, which are sounds perceived as belonging together and coming from the same source.
   a. Sounds that are similarly pitched or occurring near each other tend to be grouped together.
   b. We tend to hear continuous sounds even when they are separated in time-such as by brief bursts of static.

B. PERCEPTION OF DEPTH AND DISTANCE

Depth perception is the ability to see the visual world in three dimensions.

1. Depth perception partly relies on stimulus cues, information from the environment itself.

a. Relative size: If two objects are the same size, the object producing a larger retinal image is perceived as closer than the one producing a smaller image.
b. Height in the visual field: More distant objects tend to be higher on the horizon.
c. Interposition: Closer objects block the view of distant objects.
d. Linear perspective: As two lines come closer together, the perceived distance increases.
e. Reduced clarity: Greater distances usually yield less clarity.
f. Light and shadow: Shading helps contribute to perception of three dimensions.
g. Textural gradient: Texture appears gradually less detailed with increased distance.
h. Movement gradient: The difference in relative movement (motion parallax) between two objects gives cues to their different distances.

2. Depth perception also relies on properties of the visual system.

a. In accommodation, muscles alter the shape of the lens to focus objects from different depths. Feedback about this muscle activity gives the brain information about an object's depth.

b. Each eyeball rotates inwardly, or converges, so that an object's image projects onto each retina. The greater the inward rotation, the closer the object. Thus, feedback from muscles that move the eyeballs gives information about an object's depth.
c. The two eyeballs are in slightly different locations, so they receive slightly different images of the same object. The brain can use this difference between the two retinal images, called binocular disparity, to calculate an object's depth.

C. PERCEPTION OF MOTION

1. Looming is a rapid expansion in the image size of an object so that it fills the retin_. The image is automatically perceived as an approaching stimulus, not an expanding object (recall size constancy).

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2. Vestibular and tactile senses combine in movement perception.

Example: Motion sickness may occur when vision supplies movement information but the other senses do not.

D. PERCEPTUAL CONSTANCY

1. Perceptual constancy is the ability to create a consistent perception of an object even as its sensory features change.

2. Visual size constancy occurs as objects move closer or farther away. The perceived size of the object remains constant even though its retinal image increases and decreases.

    a. An object's perceived size equals the retinal image size multiplied by perceived distance.
    b. The perception of size constancy also stems from knowledge of objects in the world and the logical inferences based thereon.

3. As objects change orientation, the shape of their actual retinal images change, yet shape constancy allows you to know that the object's shape is still the same.
4. As the amount of light striking an object changes, brightness constancy allows you to perceive the object's brightness as relatively constant. The brightness of an object is perceived in relation to its background.

E. PERCEPTUAL ILLUSIONS

1. Illusions are perceptual "mistakes," inaccurate interpretations of sensations.

    Note: Students often confuse the following terms: illusion, an incorrect perception of a stimulus; delusion, a false belief; and hallucination, a perception in the absence of a stimulus.

2. Optical illusions are illusions of the visual system.
    a. The Miiller-Lyer and Ponzo illusions are incorrect perceptions regarding distance that result from a misapplication of linear perspective depth cues.
    b. Visual illusions are multiply determined. Distortions of perception may be created by environmental cues, motivation, experience, and expectancy.
    c. Perceptual tendencies, including the illusions you are likely to experience, are affected by your culture and past experiences.

F. CULTURE, EXPERIENCE, AND PERCEPTION

1. Optical illusions are not always automatic-they depend on a person's cultural experiences and how they have helped the person perceive the world.

    a. For individuals from cultures in which pictures are seldom seen, it can be very difficult to perceive images in photos or paintings, despite being able to perceive the exact same images in "real life."
    b. Some cultural differences attributed to perceptual differences may merely be differences in familiarity with testing materials.

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IV. RECOGNIZING THE PERCEPTUAL WORLD

1. The ability to recognize objects involves being able to construct perceptual categories and place individual objects in or out of a category stored in memory.
2. Two general processes occur in recognition.
   a. Top-down processing is the use of preexisting thoughts, motivations, and expectations to apply meaning onto a sensory event.
   b. Bottom-up processing is the extraction of meaning from a stimulus using only the sensory information coming "up" to the brain from the sensory receptors themselves.

A. BOTTOM-UP PROCESSING

1. By a feature-analysis view, sensory feature detectors extract basic features from a stimulus set, and the brain must try to synthesize a perception by combining these features.
2. The brain can also analyze visual spatial frequencies, the patterns of light and darkness, to help identify stimuli.
3. Another view holds that stimulus features are grouped into combinations called geons. The brain processes and recognizes stimuli according to the geons that they possess.

B. TOP-DOWN PROCESSING

1. Top-down processing is the imposition of higher-level cognitive processes (memories, context, expectancy, motivation) onto an incoming stimulus, actively constructing a perception based on more than the raw stimulus per se.
2. Previous experiences help create schemas, generalized mental representations of how the world works and what we can expect from it. Schemas guide or bias perception by helping to create a perceptual set, a habitual readiness to perceive a stimulus in a certain way.

_Example: It may be easier to recognize your bank teller in the bank than when you are at a grocery store.

C. TOP-DOWN AND BOTTOM-UP PROCESSING TOGETHER

1. Both top-down and bottom-up processing occur simultaneously.

   Example: In reading a word, the visual shape of the letters must be sensed (bottom-up processing), yet one can use knowledge, context, and expectancy to figure out the meaning of poorly written or degraded letters (top-down processing).

2. Top-down processing can fill in the gaps between stimuli because the stimulus world is redundantif you miss vital sensory information from one stimulus, another is likely to help you fill in the gap.

D. NETWORK PROCESSING

1. Network processing is the extensive and relatively automatic interaction of various neural feature detectors. This capacity places heavy emphasis on connections between feature detectors.

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2. Parallel distributed processing **(PDP)** models, sometimes called connectionist models, give a computational view of how perceptual systems recognize stimuli.

   a. In such models, each element is connected to all other computational elements.
   b. Some connections excite the next element, while others inhibit the next element.
   c. Each time that a connection is used, it gets a bit stronger. As stimuli occur together, the connections between the neural elements they activate become stronger. Thus, two stimuli will become more strongly "associated" with each other by more strongly activating common elements.

   d. PDP models claim that stimulus recognition occurs at the level of connections: Perceptual systems recognize the pattern of connections that a stimulus activates.

   e. Experiments seem to support the existence of such processing in humans.

      (1) Object superiority effect: People recognize stimulus features faster when they are part of a whole object.
      (2) Word superiority effect: People recognize letters faster when they are part of a word.
      (3) According to PDP models, such effects occur because the object or word additionally activates connections that you recognize as underlying the feature or letter to be identified.

V. LINKAGES: PERCEPTION AND HUMAN DEVELOPMENT

Do infants perceive the world as adults do?

1. Patterns of eye movements in infants help reveal perceptual experiences. Infants eventually stop looking at unchanging visual stimuli. This is called habituation. If the stimulus then changes, infants will start looking at it again. This is called dishabituation.

   a. By noting which stimuli cause disinhibition, researchers can infer which stimuli infants have the capacity to perceive.

   b. Such experiments show that newborn infants have color vision and can determine the orientation lines. Thus, basic feature-detection mechanisms appear to be present at birth.

   c. The capacity to visually recognize whole objects requires a few months of visual experience.

2. Face perception may be a stimulus that we are born ready to recognize as a unique part of the perceptual world. Infants only a few hours old preferentially gaze at faces as compared to similar but nonface stimuli.
3. The capacity to perceive depth probably emerges more slowly than the development of object recognition.

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VI. ATTENTION

Attention is the process of directing and focusing mental abilities to improve perception, performance, and mental experience. It helps direct sensation and perception, select information for analysis, and allocate computational resources onto that analysis.

1. Attention has three important characteristics.

    a. It improves mental processing.
    b. It requires effort.
    c. Its resources are limited.

2. Attention can take two forms.

a. Overt orienting is shifting attention by physically pointing sensory systems directly onto a tobe-attended-to stimulus, such as when you move your eyes onto something you are viewing.
b. Covert orienting is shifting attention without making a physical effort, such as when you think more about some of the images you are seeing without moving your gaze to fall directly upon it.

A. FOCUSING ON RESEARCH METHODS: AN EXPERIMENT ON "MIND READING"

Michael Posner hypothesized that if covert orientation shifts attention to a different visual region, people should be able to better perceive information in that region as compared to other regions.

1. To test his ideas, Posner and his colleagues (1978) had subjects keep their gaze on a point in the center of a screen. After subjects maintained their gaze for a second, they continued to gaze at the center while a tiny square mark flashed to the left or the right, where subjects could only use peripheral vision.
2. One cue appearing at the central fixation point told subjects that the square about to appear had an 80 percent chance of being on the left, another central cue predicted an 80 percent chance of a right-sided square, and a third possible cue predicted equal chances that the square would be left or right.
3. Results showed that the square was detected fastest when it appeared in the cued direction, and slowest when the square appeared in the direction opposite that indicated by the cue.
4. These data suggest that even though visual gaze was maintained on the same spot at all times, subjects covertly shifted attention left or right when relevant cues were provided.

B. ALLOCATING ATTENTION

1. Attention is selective, focusing on some stimuli more than others.

2. As covert and overt orienting suggest, attention control can be voluntary (goal-directed, purposeful) or involuntary (stimulus-driven).

    a. Voluntary attention control is shown by the increased likelihood of forming certain perceptions as the result of motivation and other knowledge-based, top-down processing mechanisms.

Example: If you know you are looking for Elm Street, you are more likely to attend to and notice the street signs as you drive.

b. Involuntary attention control is shown by the finding that certain stimuli more effectively draw attention from subjects than do other stimuli.

(1) Stimuli that are familiar (e.g., your name), large, intense, moving, contrasting, or novel tend to best attract attention.

3. Divided attention occurs when you simultaneously devote mental resources to more than one thing. In fact, it may sometimes be difficult to focus attention on only one thing.

a. If one task is automatic, it requires less attention, thus making it easier to attend to a second task.
b. Increased difficulty of a task interferes with the ability to perform other tasks.
c. Stress tends to restrict attention.

C. ATTENTION AND AUTOMATIC PROCESSING

Parallel processing is the ability to search rapidly for targets in several locations at once. This early feature analysis is automatic, not requiring volitional effort, and allows quick "pop out" of relevant stimuli.

Note: By contrast, serial processing is effortful, attentionally focused, step-by-step analysis.

D. ATTENTION AND THE BRAIN

1. At least three brain areas may help direct attention.

a. The posterior parietal lobe helps disengage attention away from its present focus.
b. The superior colliculus helps shift the focus of attention.
c. The thalamus's pulvinar nucleus helps attach attention on a new location.

2. The right cerebral hemisphere is generally more involved in attention control than is the left hemisphere.

VII. APPLICATIONS OF RESEARCH ON PERCEPTION

A. AVIATON PSYCHOLOGY

1. An airplane cockpit illustrates the need to use top-down processing.

a. The radio signal is often muddled by static or is clipped.
b. The messages are usually short, with little redundancy.

B. HUMAN-COMPUTER INTERACTION

1. Computer displays are designed to give stimulus depth cues used for depth perception in the physical world.

Example: The shading of “buttons” on some displays gives the appearance of depth.

2. Blinking cursors do a better job of attracting attention than nonchanging cursor displays do.
3. Pictorial images or icons used to represent objects, files, or resources are easier to detect, recognize, and interpret compared to word-based representations.

VIII. FUTURE DIRECTIONS

A. An increasingly popular trend is to build computational models of perceptual processes.
B. There is great interest in how the brain distributes attention to features of mental functioning.
C. Research will help develop virtual reality simulations, in which sensations occur that are so compelling as to inspire the feeling of actually being “in” a computer-generated world.

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CHAPTER OBJECTIVES

1. Define perception. Compare and contrast perception and sensation.
2. Discuss the debate among the constructionist, computational, and ecological viewpoints as to how perception works.
3. Define psychophysics and absolute threshold. Explain the influence of internal noise and response criterion on perception.
4. Define and describe signal-detection theory. Be sure to include sensitivity to stimuli and response criterion in your answer. Describe how information can change the response criterion.
5. Describe Weber's law. Define just-noticeable difference (JND). Explain the equation JND = KI.
6. Describe Fechner's law.
7. Describe parapsychology and extrasensory perception (ESP). Explain what conclusions are most reasonable about ESP.
8. Describe the two basic principles of perceptual organization: figure-ground and grouping. Define and give examples of proximity, similarity, continuity, closure, texture, simplicity, common fate, and common region.
9. Discuss how auditory scene analysis organizes our perception of sounds.
10. Define and describe depth perception.
11. Describe the stimulus cues that influence depth perception. Your answer should include relative size, height in the visual field, interposition, linear perspective, reduced clarity, light and shadow, textural gradient, and movement gradient.
12. Describe the cues to depth provided by accommodation, convergence, and binocular disparity.
13. Describe the cues used to perceive motion. Your answer should include looming and the brain's ability to sense the position of the eyes and head.
14. Define perceptual, size, shape, and brightness constancy.
15. Explain the basis of the Ponzo and Miiller-Lyer illusions.
16. Describe the impact of culture on perception.
17. Explain how feature analysis works.
18. Compare and contrast bottom-up processing and top-down processing.
19. Discuss the influences on top-down processing. Your answer should include expectancy, motivation, and schemas.
20. Describe how top-down processing and bottom-up processing work together.
21. Define network processing. Explain the parallel distributed processing models of pattern recognition.
22. Describe an infant's perceptual abilities.
23. Define attention. Describe the research on the covert shifting of attention.
24. Describe the influences that determine the ease of directing or dividing our attention. Explain parallel processing.
25. Describe the influence of perceptual studies on the development of aviation and computer displays.