Lecture Notes

# Chapter 3: Perception: Recognizing Patterns and Objects

## Learning Objectives

* Define the process of perception
* Explain the Gestalt approaches to perception
* Distinguish among the various types of bottom-up processes
* Differentiate among the different types of top-down processes
* Describe how the phenomenon of composite faces is used to understand the process of face perception
* Summarize the view of direct perception
* Compare and contrast the types of visual agnosias

## Outline

**I.** Setting the Stage

**A.** Perception is the process of taking sensory information and interpreting it meaningfully.

**1.** The central problem of perception is explaining how we attach meaning to sensory information.

**a)** Cognitive psychologists seek to understand how people acquire information about an object’s function.

**b)** Cognitive psychologists ask questions about the role of learning in perception.

**2.** The classic approach to perception begins with objects in the real world that we call distal stimuli.

**a)** Information about distal stimuli is received through one or more sensory organs.

**b)** The received information, registered by the senses, is called a proximal stimulus.

**c)** The meaningful interpretation of a proximal stimulus is called a percept.

**B.** Related to perception is the process of pattern recognition.

**II.** Gestalt Approaches to Perception

**A.** The essence of Gestalt approaches is the recognition that, when stimuli occur close to one another in space and time, they may group perceptually into patterns or wholes that have properties that their component parts lack.

**1.** One of the most important aspects of perceptual grouping is the process of distinguishing objects from their backgrounds—what we call figure-ground organization.

**2.** Perceptual phenomena such as illusory contours make us aware that perception requires the perceiver’s active participation, as we simplify our interpretations to make sense of our world.

**B.** Gestalt psychologists believed that perceivers follow certain principles of organization in coming to interpret patterns in stimuli.

**1.** The principle of proximity leads us to group together objects that are nearer to each other.

**2.** The principle of similarity suggests that we perceive elements that are similar in groups.

**3.** The principle of good continuation states that we group together objects whose contours form a continuous straight or curved line.

**4.** The principle of closure states that we perceive objects as closed, complete figures, even when we have to mentally “fill in the gaps” to do so.

**5.** Elements that move together will be grouped together, according to the principle of common fate.

**C.** Most of the Gestalt principles are subsumed under a more general law, the law of Pragnanz, which states that we tend to select organizations that yield the simplest and most stable shapes or forms.

**III.** Bottom-Up Processes

**A.** Psychologists studying perception distinguish between **bottom-up** and **top-down** processes.

**1.** Bottom-up (data-driven) processing begins with small bits of information from the environment that are combined to form a percept.

**2.** Top-down (theory-driven or conceptually driven) processes occur when the perceiver’s expectations, theories, or concepts guide the selection and combination of information in pattern recognition.

**B. Template matching** models are bottom-up models of pattern recognition.

**1.** They posit that your senses “read” information much like check sorting machines in a bank read check numbers—by comparing them to previously stored patterns called **templates.**

**a)** Think of a template as being something like a stencil.

**b)** A stimulus in the environment must match a template in your memory in order to be recognized, according to this model.

**c)** The model thus requires millions of different templates in our knowledge base, one for every object or pattern that we can recognize.

**2.** Template theories, however, have problems as general explanations of pattern recognition.

**a)** They require an impossibly large number of stored templates.

**b)** They do not explain how we become capable of recognizing new objects.

**c)** They cannot explain how people recognize many patterns as more or less the same thing, even when the stimulus patterns differ greatly.

**C.** Featural analysis models of perception assume that we analyze a stimulus into parts called **features** in order to recognize the whole.

**1.** Featural analysis models fit with neurological evidence for feature detectors in the retinas of some animals.

**2.** Biederman’s theory of object recognition holds that, when people see objects, they segment them into simple geometric components called **geons** that can be combined to form common objects, in much the same way that **phonemes** in language are combined to form words.

**3.** Studies involving **visual search tasks** have shown that people take longer to find a target in an array of objects that have similar features (a Q among O’s) than an array of objects that do not share features (a Z among O’s).

**4.** Similarly, research on speech perception shows that humans use **categorical perception** in interpreting speech sounds, honing in on acoustic features such as voicing or place of articulation.

**5.** Featural analysis models, however, also have problems.

**a)** There are no good definitions of what can be a feature and what cannot, except in very restricted domains.

**b)** If there are different sets of features for different types of objects, then how can the perceiver know which set to use?

**c)** And if the same set of features applies to all objects, then the list of possible features must be huge.

**D.** A third type of bottom-up model, prototype matching, argues that sensory input is matched to an idealized representation in memory called a **prototype.**

**1.** A prototype is an idealization of the thing that it represents—for example, the most typical dog that you can imagine.

**2.** Prototype models do not require an exact match between the stimulus and the stored prototype; the more features that a stimulus shares with the prototype, the more likely it is to be recognized as a match.

**3.** Prototype models take into account not only an object’s features but also the relationship between the features.

**4.** Research by Posner and Keele has shown that people learn prototypes of new classes of stimuli easily and find those prototypes easy to categorize.

**IV.** Top-Down Processes

**A.** All bottom-up models share a number of problems in explaining perception.

**1. Context effects** occur when the same stimulus is “recognized” as two different things, depending upon the context; bottom-up models have no explanation for context effects.

**2.** Top-down processes, on the other hand, are directed by expectations derived from the context.

**3.** In reality, of course, top-down processes must interact with bottom-up processes to allow you to perceive objects.

**B.** David Marr’s model of perception incorporates both bottom-up and top-down processes

**1.** Marr believes that perception begins with what he calls a *primal sketch—*a simple two-dimensional collection of unanalyzed contours.

**2.** The primal sketch is used to create a more complex representation called a 2½-D sketch, adding information about surfaces and depth to the image.

**3.** Top-down processes come into play in the construction of the final, 3-D sketch that involves recognition of the object’s identity and the “meaning” of the scene.

**C.** Perception changes with practice; this phenomenon is called **perceptual learning.**

**1.** Gibson and Gibson showed that children and adults improved performance on a card-identification task by learning to notice more features of stimuli over time.

**2.** Similarly, experienced wine tasters become able to distinguish types of wine and even vintages by learning to notice more information about the stimulus.

**D.** A classic example of top-down processing is the **word superiority effect.**

**1.** People find it easier to recognize the letter “D” in the context of a word (WORD) than in isolation or in a set of randomly ordered letters.

**2.** Explanations of this effect are still being debated.

**a)** Perhaps people detect more features in a letter when it occurs within the context of a word.

**b)** Or perhaps people make inferences about the letter when it appears in the context of a word.

**3.** Connectionist models of word and letter perception can explain the word superiority effect.

**a)** When a person perceives a word such as TRAP, a node of processing is activated.

**b)** Once a node is activated, that activation spreads to other related nodes—for example, to individual letters (like T) within that word.

**c)** If context or expectation activates a word, then, we may find it easier to identify a letter within the word than we would to identify the letter in isolation.

**V.** Face Perception

**A.** There is something special about the way that people perceive faces, relative to the way they perceive other complex visual stimuli.

**1.** Faces are perceived in a holistic manner, rather than as a collection of features.

**2.** Perception of composite faces shows this phenomenon clearly.

**a)** Composite faces are created by combining the top half of one person’s face with the bottom half of a second person’s face.

**b)** If you make two composite faces that share the same top half but different bottom halves, most people cannot tell that the top halves are identical, because of the tendency to view faces as wholes.

**c)** However, if you offset the top and bottom halves slightly, it is easy to see that the top halves are the same; this is known as the **composite face illusion.**

**VI.** Direct Perception

**A.** The models of perception we have looked at so far all assume that the perceiver must do something to the proximal stimulus in order to interpret it.

**1.** It is assumed that the proximal stimulus does not contain all of the information that we need to identify it.

**2.** So, we observers must use our knowledge to fill in the gaps.

**3.** This is known as the **constructivist approach to perception,** because we have to construct the mental representation of the object.

**B.** However, James Gibson rejects this idea and argues that the world offers so much information that there is little need to construct representations and draw inferences; this view is called **direct perception.**

**1.** In the world we live in, certain aspects of stimuli remain invariant (unchanging), such as a melody played in two different keys.

**2.** Johansson’s research showed that human motion in carrying out familiar activities (walking, dancing, etc.) is easily recognizable even if all we can see are points of light at the shoulders, elbows, wrists, hips, knees, and ankles of a model in a dark room.

**C.** An important part of Gibson’s theory is that the information available to a perceiver exists in an animal-environment ecosystem.

**1.** Different organisms have different perceptual experiences because they have different environments and different relationships to their environments.

**2.** Organisms directly perceive not only shapes and objects but also each object’s **affordances** (the acts or behaviors permitted by objects, places, and events).

**D.** Gilbon’s theories are controversial, but they certainly remind us of the need to pay attention to the way that cognition operates outside of the laboratory.

**VII.** Disruptions of Perception: Visual Agnosias

**A.** One of the best illustrations that sensation and perception are different processes comes from cognitive neuropsychological studies of **visual agnosias,** impairments in the ability to interpret visual information.

**B.** Patients with visual agnosias can see clearly, but cannot identify objects.

**1.** This is not simply a language problem, because such patients cannot use other methods such as pantomiming to indicate recognition.

**2.** It is also not a memory problem, because patients can describe what a pig is even though they cannot recognize a pig when they see one.

**3.** Patients with visual agnosias may be able to recognize objects by sound, touch, or smell, however.

**C.** Researchers classify visual agnosias into different types.

**1.** Patients with *apperceptive agnosias* can process a very limited amount of visual information; they can see outlines, but cannot match objects or categorize objects.

**2.** Patients with *associative agnosias* can match objects or drawings, but only very slowly and very carefully, and they become distracted by small details.

**3. Prosopagnosia** is a specific visual agnosia for faces, often associated with damage to a particular region in the right hemisphere.