**Chapter 1**

**What is Perception?**

The study of sensation and perception gives insight on what it means to be human. Sensation is the transduction of a physical stimulus on sensory receptors into neural responses. Perceptionis the process of the brain creating conscious perceptual experience from these neural responses and this is what guides our actions. Perception also produces an individual phenomenology, which is the entirely subjective experience of perceiving the world.

To fully understand what we now know about sensation and perception, we must understand its historic origins. Sensation and perception writings go back to ancient Egypt. Ancient Greek architects understood some visual illusions. Aristotle produced significant theories about sensation and perception, including the classical list of five senses (though we now know there are more than five). In the 19th century, much work on sensation and perception was produced, including Mueller’s doctrine of specific nerve energies, the rival theories of perception and color vision of Helmholtz and Hering, Weber’s law, and Fechner’s development of psychophysics. In the 20th century, cognitive psychology approaches emerged, including Gestalt psychology, Gibsonina direct perception, information-processing, and the computational approach. Finally, the rise of neuroscience research and methods (e.g., the microelectrode, neuropsychology, and neuroimaging) led to greater understanding of sensation and perception.

Introduction

* We tend to take our sensory abilities for granted.
* Perceptual abilities work quickly to provide information about the world around us.
* Each sensory process is completed by intricately fine-tuned processes in our brains.
* This book provides an introduction to the science of sensation and perception from the perspectives of psychology and neuroscience.

Why is This Psychology?

* It is acknowledged that a fair amount of anatomy and physiology is involved.
* However, the goal is to understand perceptual experience.
  + We want to understand how our brains make sense of our sensory world.
  + Essentially, this is a psychological goal because psychological processes (e.g., attention, intention, emotion, biases, social situation) influence how we perceive the world.

The Myth of Five Senses

* Most people were taught that there are five senses—vision, hearing, touch, smell, taste
  + This is wrong!!
  + We have the vestibular system to help keep our balance.
  + We have a proprioception system to help monitor our body’s position.
  + The sense of touch is really composed of several systems geared toward different environmental features (heat, cold, pain, itchiness, soft touch, pressure).
* Depending on how touch systems are counted, it is more accurate to say that humans have 7 to 12 different sensory systems.
* Increasingly, the study of multisensory processing is becoming an important topic.
  + That is, answering questions about how one sense can affect perception in another.

The Basics of Perception

* **Sensation** is the registration of a physical **stimulus** on sensory receptors.
  + It changes physical stimuli into information in our nervous systems.
* **Perception** is the process of creating conscious perceptual experience from sensory input.
  + Changing sensory input into meaningful conscious experience.
* Sensation and perception are usually thought of as distinct processes.
  + On the other hand, some researchers think this is a false dichotomy.
* The purpose of our perceptual processes is to determine veridically what is out there in the world. That is, we want our sensory systems to guide us to know what is really there.
* Physical stimuli are converted into a sensory representation through **neural transduction.**
  + Each sensory system has specialized neural cells called **receptors**
  + Receptors **transduce** (transform) a physical stimulus into an electrochemical signal called a **neural response.**
  + The neural response is sent to the brain for processing.
* Each sensory system has different type of receptors
* Sensation refers to the process of transduction.
* Perception refers to the processing of the neural signal and making it usable to our experience.

Action

* **Action** refers to any motor activity.
* Perception is what guides us to action.
* Action includes moving one’s eyes along the page of the book as you read, catching a ball thrown to you, or turning your head to hear a friend speak.

The Nature of Experience and Phenomenology

* **Phenomenology** refers to our internal, subjective experience of perception.
  + This is why music may make us sad or happy or why.
* Phenomenology distinguishes humans from computer-driven robots.
* Philosophers wonder if there is shared phenomenology.
* Is your blue the same as my blue? This problem is often referred to as the inverted-rainbow question.

The History of Sensation and Perception

The Beginnings

* Unknown authors of the Ramesseum medical papyri (1800 BCE) describe disruptions in visual perception and their connection to diseases of the eye.
* Ancient Greek architects were aware of how visual perception could be distorted by illusions.
* Aristotle (384-322 BCE) gave us basic ideas of sensation and perception like the classical list of five senses.
  + He was the first to record two very interesting sensory phenomena.
  + First, the Aristotle illusion in which a single touch between two crossed fingers feels like two touches.
  + Second, he described the motion aftereffect, a sensory experience that occurs after prolonged experience of visual motion in one direction.
* Thomas Young (1773-1829) argued that light is a wave and that color is detected by three kinds of nerve fibers.
* Johannes Mueller (1801-1858), a biologist, developed the **doctrine of specific nerve energies**, which argues that particular type of experience is determined by the activation of specific neurons.

Helmholtz Versus Hering

* Hermann von Helmholtz (1821-1824) elaborated on Thomas Young’s work and developed the trichromatic theory of color vision, which suggests that color vision is based on the perception of three primary colors: red, green, and blue.
* Ewald Hering (1834-1918), Helmholtz’s rival, introduced the opponent theory of color vision, which suggests two pairs of color opponents: red-green and blue-yellow.
* Modern research suggests both Helmholtz and Hering were correct to an extent.
* Helmholtz also developed a **constructivist approach to** how our senses work.
  + In this approach, perceptions are construed using information from our senses and cognitive processes.
  + We make **unconscious inferences** about the world to make an educated guess about what we actually perceive.
* Hering disagreed and viewed environmental inputs and our sensory system as adequate to perceive the world; unconscious inferences were unnecessary.

Weber, Fechner, and the Birth of Psychophysics

* Ernst Heinrich Weber (1795-1878) discovered **Weber’s law**, which states that a just-noticeable difference between two stimuli is related to the magnitude or strength of the stimuli.
* Gustav Fechner (1801-1887) is considered the founder of **psychophysics**, the study of the relation between physical stimuli and perception.
  + His book *Elements of Psychophysics* is often considered the start of the psychological study of sensation and perception.
  + Fechner’s law states that sensation is a logarithmic function of physical intensity.

The 20th Century and the Study of Perception: Cognitive Psychology Approaches

* **Gestalt Psychology** argues that we view the world in terms of general patterns and well-organized structures rather than individual elements.
  + Gestalt psychologists established several laws, which they argued were constants in visual perception.
* **Direct perception (Gibsonian approach)** argues that information in the sensory world is complex and abundant, and therefore the perceptual systems need only directly perceive such complexity.
  + Often called the **ecological approach to perception**, because it emphasized that researchers should only study real-world stimuli.
* **Information-processing approach** suggests that perceptual and cognitive systems can be viewed as the flow of information from one process to another.
* **Computational approach** attempts to specify the necessary computations the brain would need to carry out perceive the world.
  + Built on the information-processing approach but acknowledged parallel processing.

Neuroscience in Sensation and Perception

* The goal of **neuroscience** is to understand sensation and perception in terms of the structures and processes in the nervous system that produce it.
* One of the most important developments in neuroscience was the **microelectrode**, which can measure the activity of a single neuron.
* **Neuropsychology** is the study of the relation of brain damage to changes in behavior.
* **Neuroimaging** involves technologies that allow us to map living brains as they perceive, learn, and think.

In Depth: Applications of Sensation and Perception and Avoiding Collisions

* Driving is a visual task.
* Avoiding collisions is a perceptually guided action.
* When we see an approaching object, the visual system relies on depth perception and this needs to be accurate to avoid collisions.
* However, people have systematic biases when making these decisions.
  + People estimate that a large but farther away object will collide with them faster than a smaller but closer object.
  + The human visual system uses two cues to make judgments about impending collisions.
    - **Time to collision** is the estimated amount of time that an approaching object will contact another object.
    - **Size-arrival effect** suggests that large objects are judged to be closer than smaller objects.