

Hergenhahn's An Introduction to the History of Psychology

Eighth Edition

EIGHTH EDITION

HERGENHAHN'S
An Introduction to the
History of Psychology



Tracy B. Henley

Chapter 8

Physiology and Psychophysics

Learning Objectives

After reading and discussing Chapter 8, students should:

- Understand that the scientific advances of the 17th and 18th centuries allowed philosophical questions concerning man to be examined in new, more precise ways.
- Be familiar with the early research on brain functioning
- Be familiar with the rise of experimental psychology

Scientific Advances

- Advances helped to address the question: By what mechanisms do empirical events come to be represented in consciousness?
 - Everything from sense perception to motor reactions was studied intensely and gave birth to experimental psychology.

Objective and Subjective Differences

- Early reaction-time study illustrated importance of individual differences and demonstrated the importance of discrepancy between objective and subjective reality.
 - Evident that there was not a point-to-point correspondence between physical reality and the psychological experience of that reality.
 - Researchers became interested in the physiology of the organism.

Bell-Magendie Law (1 of 2)

- Demonstrated that sensory nerves enter the dorsal roots of the spinal cord and motor nerves emerge from the ventral roots.
 - Separated nerve physiology into sensory and motor functions.

Bell-Magendie Law (2 of 2)

- Significant because it demonstrated that specific mental functions are mediated by different anatomical structures.
 - No longer possible to think of nerves as general conveyers of vibrations or spirits.
 - Sensory nerves carried impulses from sense receptors to the brain
 - Motor nerves carried impulses from brain to muscles and glands.
 - This suggested separate sensory and motor regions in the brain.

Doctrine of Specific Nerve Energies

- Johannes Müller
 - Demonstrated that each of the five types of sensory nerves results in a characteristic sensation.
 - In other words, each nerve responds in its own way regardless of the stimulation which activated it.
 - Each sensory system is maximally sensitive to a specific type of stimulation but may be stimulated by other forms of energy.
 - Adequate stimulation
 - The central nervous system, not the physical stimulus, determines our sensations

Hermann von Helmholtz (1 of 4)

- Disagreed with the concept of vitalism which states that life comes from a force beyond physical and chemical processes alone
- Because it was not physical, the “life force” was not conducive to scientific analysis.
- The materialist position (Helmholtz and others) stated that life could be explained in terms of physical and chemical processes and thus there is no need to exclude the study of life or anything else from the realm of science.

Hermann von Helmholtz (2 of 4)

- Through research he was able to demonstrate the application of the principle of conservation of energy to living organisms.
- Measured the speed of nerve conduction, finding nerve conduction in humans to be between 165 and 330 feet per second.
- This provided further evidence that physical–chemical processes are involved in our interactions with the environment rather than some mysterious process.

Herman von Helmholtz (3 of 4)

- Sensations are raw elements of experience and perceptions are sensations after given meaning by the person's past experience.
- To explain the transformation from sensation to perception dependent he relied on the ideas of unconscious inference of past experience.
- Devised a theory of color vision which proposed three types of color receptors corresponding to the three primary additive colors.

Herman von Helmholtz (4 of 4)

- The firing of these receptors in various combinations results in subjective color experiences corresponding to various wavelengths of light.
- Proposed a resonance place theory of auditory perception in which the pitches of sound we hear are determined to a great extent on where along the basilar membrane the most vibration is occurring in response to a sound vibration.
- The mind's task was to create a reasonably accurate conception of reality from the various “signs” that it receives from the body's sensory systems; the mind is active.

Ewald Hering (1 of 2)

- Suggested that receptors in the eye provide information regarding depth.
 - For Hering, space perception was an innate characteristic of the eye.
- Proposed an alternative theory of color vision to Helmholtz.
 - Theory suggested receptors in the eye which respond in an opponent process manner, red–green, blue–yellow, and black–white.

Ewald Hering (2 of 2)

- Current view states that the Young–Helmholtz theory is correct at the retina level but that neural processes farther up in the system work in opponent process manners as Hering's theory proposed.

Christine Ladd-Franklin

- Proposed a theory of color vision that was based on evolutionary theory and evolution of the physiology of the system.
- Concluded that achromatic vision came first, then blue–yellow sensitivity, and finally red–green sensitivity.

Early Research on Brain Functioning

- Toward the end of the 18th century, it was believed that a person's character could be determined by analyzing his or her facial characteristics
 - Physiognomy

Phrenology (1 of 2)

- Franz Gall
 - Developed the first cohesive ideas about phrenology—the magnitude of one's faculties (in the mind) could be determined by examining the bumps and depressions on one's skull.
- Johann Spurzheim
 - Popularized the practice of phrenology with books and demonstrations of its uses.

Phrenology (2 of 2)

- Several phrenologists claimed that particular faculties can become stronger with practice.
 - Formal Discipline
 - A number of educators took this “mental muscle” approach by suggesting that practicing could make the faculties associated with a particular discipline stronger.

Pierre Flourens

- Used the ablation method (destroying part of the brain and noting behavioral consequences) and investigated localization of function in the brain.
- Findings were contrary to the phrenologists
- Observed that in some cases the function that was lost to an ablation was regained later.

Paul Broca and Carl Wernicke

- Using the clinical method (observations in the clinical setting), they were able to localize language and communication functions in the brain.
- Broca's area
 - Responsible for speech production
- Wernicke's area
 - Responsible for speech comprehension

Electrophysiology: Fritsch and Hitzig

- Using electrical stimulation of brain neurons, they found:
 - The cortex is not insensitive as previously thought
 - That when a certain area of the cortex is stimulated, muscular movements on the opposite side of the body are elicited, thus discovering the motor cortex.
 - What would turn out later to be the sensory cortex was also discovered.
 - These findings and observations by other researchers extended the Bell-Magendie law to the brain.

The Rise of Experimental Psychology

- By now, it was widely believed that conscious sensations were triggered by brain responses initiated by sense reception
 - But how are conscious mental events and the physiological processes of our sensory system related?

Ernst Weber (1 of 2)

- Investigated the sense of touch and mapped out the sensitivity of touch for the entire body using the two-point threshold.
 - Sensitivity ranged from the most sensitive on the tongue to least sensitive on the back.
- Work in kinesthesia led to the determination of the just noticeable difference (jnd)
 - The least amount of change necessary to notice a difference along a particular dimension between two stimuli.

Ernst Weber (2 of 2)

- Determined that Weber's law—the finding that the amount of change necessary to notice a difference (jnd), is a constant fraction relating the stimuli.
 - This was the first quantitative law in psychology.

Gustav Fechner (1 of 2)

- Interested in the relationship between the body and the mind
 - Led him directly to the study of psychophysics.
- Speculated that for mental sensations to change arithmetically, the physical stimulus must change geometrically.
 - Research and further mathematical workings with Weber's law resulted in Fechner's formula describing the relationship between the mental and physical.

Gustav Fechner (2 of 2)

- Other research included studies on:
 - the absolute threshold which is the lowest intensity at which a stimulus can be detected
 - the difference threshold which is the amount a stimulus magnitude that needs to be changed before a person detects a difference
- Developed various methods of research including the method of limits, the method of constant stimuli, and method of adjustment.