

# Introduction to Physiological Psychology

## Chapter 1

Majority of illustrations in this presentation are from Biological Psychology  
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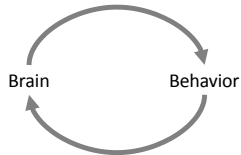
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## What is Physiological Psychology?

**Physiological psychology**, biological psychology, or behavioral neuroscience is a field of psychology that connects behavior and mental processes to bodily processes, and to the functions and actions of the brain. The brain in turn affects behavior and mind.



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## Relating Brain & Behavior

### 1. Somatic Intervention

Somatic Intervention

Administer a hormone

Stimulate brain regions

Lesion brain

Behavioral Change

Change in mating behavior

Motor movement

Behavioral deficits

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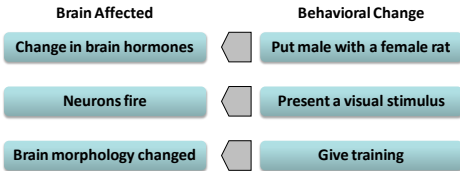
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## Relating Brain & Behavior

### 2. Behavioral Intervention



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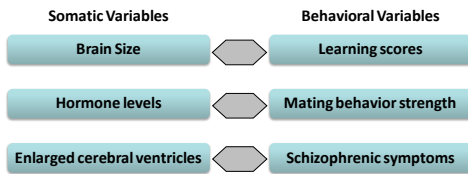
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## Relating Brain & Behavior

### 3. Correlation



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## Other Disciplines

Biological psychology is related to many other disciplines. And there are many players that contribute to this field.



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## Perspectives

To understand how brain affects behavior or mental processes we need to look at behavior rather carefully and at many different levels or perspectives.

1. Description of behavior
2. Evolution of behavior
3. Development (ontological) of behavior
4. Mechanisms of behavior
5. Applications of biopsychology to behavior

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## Description of Behavior

1. We can describe behavior in two ways. First in terms of **acts or processes**, e.g., description of limb movements carefully photographed at different positions.
2. We can also describe behavior in **functional terms**, e.g., what was the limb doing when it was going through many positions; so the limb could be involved in walking, running or hopping.

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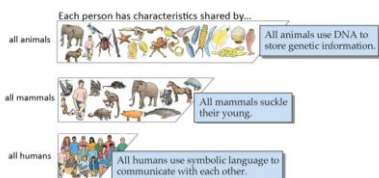
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## Evolution of Behavior

1. A number of behaviors can be shared by a variety of animals due to common elements of their biology. An earthworm, an eagle and a human all have neurons and thus can have similar tactile sensations.



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## Evolution of Behavior

2. And yet there are behaviors that are different across species, or even within a specie. Navigation in fruit-eating megabats is based on vision; in microbats, echolocation.



Vision



Echolocation

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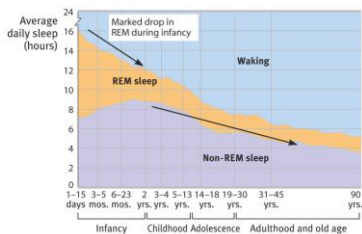
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## Development of Behavior

Behavior changes during development. So the duration of sleep in humans decreases with age. So does REM and Non-REM sleep.



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## Mechanisms of Behavior

1. So what lies underneath this behavior that we study?
2. A variety of biological mechanisms including **electrophysiological** and **biochemical** mechanisms.
3. So behaviors like walking, sleeping, making memories, and reproductive behaviors all tend to have these mechanisms for their execution.

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## Applications

1. Major goal or application of biological psychology is to improve human health.
2. Research in this field has led to the discovery of many drugs and other techniques that alleviate suffering from such conditions as insomnia, schizophrenia, and depression.

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## Levels of Analysis

1. This behavior that we have been talking about can be analyzed at many levels.
2. Social level being highest level of all. Each level as we proceed becomes more minute in analysis. **Reductionism** is an approach that analyzes any phenomenon at more basic levels of analysis.

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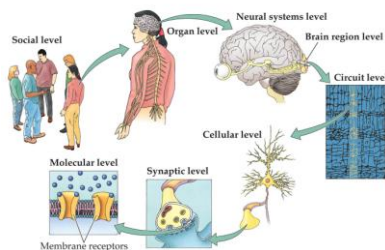
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## Levels of Analysis



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# History of Physiological Psychology

## Chapter 1

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### Early Ancestors

1. One million years ago man valued brain, and knew that injury to it caused death.
2. First brain surgery (**trephination**) took place around **7000 BCE** during Neolithic times.



Trephination by Incan Indians at Macchu Picchu



Psychosurgery was popular in Neolithic times.

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### Ancient Chinese

In **2700 BCE**, Shen Nung originated acupuncture based on Yin-yang philosophy. Acupuncture was derived from Taoist traditions that were even older (8,000 years).



Yin-yang



Acupuncture Points



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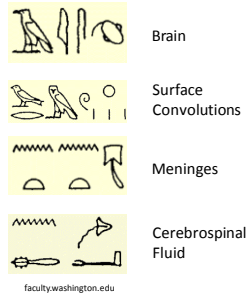
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## Ancient Egyptians

Called the *Edwin Smith Surgical Papyrus*, they were first written account of brain in **1700 BCE**, based on text that was 3000 BCE old. This account describes 28 cases of brain, skull and spinal injuries.



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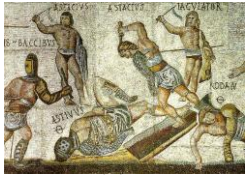
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## Hippocrates

1. Studied brain injured patients (gladiators), and noted that brain was the seat of our joys, pleasures, sorrows etc.
2. And our sensations and intelligence.



Gladiators



(470-410 BC)

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## Greek Philosophers

Plato correctly identified mind in the brain, however his student Aristotle believed that mind was in the heart, brain to him was merely a radiator to cool the blood.



Plato and Aristotle  
(447-327 BC) & (384-322 BC)

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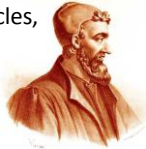
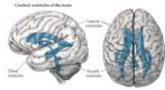
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## Roman Physician

1. Galen (Jalinoos, 129-199) a prominent Roman surgeon agreed with Hippocrates on brain as the seat of mind. Carried out dissections, and found cerebrum to be soft and cerebellum hard.
2. Also discovered fluid-filled ventricles, which he thought (cerebrospinal fluid) was used to communicate.



Aelius Galenus

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## Muslim Physicians

1. Ibn Zakariya al-Razi (Rhazes) a persian physician, criticized Galen on his theory bodily humors.
2. describes seven cranial nerves and 31 spinal nerves in *Kitab al-Hawi Fil-Tibb*.



(864?-930)

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## Al-Haytum

1. Al-Haytum (Alhazen) wrote a seven volume book on optics called *Kitab-al-Manazir*.
2. Correctly identified light as an external source for vision and dispelled Empedocles idea of the *visual ray*.



(965-1040?)

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## Al-Zahrawi

1. Al-Zahrawi (Abulcasis) an Arab surgeon from Spain, described several surgical treatments for neurological disorders.
2. Wrote *Kitab al-Tasrif*, a thirty-volume encyclopedia of medical practices.



(936-1013)

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## Ibn-i-Sina

1. Ibn-i-Sina (Avicenna) also called the Prince of Medicine wrote *Al-Qanoon fil-Tibb* 'The Canon of Medicine'.
2. In the text he talked about perception, imagination and generation of ideas.



(980-1037)

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## Rene Descartes

1. Like Plato believed that mind possessed innate ideas, and proposed **mind-body dualism** interacting at the pineal gland.
2. Descartes described reflex action, as a basis of understanding behavior from a neuroscientific view.



(1596-1650)



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## Nerves

1. Galvani and Bois-Reymond showed that electrical current would twitch muscles, and the brain generated electricity.
2. Bell and Magendie showed spinal roots carried messages in different directions.



Luigi Galvani  
(1737-1798)



Emil Du Bois-Reymond  
(1818-1896)



Charles Bell  
(1774-1842)



Francis Magendie  
(1783-1855)

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## Specific Nerve Energies

1. Muller proposed that the nature of a sensation depends on sensory fibers stimulated, not on how fibers are stimulated.
2. His student Helmholtz measured the speed of nerve conduction.



Johannes Müller (1801-1858)



H. Helmholtz (1821-1894)

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## Neuron Doctrine

1. Golgi believed that neurons connected in a **syncytium**, connecting by blending.
2. Cajal believed that neurons are separate and communicate through gaps. This came to be known as the **neuron doctrine**.



Camillo Golgi (1843-1926)



Ramón y Cajal (1852-1934)

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## Synapse

1. Studied reflex action in dogs.
2. Based on his behavioral experiments he inferred about synaptic transmission.
3. Named the gap Cajal pointed out as **synapse**.



Sir Charles Sherrington  
(1857-1952)

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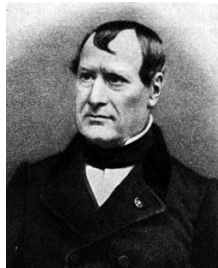
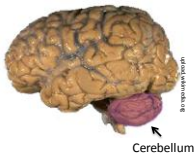
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## Brain Regions

Flourens conducted many brain ablation experiments and found that **cerebellum** played an important role in coordinated movements.



Pierre Flourens (1774-1867)

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## “Skull Bumps”

Gall studies skull bumps and proposed modularity of brain. Different parts of brain performed different functions.



Franz Gall (1758-1828)



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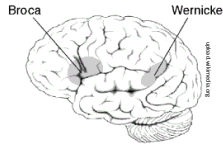
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## Speech Area

Broca, studied patient Tan after his death and found an area in the brain that was involved with speech production.



Paul Broca (1824-1880)

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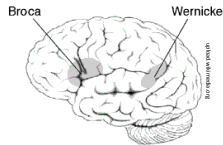
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## Speech Comprehension

Just as Broca had shown speech production area in the brain, Wernicke identified speech comprehension area.



Carl Wernicke (1848-1904)

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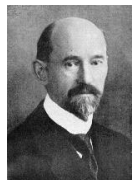
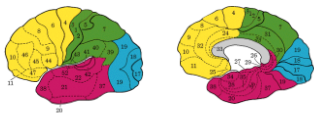
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## Brain Areas

Brodmann divided the brain into many distinct areas or regions and delineated their role in behavioral function.



Korbinian Brodmann (1868-1918)

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## Localization of Function

1. Lashley and Franz were critics of localization of function in the brain.
2. Lashley's showed that a number of behaviors like learning and memory were not localized in particular regions of the brain.



Sheperd Franz (1874-1933)



Karl Lashley (1868-1918)

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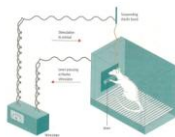
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## Reward Centers

1. Electrical stimulation of the brain evokes emotional responses in animals.
2. Reward centers in the brain.



James Olds (1922-1976)

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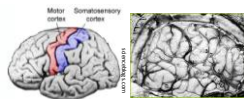
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## Electrical Brain Stimulation

1. Canadian Neurosurgeon. Electrically stimulated human brain to localize epileptic foci.
2. Stimulation of specific areas of the brain evoked specific memories.
3. Described sensory and motor cortex in the human brain.



Wilder Penfield (1891-1976)



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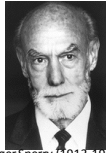
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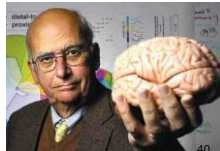
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## Brain Lateralization

1. Sperry carried experiments to discover left and right brain hemispheric specialization.
2. Gazzaniga Sperry's student conducts research on how the brain enables mind.



Roger Sperry (1913-1994)



Michael Gazzaniga (1927-Present)

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## Biology of Memory

1. Neurobiological mechanisms underlying learning and memory in primates.
2. Brain lesions specially designed to study behavioral learning and cognitive memory tasks.



Mortimer Mishkin (1927-Present)

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## Christopher Koch

Koch is promoting the study of consciousness through the use the modern tools of neurobiology. His primary collaborator in this endeavor was the late Francis Crick.



(1956-Present)

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