BCS/PSY/CVS 110
Neural Foundations of Behavior

Time: TR 9:40 – 10:55 AM
Room: Hutchinson Hall Rm 141

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Anson Cheng
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Monday 4:50-6:05 PM Gavett 301
Course organization

Textbook: Biopsychology by Pinel and Barnes, 10th ed

Course website: learn.rochester.edu
www.bcs.rochester.edu/courses/110.html

Exams: 4 unit exams and
1 optional comprehensive final

Grading: 25% for each exam
• A  93-100     C+  77-79
• A-  90-92     C  73-76
• B+  87-89     C-  70-72
• B  83-86     etc
• B-  80-82
Syllabus

1. Foundations of Biopsychology
   - disciplines and research methods
   - anatomy & physiology of the brain

2. Sensory and Motor Systems
   - mechanisms of perception
   - control of movement

3. Basic Motivations
   - sleep and dreaming
   - internal regulation
   - hormones and sex
   - language and speech
   - learning and memory

4. Mental Functions
   - cognition, personality and morality
   - reward and addiction
   - emotion and stress
   - psychiatric disorders
   - brain injury and neuroplasticity
Biopsychology

The scientific study of the biology of behavior (psychology)

Also called biological psychology, psychobiology, behavioral biology, and behavioral neuroscience
Origins of Biopsychology

Prehistory
~1 million BC

Ancient Egypt
~3000 BC

Roman Empire
~200 AD

1859 AD

~7000 BC
Trepanation

~400 BC
Ancient Greece

~1600 AD
Renaissance

1949 AD

Origins of Species
CHARLES DARWIN

The Organization of Behavior
D.O. HEBB
Biopsychology holds that all behavior is the product of interactions among three factors:

- the organisms genetic endowment, which is the product of evolution via natural selection;
- its experience;
- and its perception of the current situation.
The Man Frozen in Time
Jimmie G. was a good-looking, friendly 49-year-old. He liked to talk about his school days, and his experiences in the navy, which he was able to describe in detail. When he talked about his school days he used the past tense; when he recounted his early experiences in the navy, however, he switched to the present tense. More worrisome was that he never talked about anything that happened to him after his time in the navy. He believed he was 19.
The Man Who Made Faces Disappear
Talking with a friend, I glanced just to the right of his face wherein his head disappeared. His shoulders and necktie were still visible but the vertical stripes on the wallpaper behind him seemed to extend down to the necktie.
Biopsychology is an Integrative Discipline

Biopsychology is a neuroscientific discipline that draws together knowledge from a variety of other areas of neuroscience and applies it to the study of behavior.

Areas of neuroscience that inform our understanding of what produces and controls behavior:
- Neuroanatomy: structure
- Neurophysiology: function
- Neurochemistry: chemical bases
- Neuroendocrinology: hormones
- Neuropathology: disorders
- Neuropharmacology: drugs
Biopsychologists study many different phenomena, and they approach their research in many different ways.

Two major dimensions along which approaches vary:
- Subjects (Human vs Nonhuman)
- Design (Experiments vs Nonexperiments)
Human and Nonhuman Subjects

Humans
• Pros: have human brains; follow instructions; report experiences; cheap
• Cons: random; macro-level

Nonhumans
• Pros: controlled; micro-level; simpler brains
• Cons: nonhuman brains; expensive
Experiments: involve the controlled manipulation of variables.
• Design: between- or within-subject
• Variables: independent, dependent, and confounding

Nonexperiments: the researcher does not control the variables of interest.
• Quasi-experimental: real-world groups
• Case studies: single individual
Divisions of Biopsychology

Presented as distinct disciplines, but there is overlap
Physiological Psychology 1

Study of the neural mechanisms of behavior by manipulating the nervous systems of nonhuman animals in controlled experiments

Strategy: insert precisely a tool in the brain, use the tool, and observe behavior

To place precisely a tool:
- atlas
- stereotaxic instrument
Lesion methods: remove, damage, or inactivate a structure
  • unilateral and bilateral
  • aspiration, knife, reversible (cold)

Electrical stimulation: “activate” a structure

Physiological recordings: methods to record electrical activity inside or outside of a cell
Psychopharmacology 1

Study of the effects of drugs on the brain and behavior in nonhumans and humans

Strategy: administer drugs to increase/decrease the effects of chemical messengers in the brain, and observe the behavioral consequences

Routes of drug administration:
- inhaled
- oral
- injected
- cannula (into brain)
Measuring Chemical Activity
- 2-Deoxyglucose (2-DG) taken up by active cells, brain is removed/imaged
- Cerebral dialysis implant a tube, analyze chemicals found outside cells of behaving animals

Locating Neurotransmitters
- Immunocytochemistry labels antibodies to neuroproteins
- In situ hybridization label binds to RNA
Neuropsychology 1

Study of the psychological effects of brain damage in human patients

Strategy: assess the cognitive functions of neurologic patients using a test battery approach time-consuming refines diagnosis and care

Customized-Test-Battery Existence AND nature of deficits
Neuropsychology 2

Common test battery
- Wechsler Adult Intelligence Scale (WAIS), an IQ test
- Language lateralization sodium amytal dichotic listening

Specific test battery
- Memory: short- or long-term
- Language: sound, grammar or meaning
- Frontal-Lobe Function Wisconsin Card Sorting
Psychophysiology 1

Study of the relation between gross physiological activity and psychological processes in human subjects by noninvasive physiological recording

Strategy: record physiological activity from the surface of the human body while a behavior is performed
The five most widely studied measures:
• Brain: Electroencephalography (EEG)
• Muscle Tension: electromyography, EMG
• Eye Movement: Electrooculography
• Skin Conductance
• Cardiovascular Activity (ECG)
Cognitive Neuroscience 1

Study of the neural mechanisms of human cognition

Strategy: use functional brain imaging techniques to identify the parts of the brain that mediate various constituent (simple) cognitive processes.

Premise: cerebral blood flood and neuronal activation are tightly coupled

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Positron emission tomography PET
- inject a radioactive substance
- have subject perform behavior (active cells take up substance)
- scan a horizontal slice of brain

Functional magnetic resonance imaging (fMRI)
- no substance injected
- have subject perform behavior
- scan brain for oxygenated blood

Paired image subtraction
Comparative Psychology 1

Study of the evolution, genetics, and adaptiveness of behavior in laboratory species

Strategy: use genetic manipulations and behavioral research methods to assess species-common behaviors (e.g., eating, drinking, anxiety, aggression, sexual behavior)
Comparative Psychology 2

Gene Knockout/Replacement
Fluorescence and the brainbow

Animal Learning
Open-field test
Colony-intruder
Sexual behavior

Pavlovian/Operant conditioning

Semi-natural Paradigms
Conditioned taste aversion
Morris water maze
Defensive burying
Korsakoff’s Syndrome: a condition characterized by severe memory loss, commonly seen in alcoholics (Jimmie G.)

Hypothesis: due to alcohol

Data:
• Seen also in malnourished persons who have had little alcohol (neuropsych)
• Thiamine-deficient rats exhibit memory deficits (physio psych)
• Alcohol accelerates brain damage in thiamine-deficient rats (psychopharm)

New theory: due to thiamine deficiency but accelerated by alcohol

Treatment: patients given vitamin B1; counseled to stop drinking.