Psychology 210
Lecture 1

Biological Psychology
Interdisciplinary
  Psychology
  Physiology
  Neuroscience

Brief History of Neuroscience
Many current thoughts and trends stem from events that have occurred long ago

Before Hippocrates
________________ did not view the brain as an important structure
After death, most organs were preserved during mummification
The brain was removed through the ________________ and replaced with resin
Nervous system damage
  Thought of as an ailment unable to be treated

Before Hippocrates
Trephining/Trepanation
A means for escape of __________________ or the entrance of good spirits
The holes were made by either scraping, drilling, or cutting
Wounds were covered with shells, gourds, or even pieces of ___________________

Interesting Note
Trepanation still takes place today
www.trepan.com
For $2400, people can get them done
Some say after trepanation, they live more fulfilling lives

The first question
Where does intelligence come from?

Center of Intelligence: The ideas
________________: believed that the heart was the source of intelligence
________________: believed the holes in the brain were the source of intelligence
Hippocrates: believed the ________________ was the source of intelligence

Galen: the next step
Made careful dissections of animals
Probably dissected the mortally wounded ________________ that were under his care
**Galen’s ideas**
Liked Herophilus
Incorrectly believed that the ___________________________ throughout the ventricles played a role in the transmission of messages to and from the brain
Believed that the fluid in ventricles was continuous with the fluid in nerves
Led to the long held belief that the nervous system is ________________ filled

**René Descartes**
Philosopher in the 1600’s
Studied mathematics and physics: Expanded the fluid flowing idea of Galen to ______________

**Descartes’ ideas**
Thought tiny filaments within the nerves are tubes filled with “________________________”
Painful stimulus => “spirits” flowing to the ventricles => release of more “spirits” => triggers the withdrawal of the limb from the painful stimulus

**Finally science advances**
In Europe, ____________________________ of the human body are lifted, and finally using more modern techniques discover the truths about the brain and body
Inventions: ________________

**Luigi Galvani**
Noticed that if he touched frog legs with a ______________ metal, the leg would contract
After further experimenting, he discovered that the metal didn’t have to contain a charge to cause a contraction
A conductive metal would also produce a contraction- concluded that there is an innate vital force within the animal tissue- “______________________________”

**Galvani’s ideas**
Believed that there were now 2 kinds of electricity:
Natural: ___________________
_______________: animal, believed that static and friction created it

**Some fun: Emil du Bois-Reyond**
Used electric fish to stimulate frog legs to contract
Created a _____________________________ (ie. A frog alarm)
the frog leg would react to an electrical charge from the fish, contract, move a level and set off the alarm

**Ramon y Cajal**
Used a Golgi stain to identify _____________________________
First evidence that the nervous system is composed of cells, not a tube/liquid model
This idea became known as The Neuron Doctrine
Phrenology
Created by ________________________________
The idea that the brain is composed of distinct faculties in distinct areas
Key concept: different areas of the brain do different things

Evaluation of Phrenology
The idea that different pieces of the brain do different things and that functions can be localized stays with us today (brain imaging techniques)
Phrenology was ________________________________:
The traits that were thought the be localized were wrong funny, thoughtful, cheerful

Phrenology was misguided (continued)
Thought of the brain as a ________________: if someone is more cheerful than others, they would have a larger cheerful area, which would cause a bump in their skull to form
Thus, ________________________________believed that you could feel the skull of a person and predict all sorts of things about them

Phrenological Predictions: a 7 year old
Her head is full at the sides, giving courage, energy, and executive power, hence she will quickly translate her thoughts into actions, & be known as a brave & fearless character. She will be industrious, & show an aptitude for business, money making, & never remain poor. She has natural sagacity, reserve, tact, & forethought, & though she is forcible & determined, yet she will be watchful & equal to an emergency.
Food is an important matter in the formation of character. She should have milk, eggs, fruit, & quaker oats, or something similar to develop the boney structure. Bananas, & apples either stewed or roasted are good. Let her have all the sleep she can get, & keep her away from excitement.

Final Prediction
In reference to a vocation, she will be in her element as a lady doctor or science teacher. She is a remarkable child, & with suitable management & training her mental qualities will evolve, & she will develop into a capable & superior woman, - earnest, resolute, aspiring, positive, & independent. Her intellectual & social powers are so blended that she will be persuasive & magnetic. When her strong qualities are reversed, she will desire to argue the point, & exhibit temper, willfulness, & sarcasm. She must be treated in a gentle, considerate manner, & her parents should appeal to her intelligence, pride, & affection, then she is easily managed.

Current methods for studying the brain
____________________ imaging
Function imaging ___________ techniques
Neuropsychological methods
Structural Imaging

X-Rays
  Pictures on ________________

Computerized Axial Tomography (CAT Scan)
  Uses a special detector instead of film

Magnetic Resonance Imaging (________________)
  Uses strong magnetic fields and pulses to spin hydrogen atoms in water
  After spinning, ________________atoms emit transmissions which are
  picked up by a scanner and constructed into a “picture”

Functional Techniques

Direct techniques
  Electroencephalography-________________
  Magnetoencephalography-______________

Indirect techniques
  Positron Emission Tomography-____________
  Functional Magnetic Resonance Imaging- ____________

Non-imaging techniques
  Transcranial Magnetic Stimulation-____________
  Single cell recordings

EEG

Directly measures the electrical activity from ________________of cells
Electrical currents pass through the scalp
Measured by a large group of electrodes
Activity closest to the skull is most easily measured

EEG- frequently used during ______________

Pros and Cons of EEG

Good temporal resolution (ie. Very accurate ____________)
Poor spatial resolution (ie. Inaccurate localization of activity
Electric fields ________________as they pass through the skull

MEG

Every electric field (as detected by EEG) also has a magnetic field
________________ fields don’t smear across the skull like electric fields
Measures information strictly from groves in the brain (called sulci)
  Very limited on what it can measure

Pros and Cons of MEG

Only records in sulci
  Misses information
  Very ________________
Temporal resolution good
Spatial resolution better than EEG, not great though
PET and FMRI
Assumes that neuronal activity leads to an increase in blood flow
Detects the changes in ____________________________
More blood = more neuronal activity

PET
Uses ____________________molecules injected into the blood to measure brain activity
As radioactive molecules decay, they release positrons
Positrons collide with electrons and release gamma rays
PET machines detect gamma rays and are able to pinpoint where they came from
Usually uses radioactive glucose or _______________

How PET works
Have subjects perform two tasks
Compare the activation between the two tasks
Called “______________________________analysis”

Pros and Cons of PET
______________________________- not good
Subjects get paid more though
Spatial sensitivity is quite good- level of 1cm
Temporal sensitivity not very good- on the level of 1 minute

FMRI
Uses very strong _________________- 1.5 Tesla-11 Tesla currently in use
1.5 Tesla has a strength equivalent to 30,000 times the force of gravity
3-4 Tesla is about the “norm”

FMRI – How it works
Quite complicated- usually have full time _________________ to work the scanners
Measure the amount of oxygen in the blood- uses this as a measure of neuronal activity

Pros and Cons of FMRI
Good Spatial Resolution (3-5 mm)
Decent __________________________ Resolution (on the level of 1-2 seconds)
Inside of a magnet, you can’t do too many different things
Quite loud (very hard to study auditory system)

Issues with PET and FMRI
Only measures things indirectly
Measures ___________________________, not neuronal activity
Assumes that increases in neuronal activity requires an increase in blood flow
TMS
Uses a wand to ________________________________through the skull and target a brain area
Can do two things:
   Send strong short pulses to excite the area targeted
   Send weaker longer pulses to inhibit the area targeted

Interesting Note- TMS
TMS is actually used on ________________ patients
Doctors believe that after a stroke, the damaged side of the brain tries to repair itself
The undamaged side of the brain tries to compensate for the damaged side
This is actually detrimental to the healing of the damaged side

Interesting Note- TMS
Applying TMS to hinder the undamaged side appears to help the brain heal
Patients are seeing noted improvements after about __________________________(able to count after treatment, when unable to count prior to treatment)

Single cell recordings
Used extensively in animal studies
A microelectrode is inserted into brain tissue and recordings of action potentials can be made from nearby neurons, ideally a single neuron.
Recordings are typically _____________________(outside of the cell)
The animal can then be presented with various sensory stimuli, or trained to perform some task, and the effects on neural activity can be monitored

Pros and Cons – Single Cell Recordings
Advantages: great spatial and temporal resolution
Disadvantages: sampling only a ________________________________ fraction of a functional neural system
   Hubel and Weisel study

Neuropsychological Techniques: Lesion studies
Correlation of functional _____________________ with regions of damage
Both human and animal studies
In animals, lesions can be made experimentally
In humans, lesions are causes by “experiments of nature”
Lesion studies (con’t)

Common types of lesions in humans

Stroke (A “brain attack”)
  ________________: blockage of blood flow in an artery
  Hemorrhagic: rupture of an artery

Trauma
  Open vs. closed head injury

Tumor

Degenerative disease (e.g., alzheimers disease)
In general, the more ________________the lesion, the easier it is to link the site of
damage to a behavioral deficit

Neurosurgery Methods

Direct cortical ________________________________
  Delivery of a small electric current directly on the cortical surface
  Causes temporary disruption or facilitation of function in cortex being stimulated
  Used clinically to map function, so that critical regions can be avoided during
tissue resection
  Can be done intra-operatively, or more commonly now, via chronically implanted
electrode grids

Neurosurgery methods (con’t)

__________________________
  Sectioning of corpus callosum as a treatment for medically intractable epilepsy
  Can study the separate contributions of the left and right hemispheres to various
  abilities/tasks

Neurosurgery methods (con’t)

__________________________ procedure
  Injection of sodium amytal (a barbituate), into one and then the other carotid artery
temporarily (5-10min) puts half the brain to sleep allowing neurologists to assess function
  in the awake hemisphere

Neurosurgery methods (con’t)

General considerations
Advantages: better experimental control in some situations, e.g., temporary lesions can be
  very focal and ________________________________
Disadvantages: all subjects in these subjects are undergoing these procedures because
  they have a ________________________________, therefore it is not clear how
generalizable the results are.

Ethics

Institutional ________________________________ - at each institution
  Reviews research projects to ensure ethical conduct
Human Participants Guidelines
  No ________________
  Informed consent
  Confidentiality