Revised TA office hours (Sam), today 4-5p, and **wed 11:30-1:30**.

I will not have office hours this thurs but you should BRING QUESTIONS to the Thurs review.
You may **email me with specific questions about the Study Guide** (anytime up to 5p Monday before the exam).

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**Neuroimaging and Assessment Methods**

**Non-invasive methods**
(usually required for experimentation on humans, prefered for medical purposes)

*MRI, PET, fMRI, CAT, MEG, external/surface recordings, TMS*

**Invasive methods**
(sometimes needed for medical reasons)

*Surgically implanted electrodes (record/stimulate), tissue removal or tract separation.*
Experimental Designs

**Case Studies:**
- One subject;
- Unique situation (e.g., test subject dies in crash and donates brain, rare disorder);
- Descriptive only.

**Experimental Studies:**
- Multiple subjects in “control” or “typical” comparison group, as well as experimental group;
- Same methods used on all subjects;
- Statistics used to assess between-group differences or “effects” that can be attributed to treatment;
- “Significant difference” means the independent variable of interest has a “real” effect on the measure (dependent variable) of interest.

One form of statistical analysis looks at the mean difference between 2 groups, as a function of the variance within the groups, to determine if the groups are “significantly different.”

Such an analysis assumes that both groups follow a “normal distribution.”
Two Independent Variables:
  1. Clinical status (2 levels --- normal vs schizophrenic)
  2. Gender (2 levels --- male versus female)

Dependent Variables:
Whatever the investigators are interested in (e.g., IQ, stress index, PET scan scores, etc.)

STATISTICAL SIGNIFICANCE

Main Effect – When an independent variable has a similar effect on all sub-groups as defined by another independent variable(s). A main effect of schizophrenia would show differences between clinical and typical groups that is in the same direction for all groups.

Interaction Effect -- When an independent variable has an effect on only certain sub-groups, or different effects on sub-groups. So for example, schizophrenia might be associated with a large increase in one of the dependent variables (measures) in young men, a small increase in older men, and no effect on women. This complex effect is called an “Interaction.”
Segment 1

Touching the Brain: Electrically Stimulating the Speech Regions of the Brain

Length: 2:30

Source: Brain Story: All in the Mind (BBC Worldwide Americas Inc.)

Transcranial Magnetic Stimulation (TMS)
CAT (computer aided tomography, or CT) scanning is a process that reconstructs 2-dimensional x-ray images into 3-dimensional images of internal organs (i.e., the brain). Very dense tissue like bone blocks lots of x-rays (white); grey matter blocks some, and fluid even less (black).

Doing a CAT scan involves putting the subject in a special, donut-shaped x-ray machine.

The images are not quite as detailed as MRI, and there is some radiation. But the procedure is less expensive than MRI, so might be used as a “first line.”

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MRI (magnetic resonance imaging)

Patient is in a donut-shaped shaped giant magnet that creates a magnetic field that runs down the tube. This field realigns the hydrogen atoms in tissue. (Normally, the body's atoms spin in all different directions, but the MRI's magnet realigns hydrogen atoms so that they all spin along the same axis – a "line" down the body).

When the hydrogen atoms are facing either up or down (toward the top of the head or feet), most atoms cancel each other out (atoms facing one direction cancel the other). But there are a few that are not canceled out.

Next, the MRI sends a radio pulse at the area of the body being scanned. This pulse makes some of the "uncancelled" H atoms spin at a particular frequency and in a particular direction, depending on the type of tissue. When the pulse shuts off, the atoms release energy and give off a signal that the MRI detects, forming an image of the tissue.
About Us

The University of Connecticut is excited to announce the opening of the new UConn Brain Imaging Research Center (BIRC), scheduled for March 2016. The BIRC will be housed in the David C. Phillips Communication Sciences Building, which is currently undergoing renovations to accommodate the MRI scanner as well as several research laboratories.

Contact Us

Phone: (860) 486-4042
E-mail: peter.moffia@uconn.edu
Address: Brain Imaging Research Center

Center Events

5/4 – Announcing MRI Seed Grants
3/10 – Siemens MRI Arrives on Campus
Join the MRI Center: Let’s Meet!
1/12 – Intro MRI Workshop
3/4 – Uhrig Wang Colloquium
Magnetoencephalography (MEG) is an imaging technique used to measure the magnetic fields produced by electrical activity in the brain, with sensitive devices such as superconducting quantum interference devices (SQUIDs).

MEG (and EEG) signals derive from the net effect of ionic currents flowing in the dendrites of neurons during synaptic transmission.
PET (positron emission tomography) scans measure regional glucose metabolism.

Subject is injected with a very small amount of radioactive glucose. The PET scans the absorption of the radioactivity from outside the head. (Brain cells use glucose as fuel, and PET works on the theory that if brain cells are more active, they will consume more radioactive glucose, and if less active, they will consume less of it).

A computer shows the levels of activity as a color-coded brain map, with one color (usually red) indicating more active brain areas, and another color (usually blue) indicating the less active areas.

PET imaging software allows researchers to look at cross-sectional "slices" of the brain, and therefore observe deep brain structures, which earlier techniques like EEG could not. PET used to be one of the most popular scanning techniques in neuroscience research, but was overtaken by fMRI.
Functional magnetic resonance imaging (fMRI) uses MRI but also measures of haemodynamic (blood-oxygen) levels reflecting neural activity in the brain. This blood-oxygen signal overlies the static MRI image of the tissue.

This works because the magnetic resonance (MR) signal of blood is different depending on the level of oxygen. This difference can be measured as blood-oxygen-level dependent (BOLD) contrast. Higher BOLD signals reflect lower concentration of deoxygenated hemoglobin (indicating more activity).

So just as the PET scan measures “activity” by glucose consumption, the fMRI measures “activity” by oxygen level (an index of oxygen consumption).

Brain areas with low blood oxygen are presumed to be more active.
Scientists at the University of California, Berkeley, have reconstructed the internal “movie” that plays in a person’s head. To re-create dynamic visual experiences, they used functional magnetic resonance imaging (fMRI) to measure the brain activity of volunteers (the other members of the research team) as they watched short movie clips (left panel in the video below). A computational model crunched the fMRI data to reproduce the images, as shown in the right panel.
Intensely pleasurable responses to music correlate with activity in brain regions implicated in reward and emotion.

Subjects selected “chills-Inducing” musical pieces

Cerebral blood flow increases and decreases were observed in brain regions thought to be involved in reward/motivation, emotion, and arousal – ventral striatum (VStr), midbrain (Mb), amygdala (Am), orbitofrontal (Of) cortex, visual cortex (VC) and ventral medial prefrontal cortex (VMPF). These brain structures are known to be active to other euphoria-inducing stimuli, such as food, sex, and drugs of abuse.

MRI scans predict pop music success

by Kate Malville

An Emory University experiment originally designed to see how peer pressure affects teenagers has also been found to accurately predict the success or failure of pop songs. “We have scientifically demonstrated that you can, to some extent, use neuroimaging in a group of people to predict cultural popularity,” boasted Emory’s Gregory Berns. His findings appear in The Journal of Consumer Psychology.
Back in 2006, as part of a study into how peer pressure affects teenagers’ opinions, Berns collected 120 songs by relatively unknown musicians without recording contracts from MySpace pages. Then he had 27 kids, aged 12 to 17, listen to the songs while their brains were being scanned using functional magnetic resonance imaging (fMRI). The teens were also asked to rate each song on a scale from one to five. Unknown songs were used to ensure that the teens were hearing them for the first time.

Three years later, while watching “American Idol” with his two young daughters, Berns suddenly heard a song he recognized from that study (“Apologize,” by One Republic), and realized that it had become a hit.

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**NeuroFocus Uses Neuromarketing To Hack Your Brain**

Intel, PayPal, PepsiCo, Google, HP, Citi, and Microsoft are spending millions to plumb your mind. Here's how it's done.
<table>
<thead>
<tr>
<th>Method</th>
<th>Invasive?</th>
<th>Structural detail (pictures or maps of structures)</th>
<th>Functional detail (task-related changes in activity)</th>
<th>Measures</th>
</tr>
</thead>
<tbody>
<tr>
<td>Electrode Implants</td>
<td>High</td>
<td>None</td>
<td>High</td>
<td>Functional effect of stimulation</td>
</tr>
<tr>
<td>TMS</td>
<td>Med</td>
<td>None</td>
<td>Med</td>
<td>Functional effects of stimulation</td>
</tr>
<tr>
<td>CAT</td>
<td>Low</td>
<td>High detail</td>
<td>None</td>
<td>Tissue density</td>
</tr>
<tr>
<td>MRI</td>
<td>Low</td>
<td>High detail</td>
<td>None</td>
<td>Atomic resonance</td>
</tr>
<tr>
<td>MEG/EEG</td>
<td>Low</td>
<td>Low detail</td>
<td>High detail</td>
<td>Electro-magnetic fields</td>
</tr>
<tr>
<td>PET</td>
<td>Med</td>
<td>Med detail</td>
<td>High detail</td>
<td>Glucose use</td>
</tr>
<tr>
<td>fMRI</td>
<td>Low</td>
<td>High detail</td>
<td>High detail</td>
<td>BOLD signal (O2)</td>
</tr>
</tbody>
</table>
**Coma** is a state of unconsciousness similar to deep sleep, but no amount of stimuli (sounds, sensations) can awaken the brain to become alert. A person in a coma can’t even respond to pain. Comas usually last up to a few weeks. Coma survivors (those who awaken) may or may not have permanent brain damage.

- The person looks like they’re asleep
- They can’t wake up, talk or respond to commands

Alternately, the person descends into a [vegetative state](#). If this lasts longer than a month, it is [persistent vegetative state](#). The brain loses higher cortical functions (consciousness, self-awareness and personality) but can still perform involuntary brainstem functions like breathing and swallowing, regulating heart rate and blood pressure, controlling sleep cycles, even smiling or random movement. Vegetative state can continue for months or even years. The longer the person is vegetative, the bleaker their chances of recovery.

- The eyes may open in response to stimuli
- The person may move their body, but not to a command
- Heart rate, blood pressure and respiration continue
- The person can randomly laugh, cry or make faces.
Mos Def in “House,” Locked In Syndrome
Terri Schiavo entered a vegetative state in 1990 after adopting an "iced tea diet" (related to her bulimia), resulting in a disastrous potassium deficiency that caused irreversible brain damage. In this persistent vegetative state she remained the last fifteen years of her life, with neurological tests indicating her cerebral cortex was extensively damaged (confirmed in post mortem).
Owen et al. (2007) saw supplementary motor area (SMA) activity during **tennis imagery** in a vegetative patient, and a group of 12 healthy volunteers (controls). Imagining **moving around a house** activated parahippocampal gyrus (PPA), posterior parietal-lobe (PPC), and lateral premotor cortex (PMC) in all subjects.
• Study Guides will be posted later today covering first 4 lectures (9/4 through 9/15).

• Review session thurs Sept 17 – BRING STUDY GUIDE and any questions to class.

• Test 1, in class, tues Sept 22 – 50 multiple choice questions.

• Critical scantron info – PS# (ID), name (last, first), and column K = version number (1 or 2)