COLUMBIA UNIVERSITY
IN THE CITY OF NEW YORK

Science of Psychology

PSY W1001 Section 2
MW 8:40-9:55 Fall 2012

Monday, September 17

Behavioral Neuroscience

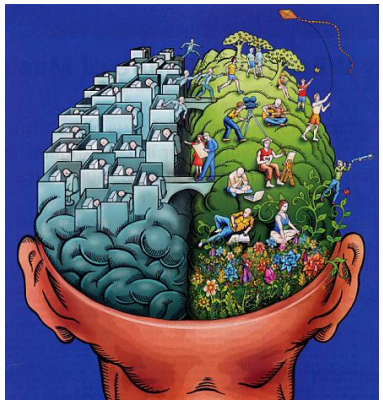
Announcements

- Exams
  - Short Answer Question
  - Studying and preparing for exams.
- Written assignment
  - Please see the file posted on Courseworks
  - If you're in doubt about your article please ask us.

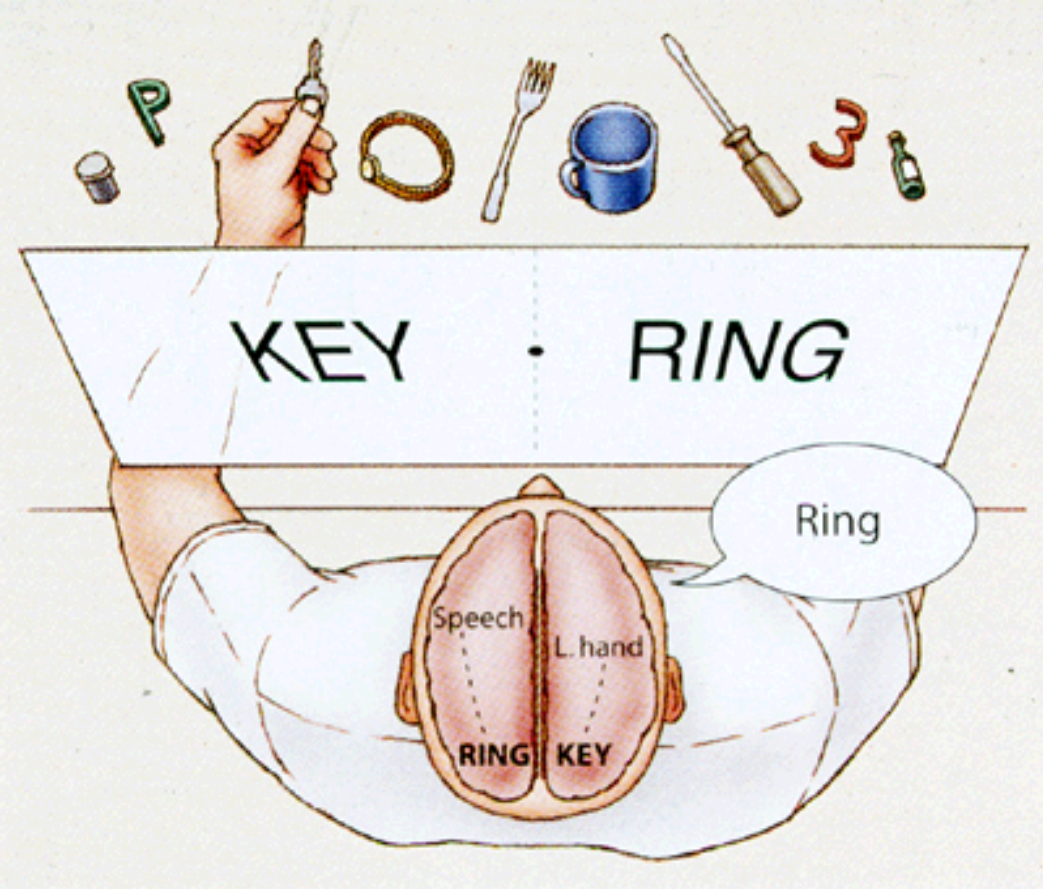
- Any questions from last lecture?

Two Halves of the Same Coin?

- Lateralization
  - Two "sides" to the brain: left and right hemispheres
  - Contralateral organization:
    - LEFT hemisphere controls actions of RIGHT side of body (and vice versa)
  - Most structures are doubled and symmetrical:
    - LEFT amygdala, RIGHT amygdala
  - Connected through commissures
    - bundled neural fibers transfer information between hemispheres
    - Corpus Callosum is the largest
  - What if there is no connection between hemispheres? (Video)

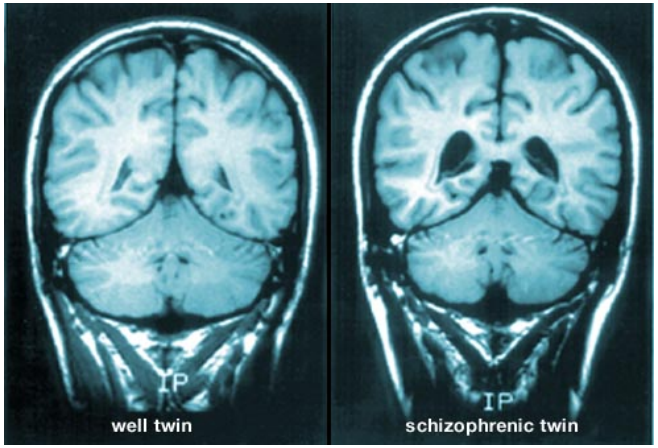


How can this be?



Studying intact human brains

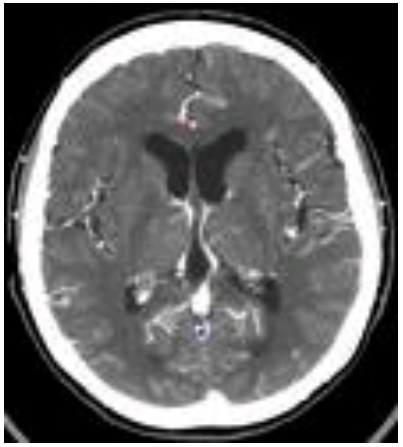
- Structural methods
  - Can correlate different size brain areas with different behavior
    - Larger lateral ventricles in patients with schizophrenia
    - Larger hippocampus in London cab drivers
  - *Caveat: These are correlations!!*
- Functional methods
  - Can correlate activity in specific brain areas with behavior
    - Good for cognitive tasks
    - Not good for motor tasks
  - Still Correlations!!
    - Mirror neuron studies in humans

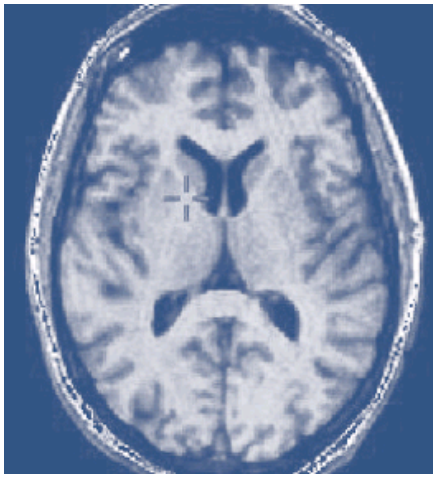


Measuring Structure

- Two main methods
  - Computerized Tomography (CT) scan
    - Older technology, not used too much any more
  - Magnetic Resonance Imaging (MRI)
    - Gives great resolution
      - Fractions of millimeters

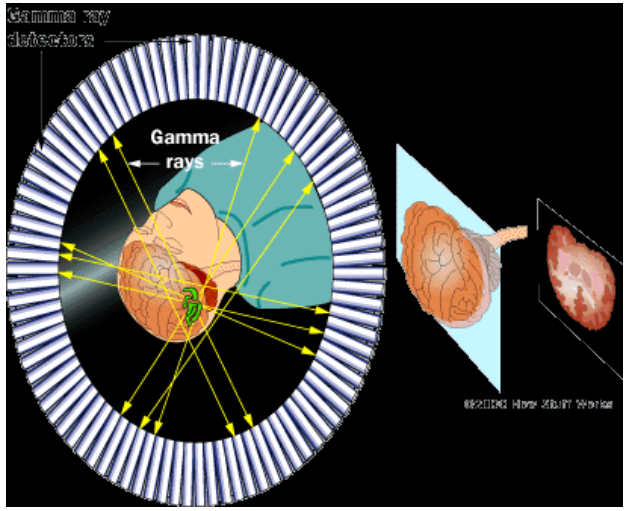
"I hate cats! I want a dog scan."

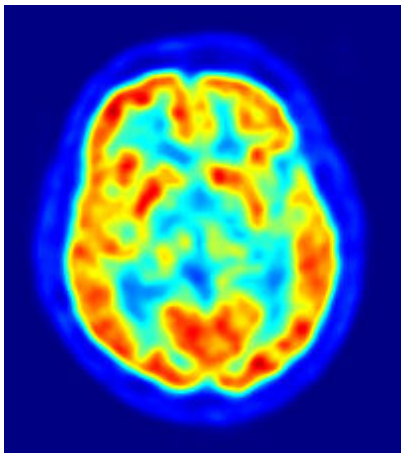




Measuring Function

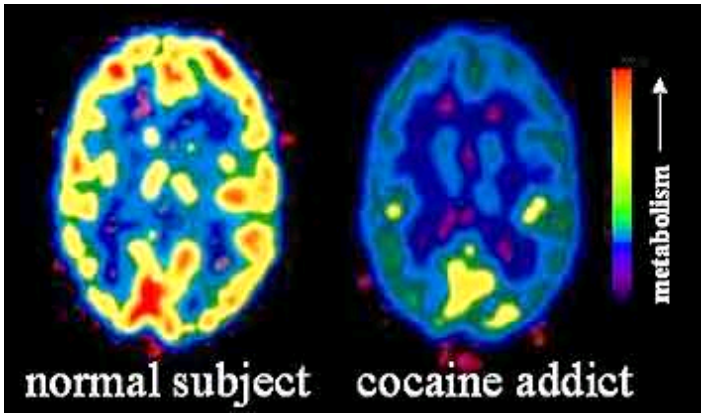
- Positron Emission Tomography (PET)
  - Injection of isotope
  - When an area becomes more active, more isotope is taken up
  - Can detect where there is more radioactivity
  - Does not give structural information
    - Can be inferred from CT or MRI





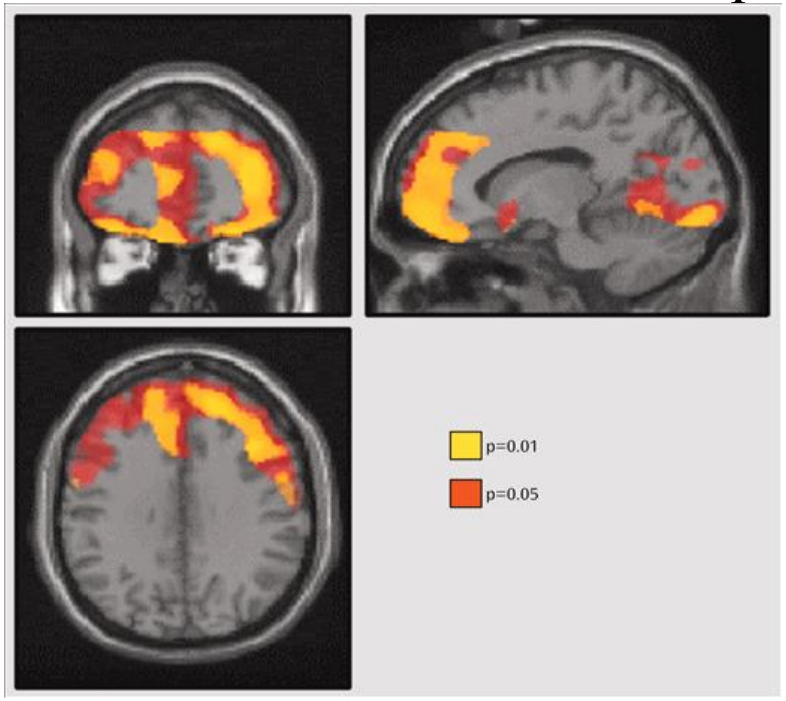
Uses of PET

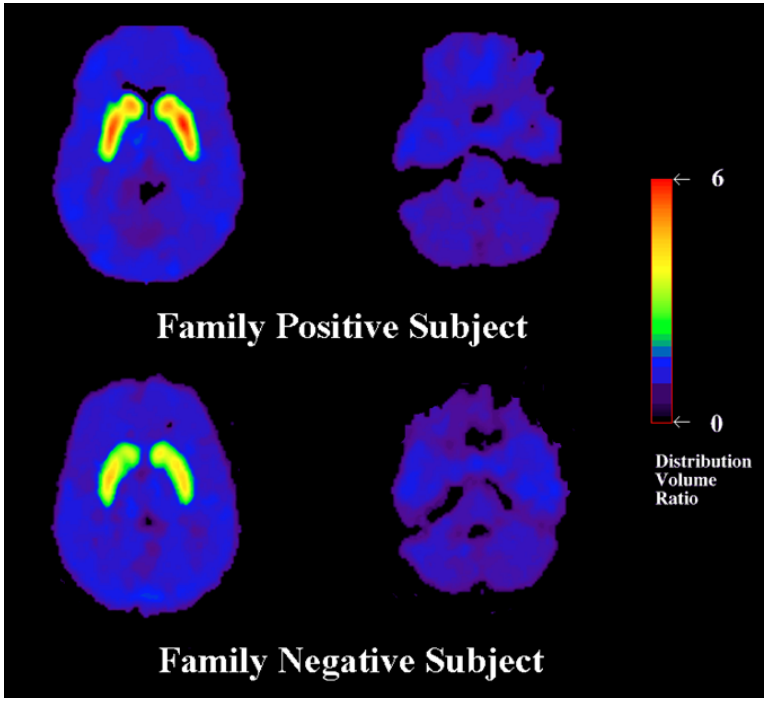
- Can be used during long cognitive tasks
  - Can compare large-area differences in activity
- Can look at long-term changes in brain activity
  - Compare the brains of healthy control individuals to individuals in a population of interest.



More about PET

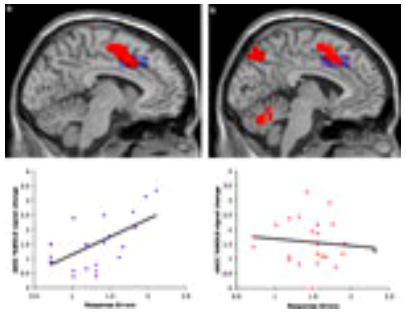
- Can study anything that can be labeled with an isotope
  - Neurotransmitter receptors

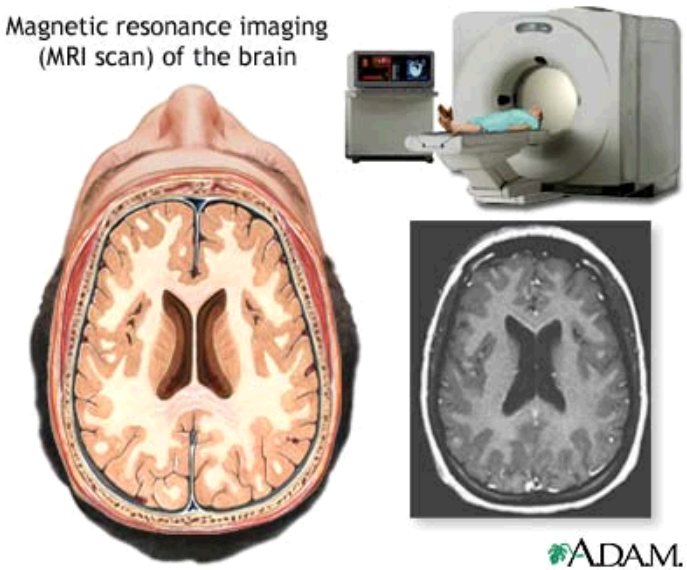




Other Functional Measures

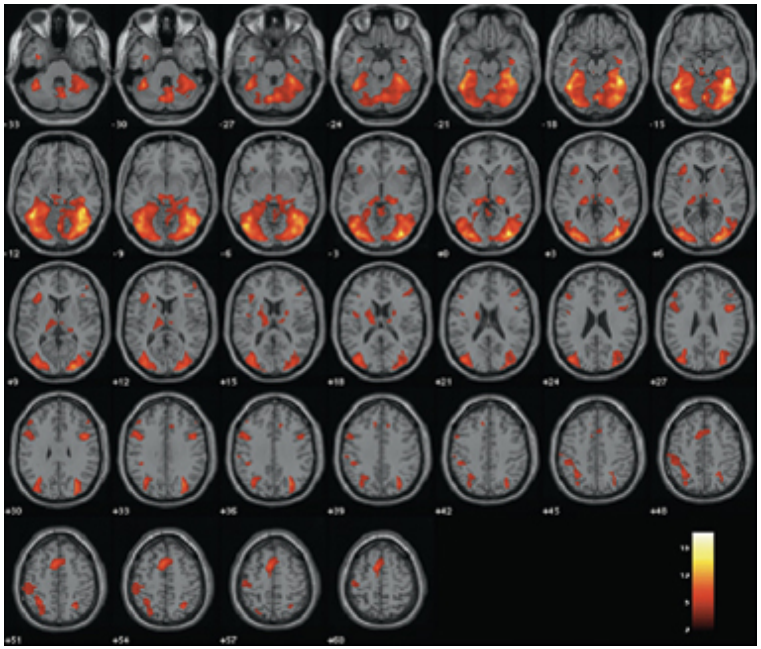
- Functional MRI (fMRI)
  - Measures the resonance signal of blood
    - Different signal between oxygenated and non - oxygenated blood
    - More activity in the brain means more oxygen use
    - More oxygen use means more blood flow to that area
    - More blood flow means more oxygenated blood
    - This changes the resonance signal
      - Blood-oxygenation level-dependent (BOLD) signal





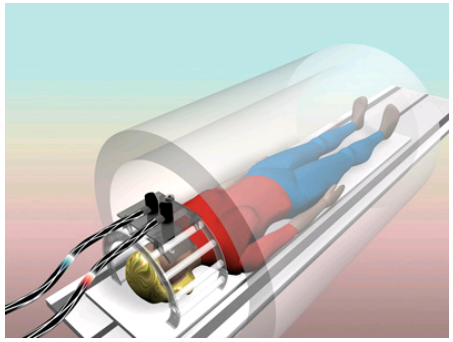
Example of BOLD signal

- fMRI and Memory



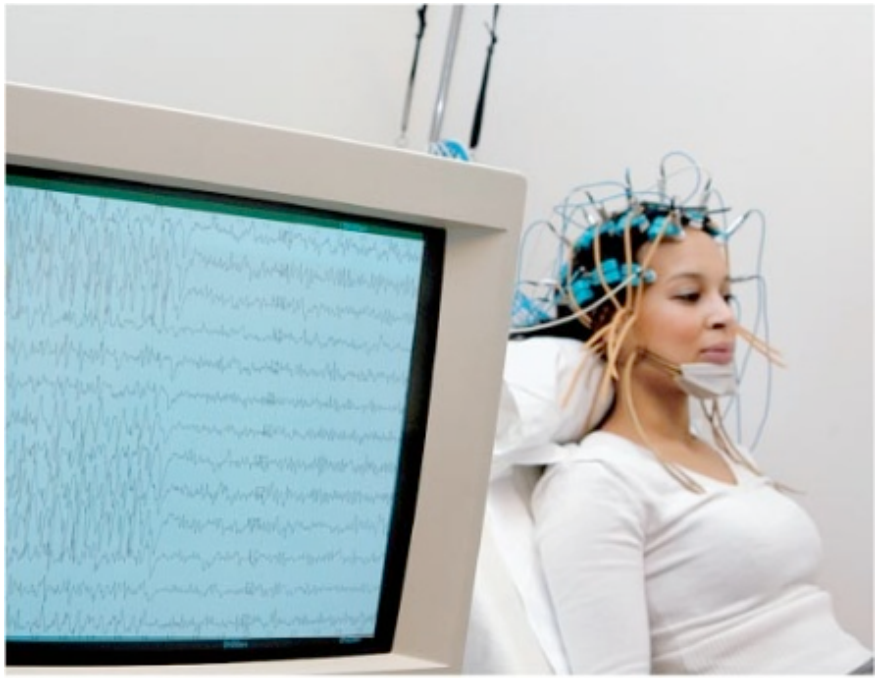
What can you use fMRI for?

- What can't you use fMRI for?
  - Many uses
    - Good physical resolution
    - Good temporal resolution (1-2s)
    - Can be used in MANY cognitive tasks
- But….
  - Can't allow movement
  - Requires specialized equipment
    - NO FERROUS METALS!!!



Activity Measures

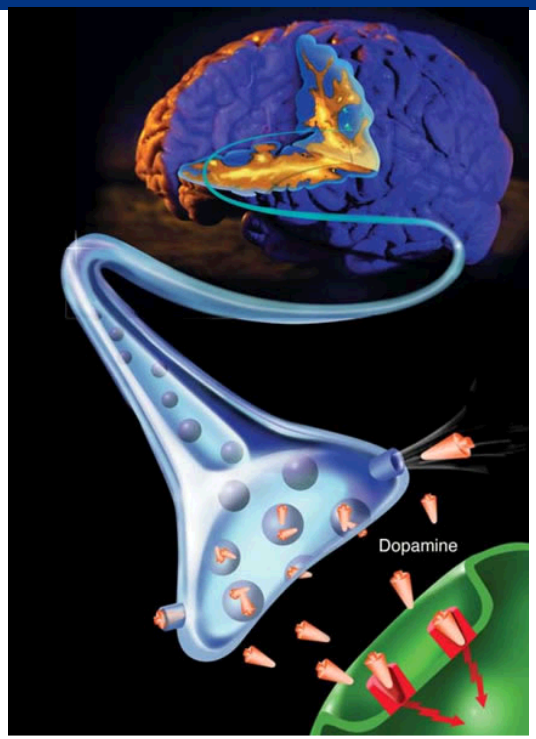
- EEG (Electroencephalography)
- MEG (Magnetic Encephalography)

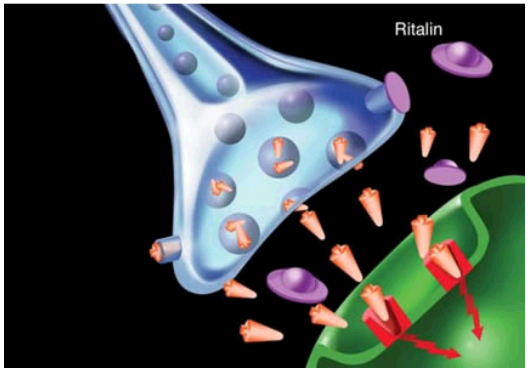


Pharmacology

- How does brain function change with different drugs on board?
  - Ritalin increases the release of several neurotransmitters.
  - What is the effect on behavior? Brain function? Cognition?

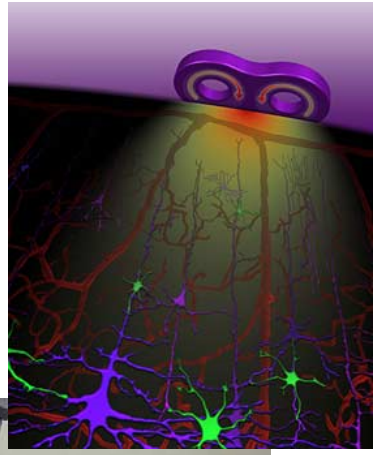
Note: More on drugs when we discuss consciousness





Brain Stimulation

- External brain stimulation
  - Transcranial Magnetic Stimulation (TMS)
    - (Large TMS research group at Columbia)
    - Can disrupt cortical function for brief time
    - "Reversible lesion"
    - Can infer causal relationship!!
    - Problems
      - Not too well localized
      - Can be uncomfortable



Converging Evidence

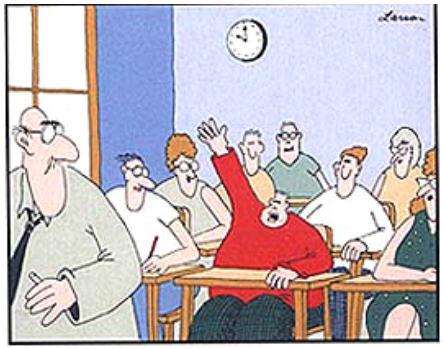
- No one method is the answer
  - Multiple methods give more complete picture

Brain Plasticity

- The brain is plastic
  - Changes in organization and function based on input, environment
    - Sensory stimulation

- Reorganization vs. new growth
  - Do you grow new brain cells?

- Exercise and the brain



"Mr. Osborne, may I be excused? My brain is full."

A few notes

- Be on time
  - But, if you are a few minutes late, please sit at the edges – don't disrupt others
- Latecomers
  - Always get notes, especially check if there have been important announcements made at the beginning of lecture
- Classroom etiquette
  - Cell phones silent in the lecture, computers only for notes
  - Empty your own trash
  - Do not leave before 9:55 unless the lecture is over.

Study Questions

- What is lateralization? What evidence supports the idea of lateralization of function in the brain? Give at least one example of behavior that is strongly lateralized.
- What happens when the two cerebral hemispheres are disconnected ("split brain")? Be specific, including the research methods used to test split brain patients.
- A person with a split brain sees the work "Ring" presented to the right, and the word "Key" presented to the left. What will the person verbally report seeing? What would they pick up with their right hand? With their left hand?
- In the Archimbaldo paintings like the one below, what would a split brain patient report seeing if the image was flashed to the right of a fixation cross? To the left? Why would Gazzaniga suggest the responses differ?
- What is the main difference between a PET scan and and MRI or CT scan?
- When would an experimenter opt to use a PET scan? (Think of at least two examples)
- How is an fMRI different from a PET scan? What is the difference between fMRI and MRI?
- For each of the methods used to study human brain function discuss the advantages and disadvantages of each method, as well as the types of information that each method provides.
- Why are we able to make causal statements from TMS?
- What is plasticity? How does the brain show plasticity?