



## Non-Invasive Techniques

**Key: Does not hurt the organism**

Psychology 372

Physiological Psychology

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### Many Procedures

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- X-Ray
- CT (CAT)
- MRI
- FMRI
- PET
- SPECT
- SQUID
- EEG

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### X-RAY

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- Typical X-Ray you receive at the physician's office.
- Can be used to examine brain structures
- Dyes can be injected and brain structures examined
- Air can be inserted into the spinal column and brain structures examined

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### Advantages

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- Is relatively cheap.
- Good to look at basic structures
- Good for bones and other things

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### Disadvantages

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- When injecting air, causes a major headache
- Cannot look at function
- Cannot see detail as well as other procedures
- Cannot be used to examine function.

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### Cerebral Angiography

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- Uses radio-opaque dyes
- Inject dye into the vertebral or carotid artery.
- X-ray the brain
- Dyes blocks x-rays and allows you to see brain arteries extremely well.
- Allows you to see vascular deformities
  - Balloon shape – aneurysm
  - Deformity from where the artery should be – Tumor

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Computerized Axial Tomography  
CT or CAT

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- Generally is a fancy X-Ray but uses a computer to create the image
- X-Ray unit moves around the structure (e.g., head) and puts X-Rays through to a detector on the opposite side
- Basically gives you a picture of a slice of tissue.
- Gives a good picture of the tissue at that level.

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Positron Emission Tomography

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- Similar to A CT Scan
- Can be used to look at brain structures
  - Not used for as much today
- Primarily is used to examine brain functioning

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Procedure

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- Use C11 or O15
- Use a Cyclotron to produce radioactive labels
- C11 or O15 attaches easily to other compounds such as glucose
- Result 2-DG = 2 Deoxyglucose
  - Has a short half life

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Procedure

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- Make Glucose "Hot"
- Put radioactive glucose into the patient
- The patient is now emitting particles in all cells but particles concentrate in:
  - tumor sites
  - places that are using lots of glucose
- Have a scanner pick up the particles
- Computer makes a picture of where the glucose is concentrated

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Result

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- Can see where a tumor is located
- Can determine which part of the brain is operating when doing a particular task.
  - Movement
  - Thinking
  - Visual Processing

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Psychological/Psychiatric Disorders

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- People with Schizophrenia show more activity in the Frontal and Occipital lobes than normals
- People with depression show decreased glucose usage than normals
- Can be used with a variety of disorders.

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### Advantages

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- Great for looking a brain functioning
- Is helping us to understand how the brain is working.
- Is relatively safe

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### Disadvantages

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- Cyclotron is expensive
- Thus, PET is expensive
- It it an invasive technique
  - anytime you add something in a organism, you risk a reaction
- Can get the label "to hot"

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### Magnetic Resonance Imagery

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- Similar to a CT scan but uses magnetic fields instead of X-Rays
- Causes the nuclei of some atoms to spin in specific orientations
- When you add specific radio frequencies, the nuclei from water molecules (Hydrogen) emit particular frequencies as well
- Have a detector for the Hydrogen frequencies

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### Magnetic Resonance Imagery

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- Is also used to examine brain structures
- Great to determine things about
  - Tumors
  - Strokes
- Other things (hydrocephalus)
- Can be used for any structure
  - Full body scans

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### Uses

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- Very good at detecting certain diseases
  - MS
- Have little water in White Matter
- Lots of resonance in Gray Matter
  - Myelin has little water
  - With demyelination, glial cells move in- have lots of water

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### Uses

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- Good for finding tumors
- Good for strokes
- Good for finding focal point seizures
- Can be used on any body structure as well

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### Advantages

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- Can be used on any structure
- Provides better detail than CT
- Does not use X-Rays - Lower radiation
- Great for focal points

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### Disadvantage

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- Is expensive
- Hear lots of loud noise like banging
- Can be scary

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### Functional MRI (fMRI)

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- Similar to MRI but look at function
- Looks at Oxygen metabolism instead of Hydrogen
- Have higher resolution than PET scans
  - Get better detail about particular brain regions.

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### Single-Photon Emission Computerized Tomography (SPECT)

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- Is like a PET Scan but more refined

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### Superconducting QUantum Interference Device (SQUID)

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- Like MRI – Are used to pick up changes in magnetic fields
  - When neurons fire
    - creates a change in electrical current
    - causes a magnetic field
  - So, changes in magnetic field indicate changes in neural activity.
  - Can monitor changes of one milliseconds while other techniques take seconds.
  - Is extremely sensitive

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### Williamson and Kaufman

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- Used SQUID to monitor the brain of a person listening to a piano
- Found
  - the brain hears loud sounds in a different place from quieter sounds
  - Brain distance between areas that hear a low C on a piano is the same distance that hears middle C from a high C

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### Faces

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- Place where the brain remembers faces is different from where it remembers objects
  - Faces - Right hemisphere that specializes in spatial configurations
  - Objects - (Spatial) - Is recalled in the cortex that originally processed how the spatula felt and how the hands moved it.
- When objects to be recalled close to where you want to use the information.

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### Magnetic Source Imaging (MSI)

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- Uses SQUID to measure ions in the brain or other areas (e.g., heart).
- Magnetoencephalography (MEG)
  - Measures magnetic fields of the brain
- Magnetocardiography (MCG)
  - Measures magnetic fields of the heart.

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### Some Websites for More Information

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#### SQUID

- <http://www.wikipedia.org/wiki/SQUID>
- <http://www.siue.edu/~tpartha/images/magnetometry.htm>

#### Medical Techniques

- <http://imasun.lbl.gov/~budinger/medhome.html>

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