

# 20181112 COGS 101b Lecture Notes

Cabinet COGS101b Lecture Notes

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Cognitive Neuroscience

Methods used in cognitive neuroscience

Basic Assumptions in Cognitive Neuroscience

General Techniques for studying brain function

Observe people with neurological damage

Use imaging techniques

Spatial imaging

Temporal imaging

Use intervention technique

Neural Representation

## Cognitive Neuroscience

**Definition** The *physiological* basis for human mental processes. Aimed at understanding how brain structure is related to brain function.

“What are the neural underpinnings in the process of forgetting...?”

## Methods used in cognitive neuroscience

## Basic Assumptions in Cognitive Neuroscience

1. Neurons send electrical signals
2. Different areas of the brain are responsible for carrying out different functions (**localization**)

# General Techniques for studying brain function

1. Observe people with neurological damage & compare their function to healthy individuals (neuropsychology)
2. Use imaging techniques to observe which regions are active during a task
3. Use intervention technique to activate (TMS) or disable and observe changes in the performance of the task

## Observe people with neurological damage

Most parts of the brain come in pairs, located symmetrically in the left and right hemispheres.

**Lateralization:** There are differences in function between the left and right side structures

**Contralateral organization:** Many of the brain's signals are crossed. Sensations from the right side of the body are projected on the left hemisphere (and vice versa).

The two halves of the brain work together, their functioning is closely integrated.

Made possible by commissures, the largest of which is the **corpus callosum**.

In epilepsy patients, the corpus callosum is severed, making them split brain patients.

These patients demonstrate contralateral organization: they cannot verbalize words displayed in the left visual field, but they can when the word is displayed in the right visual field.

Also, patients cannot feel and grab objects with the contralateral hand because the corpus collusum is not there to communicate information between the two hemispheres.

## Use imaging techniques

### Spatial imaging

**Computed Tomography (CT):** X-ray, better for bony structures

**Magnetic Resonance Imaing (MRI):** For soft tissue.

**Positron Emission Tomography (PET):** Inject a radioactive substance. Because neurons require glucose, more activity causes the tracer to decay and emit photons. The PET can detects these protons. Spatial and temporal resolution is only *okay*.

Why use PET over fMRI? PET scanners are less subject to movement. Patients can move more than they can in a fMRI.

**Functional Magnetic Resonance Imaging:** Traces blood flow. Blood contains hemoglobin which is comprised of oxygen and iron. Magnets cause iron to line up. Active regions in the brain will cause higher concentrations of iron, which the fMRI detects.

**Voxels:** units of analysis in an fMRI (like a pixel in a digital photo).

Note: fMRI readings don't necessarily imply that the active area on the fMRI is the area responsible for the activity (correlation doesn't imply causation).

Double disassociation is a more reliable method of identifying causality.

## Temporal imaging

**Electroencephalography (EEG):** Measures electrical activity. Use for measuring timescale of information processing. Very poor spatial resolution. Good for rhythmic patterns ( $\beta$  waves,  $\alpha$  waves, etc...) and event related potentials.

## Use intervention technique

# Neural Representation

A Hypothetical internal symbol that represents the external world (stimuli).