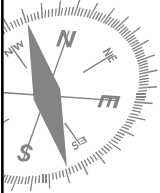


Biological Bases of Behaviour



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Reading:

▶ Psychology: An Introductory Text for the University of Auckland. Chapter Four. Pages 67-118 (taken from the TOP right hand side)

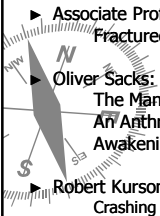
Pages 307-330 for Language and Handedness.

▶ Professor Michael Corballis:
From Hand to Mouth
The Lopsided Ape

▶ Associate Professor Jenni Ogden:
Fractured Minds

▶ Oliver Sacks:
The Man Who Mistook His Wife for a Hat
An Anthropologist on Mars
Awakenings

▶ Robert Kurson:
Crashing Through



What you should be able to do after these lectures:

▶ Describe & understand human nervous system & its components.

▶ Describe & understand functions of these components.

▶ Understand neurotransmission & how brain cells communicate.



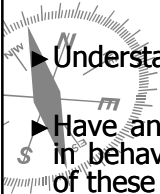
What you should be able to do after these lectures:

▶ Describe techniques used in neuroscience & psychobiology to study behaviour.

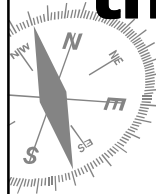
▶ Describe lobes of the brain.

▶ Understand function of these lobes.

▶ Have an awareness of the effects of drugs in behaviour & the neurophysiological basis of these effects.



How we study the brain, and why.



How the Nervous System Is Studied

- ▶ An enormous amount of *neurons* (individual cells - information processors of nervous system). Each connects to many others.
- ▶ Some techniques allow observation of individual neurons, others a picture of the entire living brain without seriously disturbing its owner.



- ▶ **The Big Question:** Is the mind just a mechanical function of the brain?

- ▶ Can consciousness be reduced to the firing of nerve cells in the brain?

- ▶ Are we really just machines?

- ▶ Or robots?

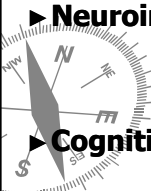


How do we study how the brain creates mind?

- ▶ **Neuropsychology:**

- ▶ **Neuroimaging:**

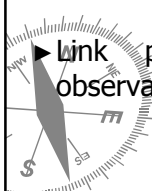
- ▶ **Cognitive neuroscience:**



Clinical Observation

- ▶ Direct clinical observation of patients with brain damage or disease.

- ▶ Link physical brain abnormality with observable changes in behaviour.

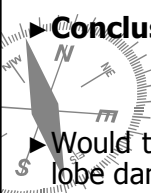


Neuropsychology

- ▶ 1848, Phineas Gage (construction foreman) had an iron rod rammed through left cheek & skull. Walk & talk, but became unruly, unsociable, bad-mannered, unable to plan

- ▶ **Conclusion:**

- ▶ Would this tell us how everyone with frontal lobe damage behaves? No!

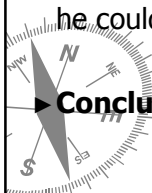


Neuropsychology

- ▶ Paul Broca studied patients with left frontal lobe damage.

- ▶ Patient called "Tan" - only articulate sound he could make.

- ▶ **Conclusion:**



Neuropsychology

- ▶ Brenda Milner worked with HM.
- ▶ Surgery for intractable epilepsy in late 50's.
- ▶ Removed much of temporal lobe including hippocampus.
- ▶ **Conclusion:**

Invasive techniques

- ▶ 1850 brain studied directly by opening skull while subject was alive. Activate/inactivate a region & watch behaviour change. Stimulated with electricity, chemicals, heat or cold.
- ▶ Could also be lesioned (destroyed).
- ▶ If connecting pathways were known tissue could be isolated by cutting (transecting) pathways.
- ▶ Nowadays (thankfully) with arrival of ethics committees - unethical.

Lesioning

- ▶ Experimental brain lesions, usually an injury to brain tissue, in animals.
- ▶ Sometimes done in humans to alleviate Parkinson's Disease for example.
- ▶ Use stereotaxic apparatus to insert a fine wire into a particular location in the brain.

Neuroimaging

Views of brains anatomy (*structure*)
No invasion of brain tissue, owner of brain is fully awake and conscious.

- ▶ **Computerised tomography (CT)**
- ▶ **Magnetic resonance imaging (MRI)**

Neuroimaging

Views of brains physiology (*function*).
No invasion of brain tissue, owner of brain is fully awake and conscious.

- ▶ Positron emission tomography (PET)
- ▶ Functional magnetic resonance imaging (fMRI)
- ▶ Electroencephalography (EEG)
- ▶ Magnetoencephalography (MEG)
- ▶ Transcranial magnetic stimulation (TMS)

CT Scan

Computerised tomography

- ▶ X rays of brain taken at different angles.
- ▶ Computer constructs detailed composite picture of the area.
- ▶ Shows **brain anatomy**

MRI

Magnetic Resonance Imaging

- ▶ Safer - no x rays.
- ▶ Magnetic field over head, reverberations produced by hydrogen molecules picked up by scanner.
- ▶ Computer examines signals for subtle differences that identify the tissue that generated them (blood, nerve fibres, or membranes).
- ▶ Creates a 3D **anatomical** picture of the brain.
- ▶ Very detailed picture: shows tumours, tissue degeneration, blood clots & leaks that may signal strokes.

EEG

Electroencephalography

- ▶ Detects electrical currents generated by neurons on brain surface by affixing metal electrodes to scalp.
- ▶ Activity at brains surface only
- ▶ Poor spatial resolution, excellent temporal resolution (picks up fast changes)
- ▶ Resolution improved with high-density arrays.

Event-related potentials

Average signals across many trials to deal with noise.

Stimulus repeated – each EEG response averaged to produce a clearer signal - ERP.

Some measure sensory responses to stimuli – N100 – appearing 100 ms after the onset of a stimulus.

Some associated with more cognitive functions – P300 & N400.

N400

Linked with language processing.

Elicited in sentences where the last word is surprising/inappropriate although linguistically legal:

A man who has lost 90% of his brain is called a zombie.

A man who has lost 90% of his brain is called a widower.

The more difficult the task, the greater the amplitude of the N400.

PET Scans

Positron Emission Tomography

- ▶ Subject injected with safe dose of radioactive sugar resembling glucose (metabolic fuel for brain)
- ▶ Areas that are more active will soak up more sugar & give off more radioactivity.
- ▶ Shows which regions of the brain are active or inactive.

PET Scans

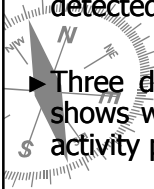
Positron Emission Tomography

- ▶ Subject exposed to (very slight) radiation.
- ▶ Slow to pick up reactions in brain.
- ▶ Largely replaced by functional magnetic resonance imaging (fMRI)

fMRI

Functional Magnetic Resonance Imaging

- ▶ Detects fast changing aspects of brain physiology (blood flow & oxygen use) without any radioactivity. Blood contains iron, changes in magnetic fields can be detected.
- ▶ Three dimensional image of brain at work, shows which parts are active. Superimposes activity patterns onto the MRI image.



MEG

Magnetoencephalography

- ▶ Picks up magnetic fields generated by neurons.
- ▶ Excellent temporal resolution, and complementary to EEG.
- ▶ Measured by a SQUID



TMS

Transcranial magnetic stimulation.

- ▶ Create temporary brain dysfunction, perform experiments that wouldn't be possible otherwise.
- ▶ Series of strong magnetic pulses on scalp, causes temporary disruption in region directly below the area.
- ▶ Are brain areas used for vision also needed for visual imagery?

