

Lecture 8

Neuroscience 1:
Neuroanatomy,
Neurophysiology,
Neuropsychology

THE GHOST IN THE MACHINE, Tuesday 25 November 2004

Life

Overview of today's lecture

based on Churchland, chapter 7 sections 1-2-3

1. **Neuroanatomy, evolutionary background**
 - a) **Development of nervous systems**
2. **Neurophysiology and neural organization**
 - a) **Neurons: structure, function, types**
 - b) **Organization of the network (mostly homework)**
3. **Neuropsychology**

Development of nervous systems

e.g. the snail at the bottom of the ocean

CONTROL

sensitivity to environment



muscle tissues

beginnings of a **nervous system**

Development of nervous systems

Primitive spinal cord:

Elongated **central ganglion** (=cluster of cells).

With:

1. **Motor fibres** (emanating from *ventral roots*) □ send command impulses from spinal cord to the body's muscle tissues,
2. **Somatosensory fibres** (emanating from *dorsal roots*) □ bring information about tactile stimulation and muscle activity to the central cord

Development of nervous systems

Spinal cord + Brain stem:

1. **forebrain**
2. **midbrain**
3. **hindbrain**



- 1: olfactory stimuli
- 2: auditory & visual information
- 3: coordination of motor activity

Development of nervous systems

In primates and humans:

cerebellum

&

cerebral hemispheres

become bigger and more important.

So do these distinguish us from 'lower' animals?

2. Neurophysiology & neural organisation

Nervous system: behaviour control, information flow

A. Elements of the network: **neurons**

- a) **structure**
- b) **function**
- c) **types of neurons**

B. Organization of the **network**

- a) **sensory projections within the brain**
- b) **motor projections outward**
- c) **internal organisation**

a) Neurons: structure

- neurons = brains cells
- cell body/soma
- input: many dendrites (in a treelike structure)
- output: the axon

connections between neurons: **synapses**

a) Neurons: function

*How does information flow from one neuron to another?
The activity of one neuron influences the activity of others,
how?*

- Along the **axon**: **action potential** (electrical pulse)
- In the **synapse**: **neurotransmitter** (chemical) is transmitted through the synaptic cleft to the next neuron's dendrite.
- Synapse can be
inhibitory: next neuron is hyperpolarized, less likely to fire
or **excitatory**: next neuron depolarized: will fire

a) Neurons: function

Several dendrites to a neuron, with several synapses on each, i.e. several inputs.

Each synapse = either "fire" or "don't fire"

Whether neuron will fire or not depends on:

1. how many excitatory synapses activated & how close they are to the cell body
2. temporal frequency of synaptic activation

a) Neurons: types

- **motor neurons**: activate muscles through:
 1. the spiking frequency of individual motor neurons,
 2. the activation of dormant neurons in the muscle itself
- **sensory neurons**: input: outside world
 - many different kinds
 - e.g. rod and cone receptor in eye: very short somatosensory receptor: cf. motor neurons
- **interneurons**: all the other kinds of neurons
 - different sizes and structures

a) Neurons: some other points

- Nervous system: not only brain, but whole system of neurons reaching to our skin, muscles, etc.
NS: throughout the whole body.
- In the brain: some neurons: only very locally connected, others: connected to distant parts.
- Cortex

b) Organisation of the nervous network

Finding out:

- dissection: gross anatomy
- cell staining technique:
interconnectivity of the nerve cells

b) Organisation of the nervous network

Sensory and motor projections

HOMEWORK:

Read pp. 135-142 carefully at home.

3. Neuropsychology

“...to understand and explain psychological phenomena in terms of the neurochemical, neurophysiological, and neurofunctional activities of the brain.” (p. 143)

- mainly *abnormal* psychology
- but also:

neural correlates □ functional map of normal brain found by imaging techniques, brain probing, etc.

3. Neuropsychology

Careful though!

1. Location of lesion \neq location of function
2. Lesions might not map perfectly onto common sense psychological notions
e.g. blindsight

3. Neuropsychology

Chemical workings of the brain:
psychoactive drugs
and the biochemical basis of mental disorders.

- For next week: Lecture based on Churchland ch. 7 sections 4-5.
But also read Stillings Ch. 2 section 2.10 on Connectionism
- essay: Thursday!!
- questionnaire: course review

the end