

Biological Psychology

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Methods (Lecture 1-2, 5-10)

Lecture 1-2: Transcranial Magnetic Stimulation (TMS) General Methodology and Research Applications

1. What is TMS?

TMS is a **non-invasive** technique that creates **virtual cortical lesions**.

2. What are lesions in the Broca and Wernicke area linked to?

Broca: Speech **Production** Wernicke: Speech **comprehension**

3. Why are TMS is used over real patients with real lesions?
 - a. Not enough patients with circumscribed lesions
 - b. Usually lesions aren't in a specific area
 - c. Brain plasticity might compensate over time

4. How does TMS work?

TMS can be applied externally. Electrodes are placed **over the scalp** to produce **rapidly changing magnetic fields** to **induce electrical currents**. This **depolarises** the neurons in the cortex, causing neurons to fire **rapidly and** randomly, increasing **neural noise**. The neural noise masks **correctly firing neurons**.

5. Name 4 important groups of people that influenced TMS?
 - a. Hitzig and Fritsch: first ones to use **electronic stimulation** on **animals**
 - b. D' A: found that stimulation of the **visual cortex** elicited **phosphenes**
 - c. Stevens and Magnussen: created the **first** head coil that **covered whole head**
 - d. Barker, J & F: created the **current** TMS system
6. How does the current TMS system work?

The current TMS is **not painful**. A **capacitor** is charged and **quickly switched on and off**. This creates **electrical current** that is needed to generate **magnetic fields**. The process can be **modified** so that it creates **rTMS** (super-fast pulses). In order to have **enough power**, the pulses have to be **very short loading times** (100-200 micro seconds), and **very short duration** (<1 millisecond).

7. Why use a figure eight coil?

The figure eight coil allows **more precision** due to **offset current loops**.

8. What are the **four** ways TMS can be used?
 - a. The **neural noise** approach: creating neural noise in a specific region to find causal connections between the region and the action/use (The visual mask study and magnetic coil stimulation)

- b. The **probing excitability** approach: testing to see if a region is activated during a cognitive task. Usually on **motor cortex**. TMS is applied to the area that is hypothesised to be involved in the task, if it is involved, then **Motor Evoked Potentials** (MEPs) should be higher
 - c. The **virtual lesion** approach: creating virtual lesions to see if it impairs a specific task, using **rTMS**
 - d. The **paired-pulse** approach: sending two pulses (one **supra-threshold**, one, **sub-threshold**) of TMS to a specific area. It measures how strongly the first pulse influences the second pulse (Study: M1 in Schizophrenia)
9. How can TMS be used to treat **depressions**?

One hemisphere is stimulated above the **pre-frontal cortex** with the idea that **depression** is caused by **imbalance of prefrontal activity between hemispheres**

Lecture 5-6: Electroencephalography (EEG) General Methodology and Research Applications

1. What is EEG?

EEG is a method to **detect neural activity** by placing **electrodes on the scalp**.

2. How does EEG work?

EEG picks up **small fluctuations** of **electrical signals**. These signals are **noisy**, but are **systematically related to cognitive processes**.

3. What is another form of EEG?

Intercranial EEG, which is **invasive**, and works by placing electrodes on an **exposed cortex**

4. What are the benefits of EEG? What are the advantages and disadvantages?

EEG is **easy to use** and **relatively cheap**. It has **good temporal resolution and fast processing speeds**. However, it has **bad spatial resolution** and you usually are not able to find where the signal **originates from**.

5. Explain the discovery of EEG.

Berger was interested in exploring the **psychic expressions** in the brain, so he performed EEG on his wife (the electrodes were placed **under her scalp**). He did not realise the **basis** or the **potential** of his discovery.

6. What is alpha rhythm?

Inconsistent electrical signal when people **close their eyes**, between **8-13 Hz**.

7. Explain the EEG activity.