



MRC Cognition
and Brain
Sciences Unit



UNIVERSITY OF
CAMBRIDGE

Brain Stimulation For Neuroimaging

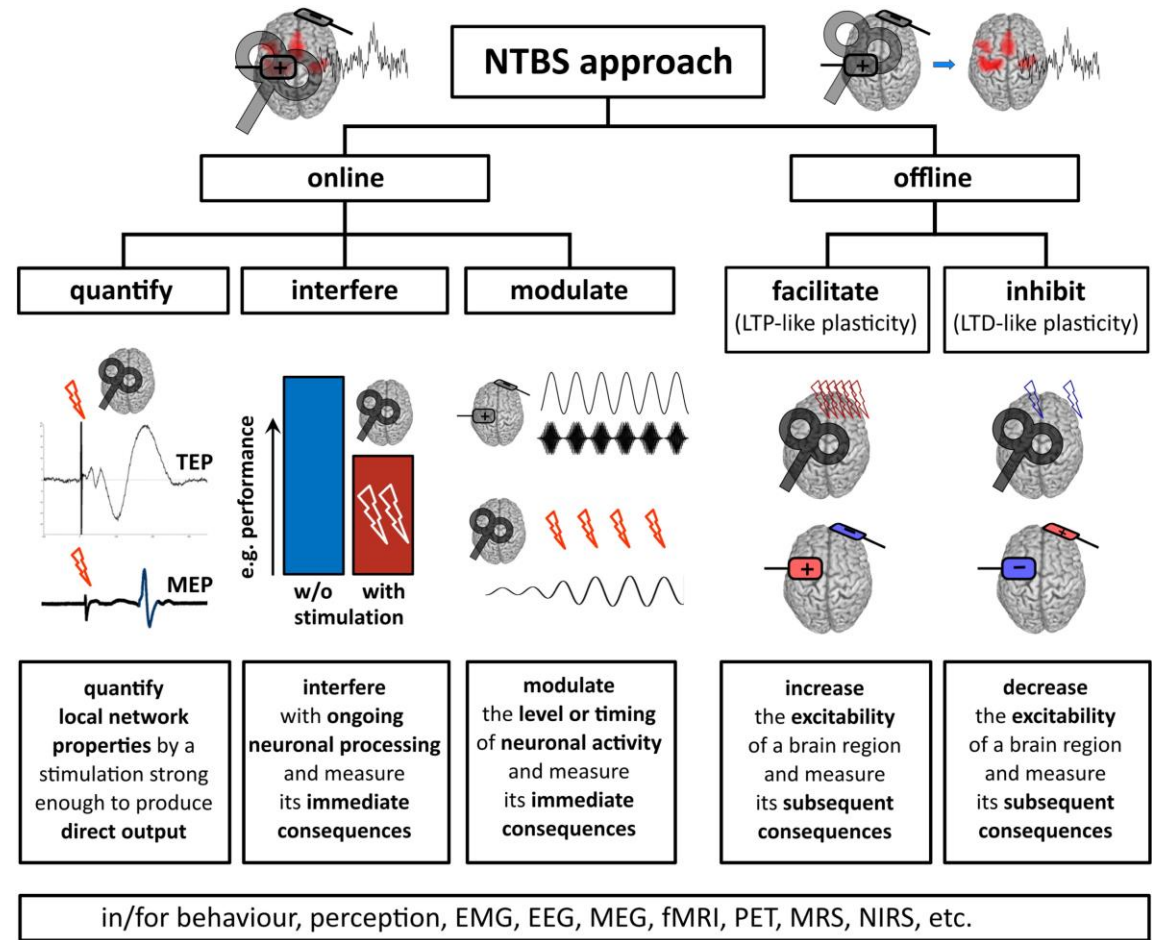
Friday 27th September 2024

Why should imagers care about NIBS?

- Brain stimulation methods allow us to test whether correlational neuroimaging measures play a **causal role** in cognition.
- Neuroimaging can be used to **validate your intervention** – did the stimulation do what you expected it to do?

Brain Stimulation Methods (NIBS)

- NIBS = Non-invasive brain stimulation
- Terms refers to a family of technologies that allow us to modulate activity with the human brain from outside the skull.



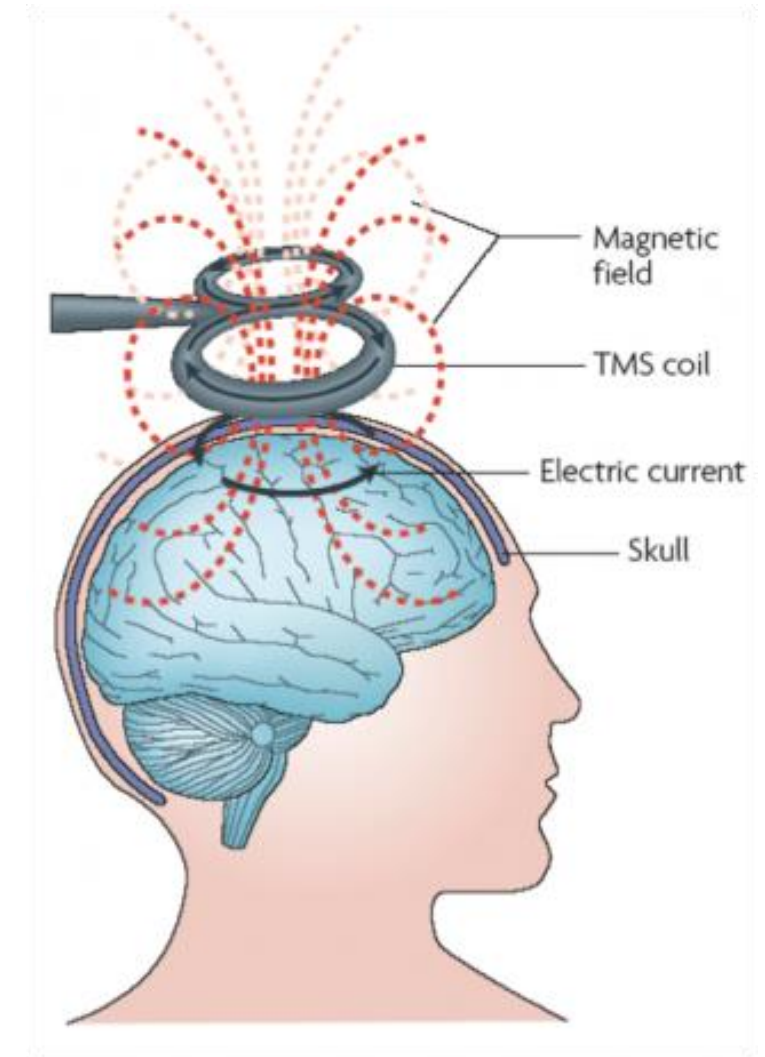
Types of stimulation

- NIBS methods can be grouped together by their **mode of stimulation**:
 - Magnetic stimulation
 - Electrical stimulation
 - Ultrasound stimulation
- Note: we can also think about grouping stimulation protocols **according to their impact** on the brain/behaviour!

Magnetic Stimulation

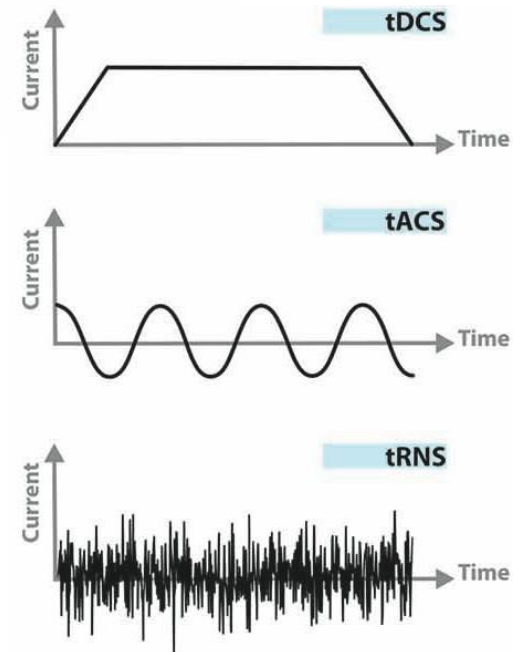
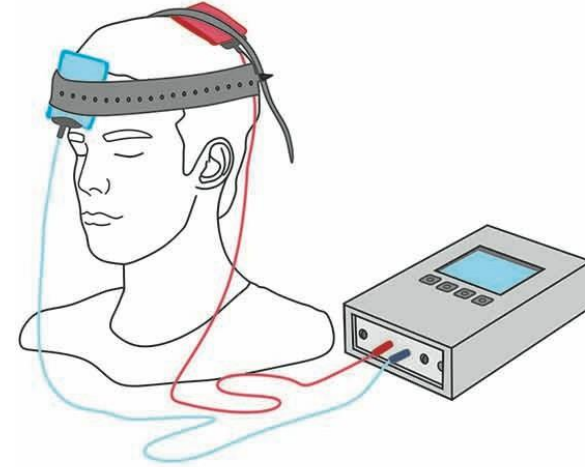
- TMS uses the principle of **electromagnetic induction** – current is run through a coil of wire, which generated a perpendicular magnetic field
- This magnetic field can pass through your skull and leads to the induction of an electric current in the underlying neural tissue*
- TMS can be delivered as one brief pulse (“single pulse”) or a series of pulses (“repetitive”), which are thought to have different effects in the brain
- TMS may be preferred over other forms of stimulation if you want a **brief, focal method** of stimulation.

*TMS will also interact with other electrical circuits



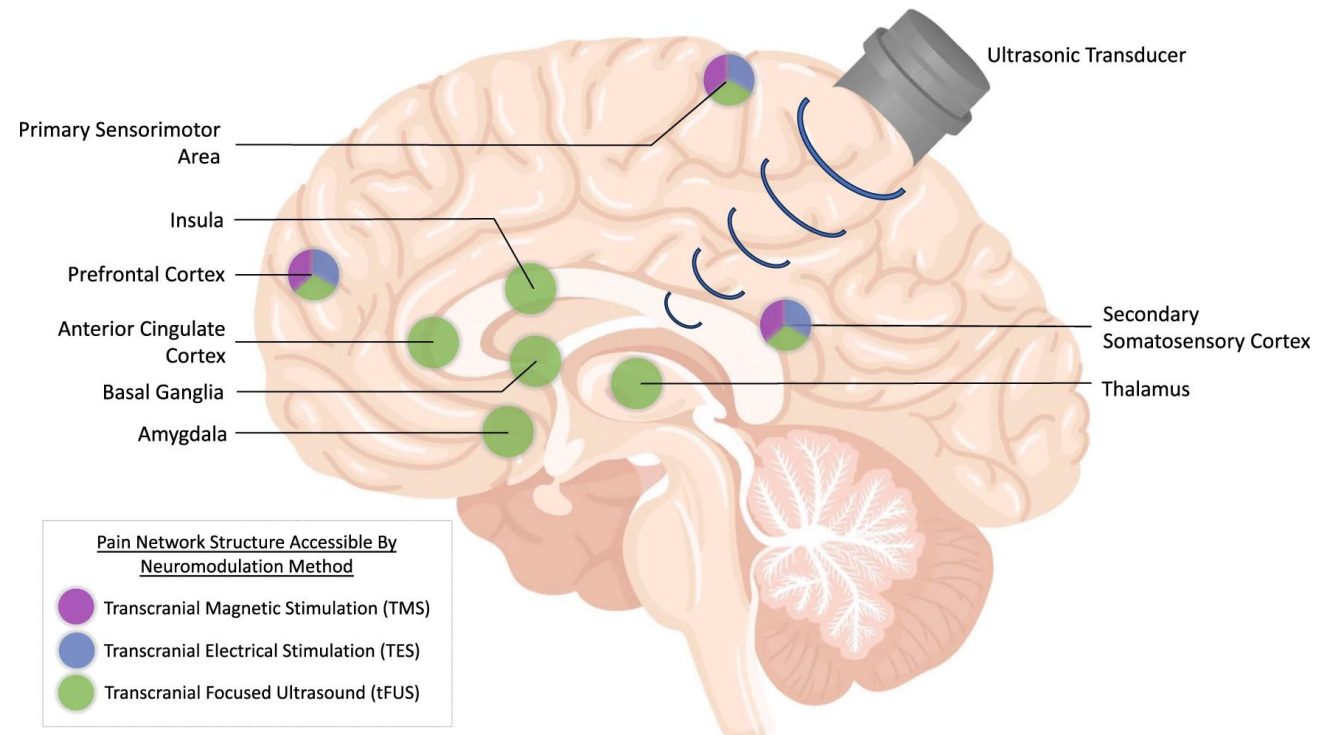
Electrical Stimulation

- Electrical stimulation is an alternative to TMS. There are several types of electrical stimulation, which are defined by the variation in current over time.
- Electrical stimulation requires at least two electrodes to be placed on the scalp (anode/cathode).
- Relative to TMS, electrical stimulation is less focal in both space and time.
- It is preferred when your application might require the stimulation effect to last for a longer period of time, or for interacting with brain oscillations (tACS).
- Not typically used for concurrent EEG studies (NB: temporal interference)



Ultrasound

- Uses sound waves (pressure) to stimulate neural tissue
- Neurons are stimulated mechanically – although the exact neural mechanisms of action are not well understood.
- Thought to have two key advantages over TMS:
 - More spatially targets
 - Can access deep structures directly



Today's Session

Please ask questions – we have lots of breaks & and dedicated Q&A time at the end 😊

9.10-9.50: *Combining TMS with EEG* - Runhao Lu

9.50 – 10.10: BREAK

10.10-10.45: *A novel simultaneous TMS-fMRI setup for high resolution whole brain imaging* – Dr Moataz Assem

10:45-11.15: *Concurrent TMS-fMRI artifacts: Avoidance and rejection* – Dr Jade Jackson

11.15-11.25: BREAK

11.30-12: *Summary, Q&A*