APA 2120

Lecture 10: Neural Stimulation
Oct 11, 2012

u Ottawa
L'Université canadienne
Canada's university

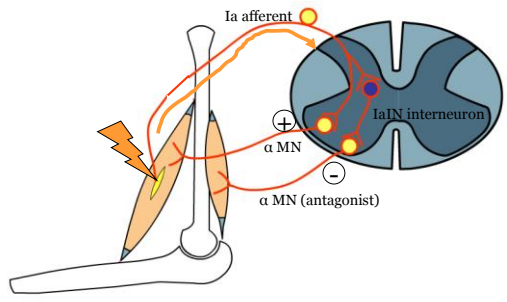
V. Ramachandran

- http://www.youtube.com/watch?v=Rl2LwnaUA-k#t=9m29s
- http://www.ted.com/talks/vs_ramachandran_the_neurons_that_shaped_civilization.html

Q: How does one assess motor preparation?

- 1) Reaction time
  - Simple RT
  - Choice RT
  - Precuing
- 2) Ability to inhibit a movement
- 3) Measure neural excitability
  - H-Reflex

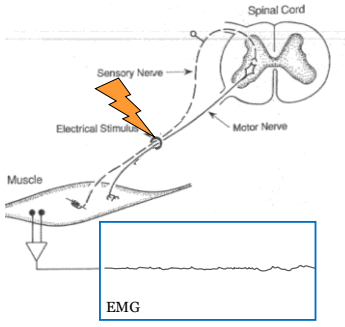
M1 reflex circuit



Hoffman (H)-Reflex

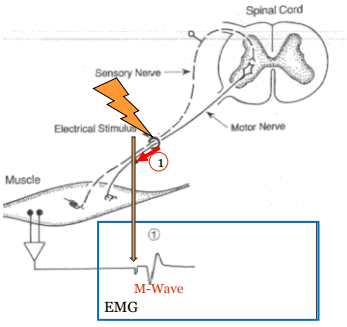
- Artificial (electrical) activation of the Monosynaptic (M1) stretch reflex
- EMG response can Indicate motor neuron pool excitability in the spinal cord

H-reflex



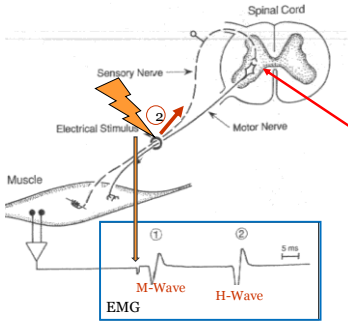
- 1. Electrically stimulate nerve bundle
- 2. Measure EMG

H-reflex



- **Electrically stimulate nerve**
- Directly activates large motor neurons (1)
- Short latency response in muscle (measured with EMG **(this is M-Wave)** - Reflects size of electrical stimulus

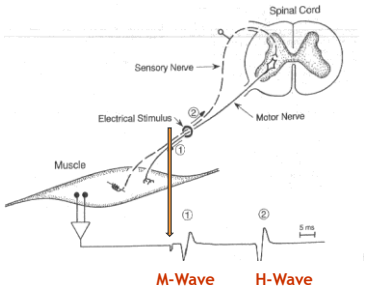
H-reflex

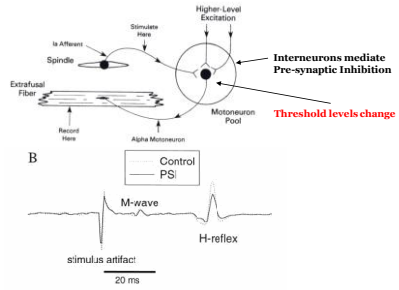


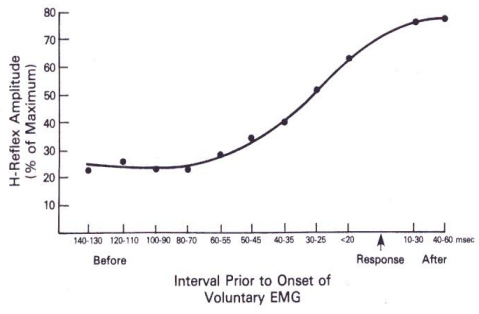
- **Electrically stimulate nerve**
- Also activates (recruits) large sensory neurons (2)
- sensory afferents synapse with MN in spinal cord
- Longer latency EMG response (**H-Wave**) provides indication of size of reflex response to a given stimulus. This can change depending on spinal cord excitability

H-reflex

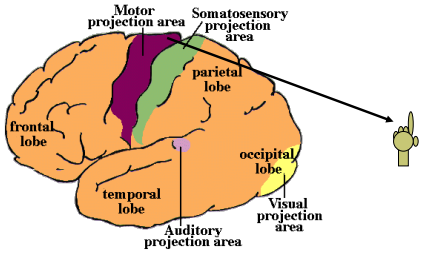
- Way to test Pathway Excitability
- How?
- Electrically stimulate reflex pathway
- Larger response = higher pathway excitability







What does Excitability tell us?



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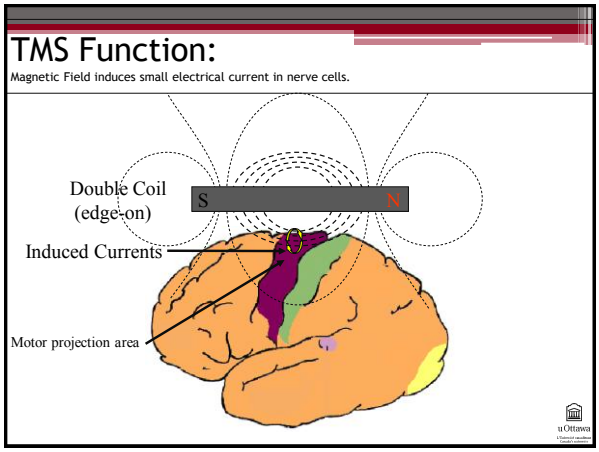
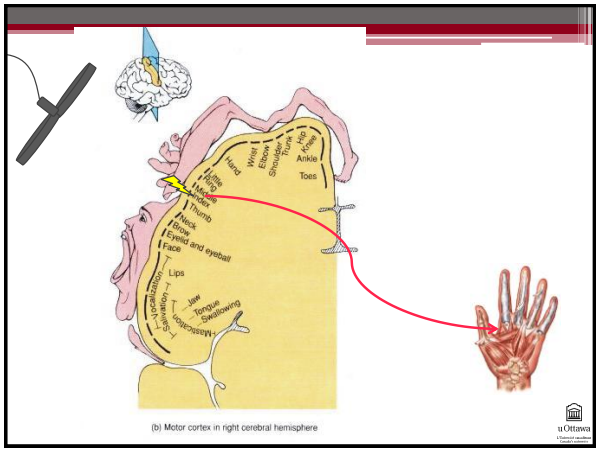
- 3) Measure neural excitability
  - H-Reflex
  - TMS

Transcranial Magnetic Stimulation (TMS)

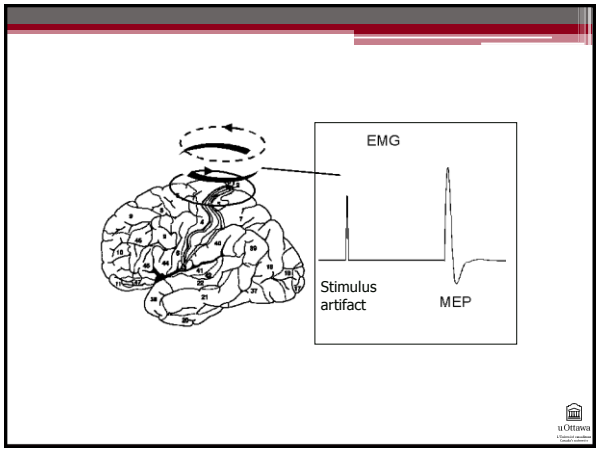
TMS Function:

Very powerful electrical discharge creates intense magnetic field.

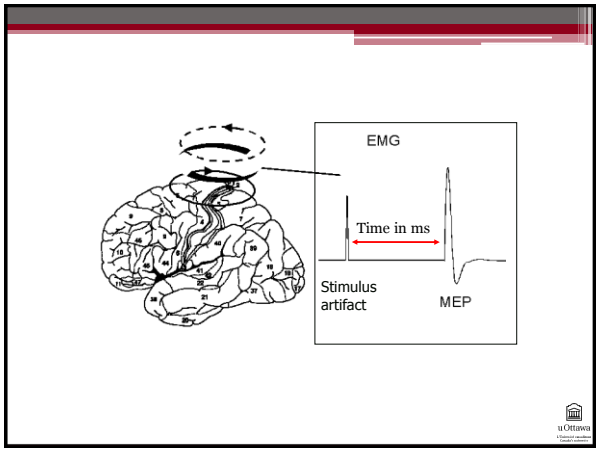




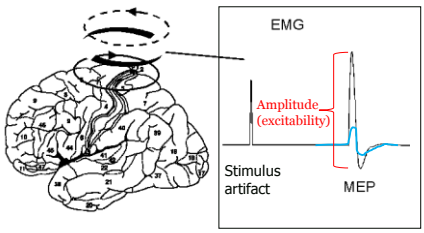
- induce magnetic field which will create muscle spasm
-



- we can use emg to measure the motor evoked potential (MEP)

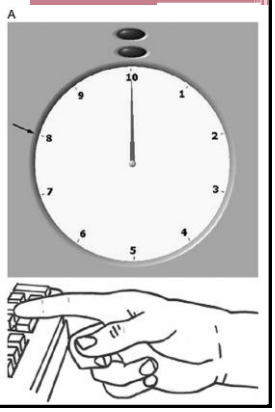


- the time in ms tells us conduction time (how long it takes for the stimulus to go from the cortex to the muscle)
- conduction time only involves the activity from the brain to the muscle.



Coxon & Byblow 2006

- Used anticipation-timing task:
  - to investigate cortical excitability associated with preparation and inhibition



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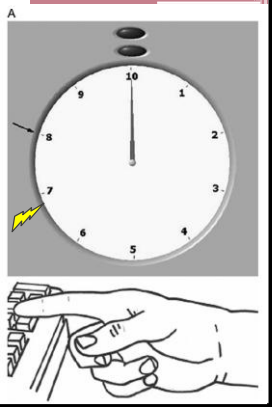

Coxon & Byblow 2006

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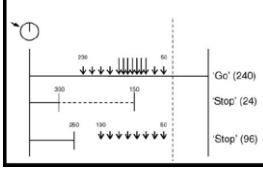
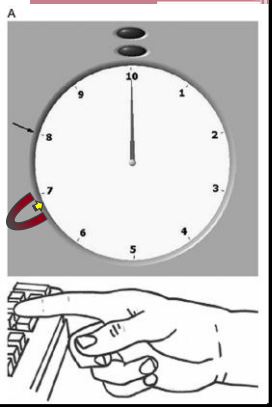
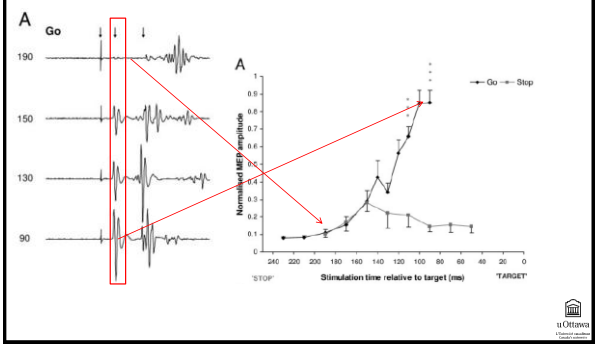


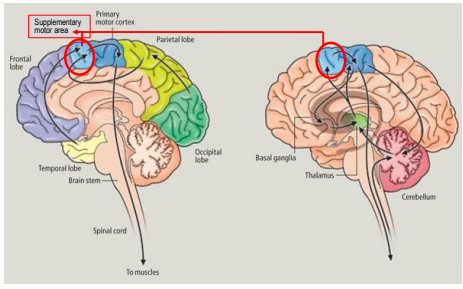




Motor Preparation / planning

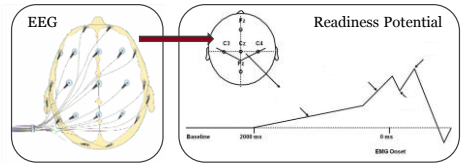
- Q: How does one assess motor planning?
- **Q: Can we modify / change motor planning?**

The Supplementary Motor Area (SMA)



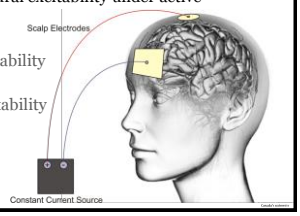
Role of SMA in preparation

- Involved in planning of self-initiated movements, cued movements, and imagined movements, and when mentally rehearsing.
- SMA is active when people simply observe graspable objects



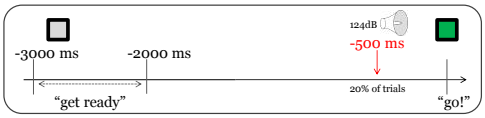
Transcranial Direct Current Stimulation (tDCS)

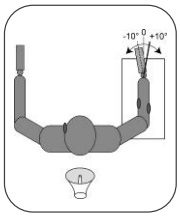
- Non-invasive method of Brain Stimulation
- Spatially restricted
- Induces transient changes in neural excitability under active electrode
  - Anodal Stimulation ⇧ excitability
  - Cathodal Stimulation ⇩ excitability



- direct current stimulation (electrical)
- really low amount 9v battery
- difference between this and TMS
--> very low amount of current in comparison, doesnt induce any firing of neurons, because its so low voltage.
- whereas TMS induces action potentials.

Methods



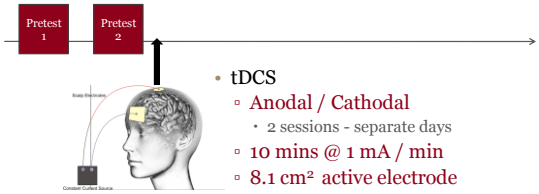


- Task: 20 deg wrist extension RT task

- if you increase excitebility, than you will have a faster reaction time.
-

Blocks

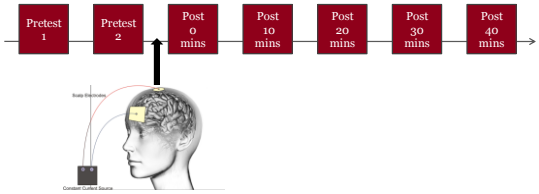
Each Block:
20 Control
5 Startle



- tDCS
  - Anodal / Cathodal
    - 2 sessions - separate days
  - 10 mins @ 1 mA / min
  - 8.1 cm² active electrode
    - current density 0.123 mA / cm²

Blocks

Each Block:
20 Control
5 Startle



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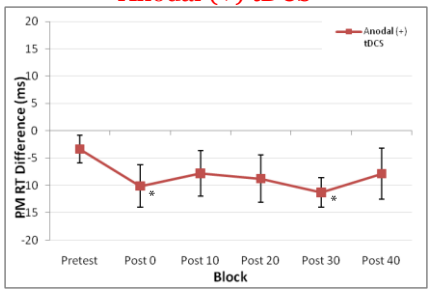
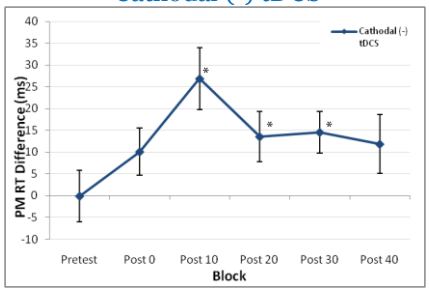
Results: Control Trial RT

Anodal (+) tDCS



Results: Control Trial RT

Cathodal (-) tDCS



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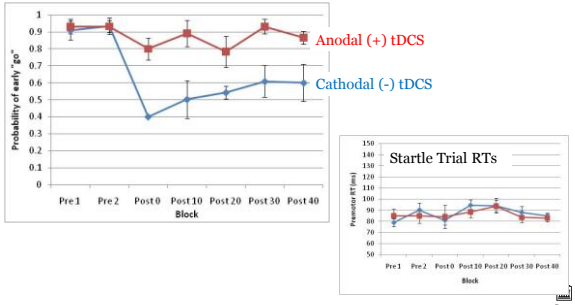
Results
Probability of early release by Startle



Take Home / Conclusions

- Cathodal tDCS leads to Slower RT and Decreased probability of release by startle.
- Anodal tDCS leads to Faster RT and possible Increase in probability of release by startle.
- Modulating the excitability of SMA changes the preparatory state of the motor system.
- Suggests SMA is strongly involved in preparation of cued actions.

Reminder

- Question Session Monday (I am away)
- Mid-Term Exam Thursday the 18th

- I will be available for review and questions From 12pm to 6pm Wednesday Oct 17th
  - **MNT 352** – If I'm not there I'll be back within 15-20 minutes