

Modular Transcranial Magnetic Stimulator

-- A Cure for Depression May Just Hide Inside Your Tesla

Jinshui Zhang

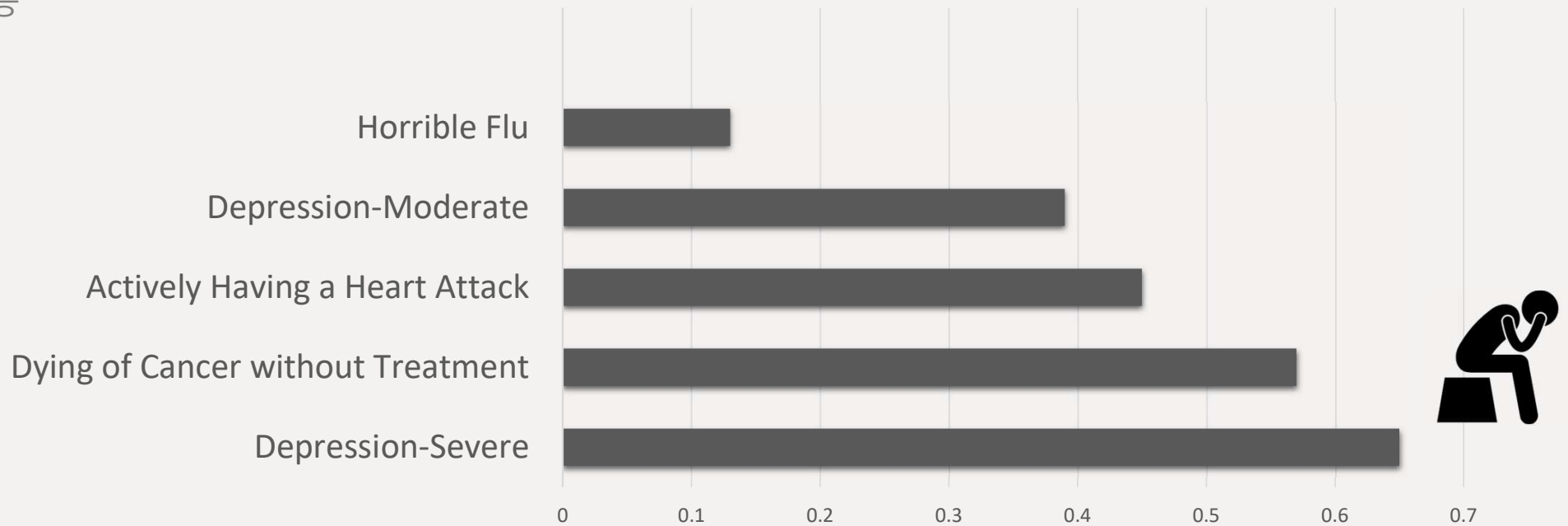
Advisor: Stefan M. Goetz

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Depression hurts

抑郁症
Depresión
우울증

Disability Weight



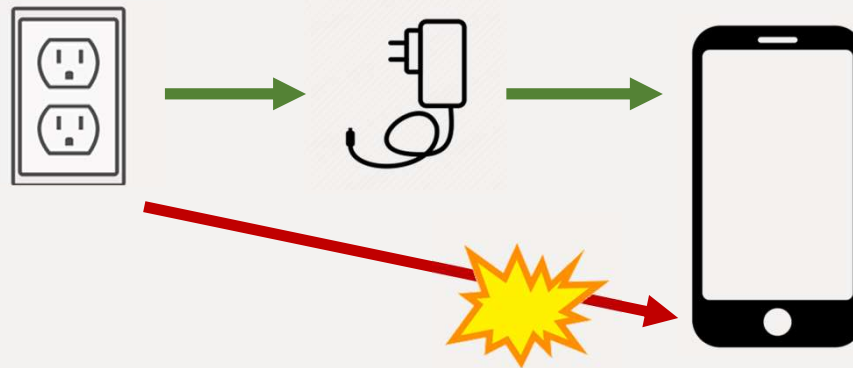
Salomon, et al., The Lancet Global Health, 2015.

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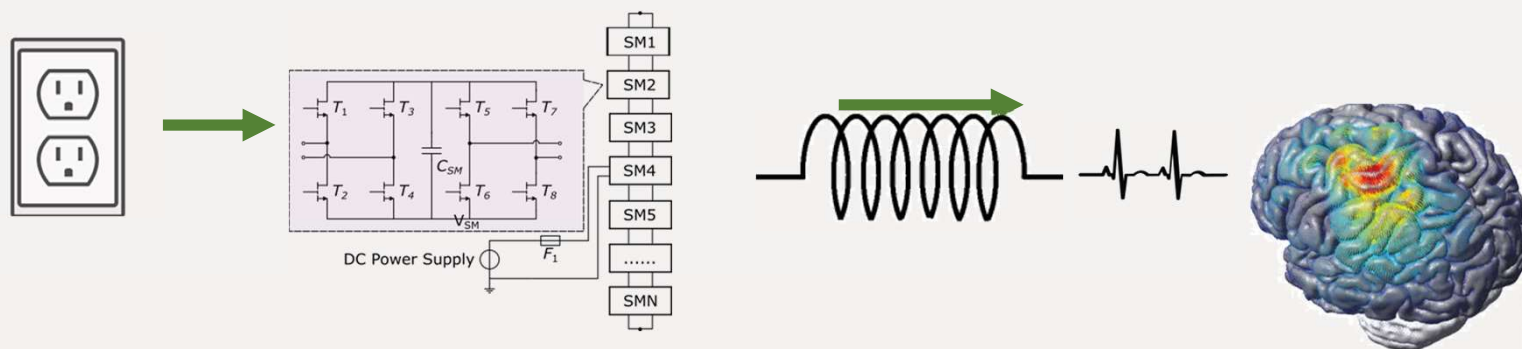
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Power Electronics: mastering the electricity

- Typical Application of power electronics: phone charger



- It can deliver energy to your phone; it can also deliver it to your brain



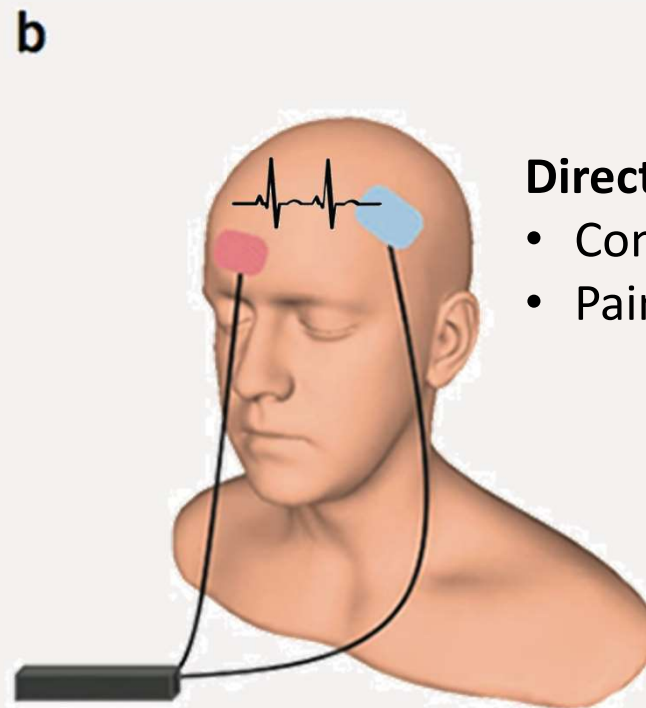
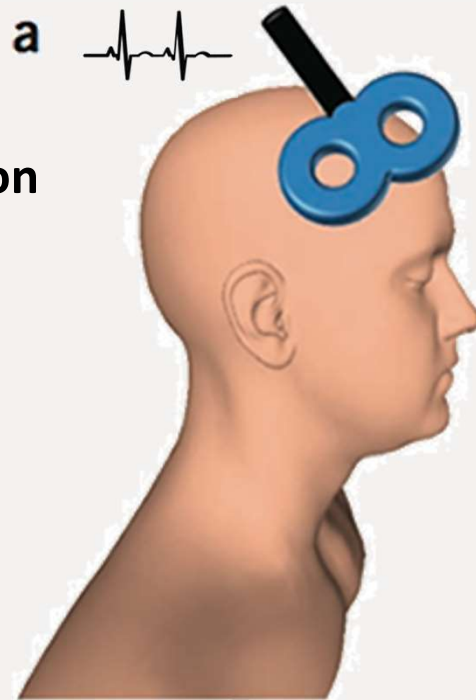
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How to stimulate your brain: TMS vs tDCS

TMS

tDCS



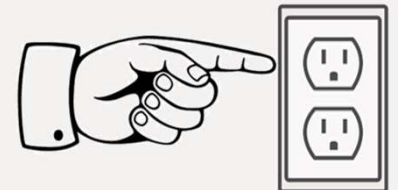
Magnetic Stimulation

- No Contact
- No pain

Direct Current Stimulation

- Contact to scalp
- Pain

Dayan et al., Nature Neuroscience, 2013



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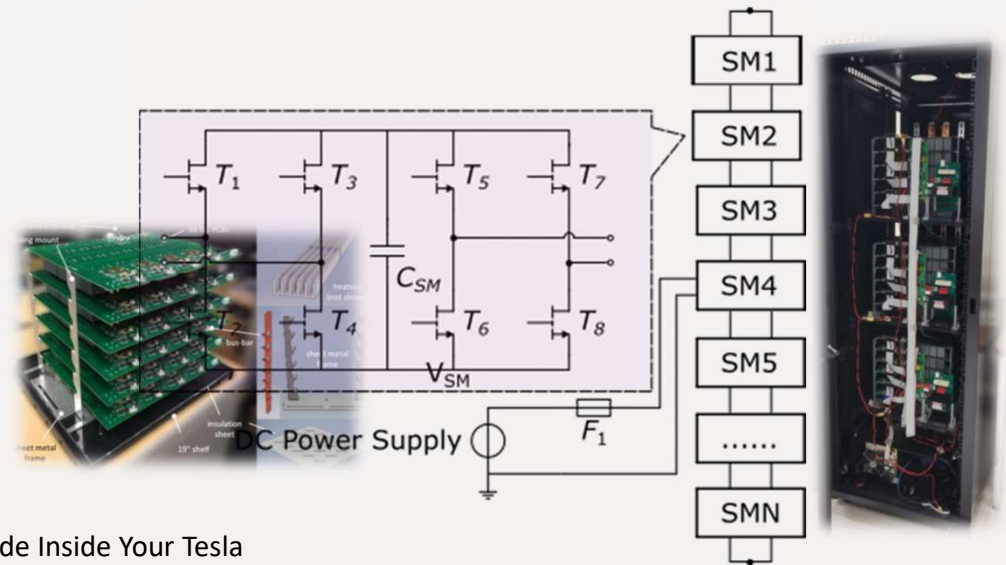
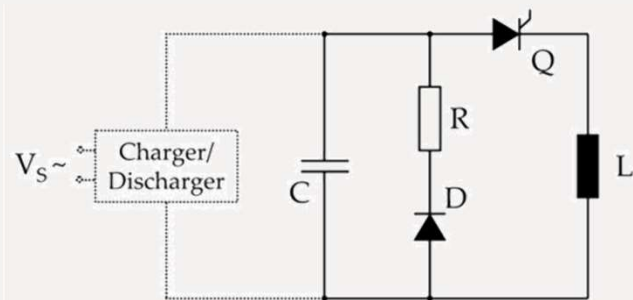
Modular Transcranial Magnetic Stimulator: **Lego** for TMS Scientists

Traditional TMS Techniques

- Resonant Circuit
- Limited TMS pulse shape (sine)
- Limited bandwidth
- Limited power level

Modular Transcranial Magnetic Stimulator

- Flexible TMS pulse shape (any)
- Customized TMS pulse sequence
- Wide bandwidth
- Extendable power level



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To design the cure, instead of to discover

Patient Profile Based Cure



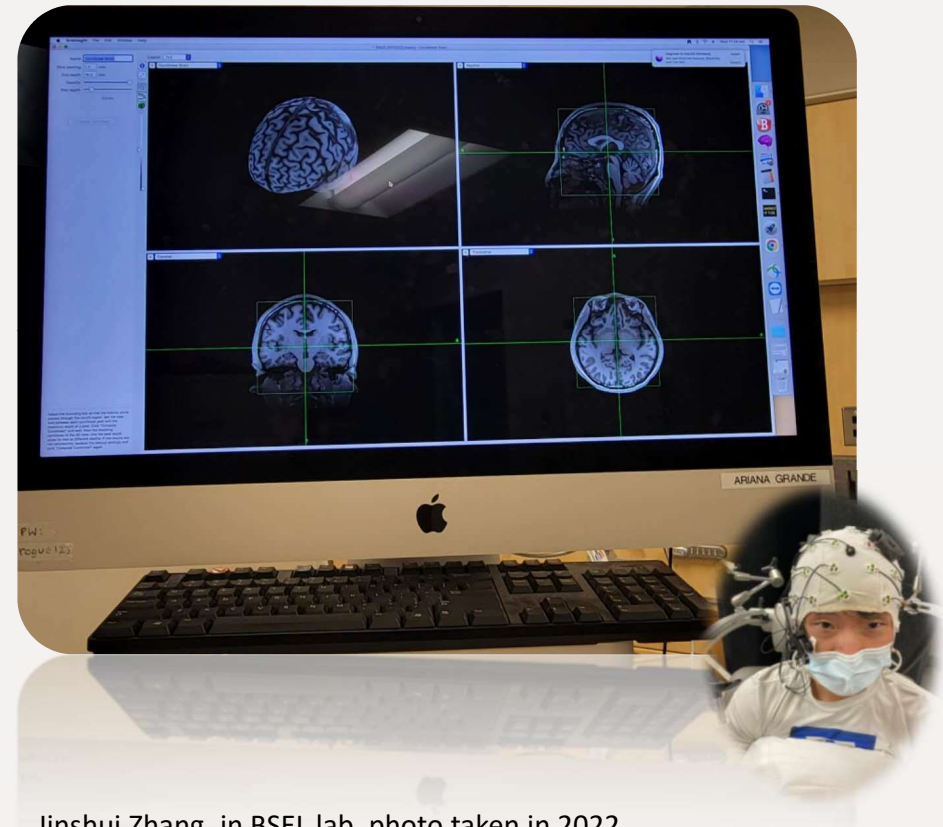
Pulse Intensity

Pulse Shape

Coil Shape

Coil Location

... ..



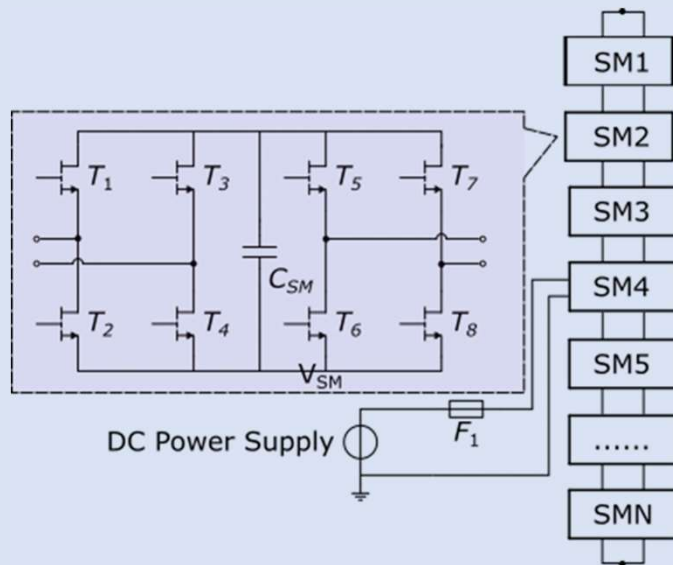
Jinshui Zhang, in BSEL lab, photo taken in 2022.

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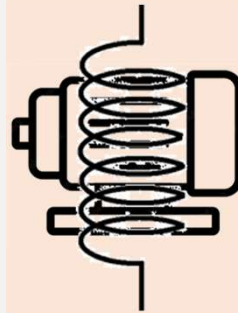
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Take off the coil, grab a motor..... Bang! An Electric Vehicle!

Power Converter



Load



Mechanical engineering professor Josiah Knight, standing, with neuroscientists Angel Peterchev and Stefan Goetz on right.

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