TMS (Transcranial Magnetic Stimulation)

- A changing magnetic field induces electric currents in the brain, causing depolarization of cellular membranes and thereby neuronal activation!

MEG: measure magnetic field
TMS: administer magnetic field.
Neuronal activity caused by TMS and recorded by high resolution EEG.

TMS (Transcranial Magnetic Stimulation)

- (Cognitive) neuroscience generally involves correlational reasoning: e.g. delay in reaction time correlates with increased activity in an area
- TMS allows for causal reasoning!
- TMS works best for the motor cortex (e.g. it is apparently pretty easy to make a person’s thumb twitch..)
- It’s usefulness for cognitive neuroscience is still highly debated.

• What is the role of Broca’s area?
  – Articulatory deficit (remember the early days…)?
  – Lexical access problem?
  – Syntax?

• Administer TMS to Broca’s area
  (F3op (pars opercularis, BA 44) / F3t (pars triangularis, BA 45)).

• By “zapping” Broca’s area, can we selectively improve syntactic performance?
• First: determine the position of Broca’s area and left middle frontal gyrus for each subject individually.

• Design

Session 1:
Syntactic decisions with TMS to Broca’s area vs. without.
At  
0ms
150ms
350ms after verb.
Grammatical or not?

Session 2:
Semantic decisions with TMS to Broca’s area vs. without.
At  
0ms
150ms
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Anomalous or not?

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T = 0 ms
All. n.s.

T = 150 ms
Syntactic priming

T = 350 ms
All n.s.

Figure 3. Selective Priming Effects of TMS on Syntactic Processing at the Left F3op/F3st
ΔRT (mean and standard error across subjects) indicates the change of RTs (Real – Sham) elicited by the TMS. Each bar denotes ΔRT for either normal (N) or anomalous (A) sentences. TMS was delivered at one of three time points: 0 ms (A), 150 ms (B), and 350 ms (C) from the presentation of a verb. *p < 0.05, **p < 0.01 (t-test, n = 6).

• Is this caused by zapping Broca’s area or just by zapping?

• To determine this, syntactic judgments were made while the left middle frontal gyrus (F2, ~39 mm away from Broca’s area) was zapped.
  – TMS was administered only at 150ms.

Figure 4. The Absence of TMS Effects on the Language Tasks at the Left F2
Each bar denotes ΔRT for either N or A sentences. TMS was delivered at 150 ms from the presentation of a verb.