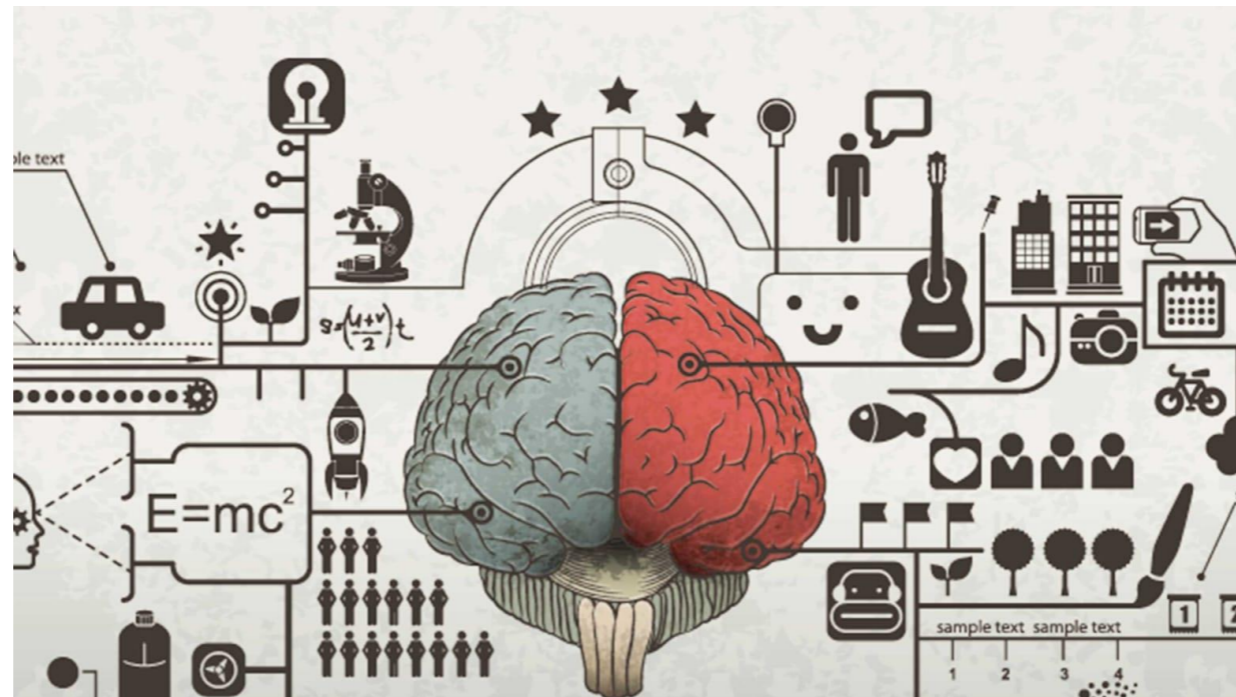


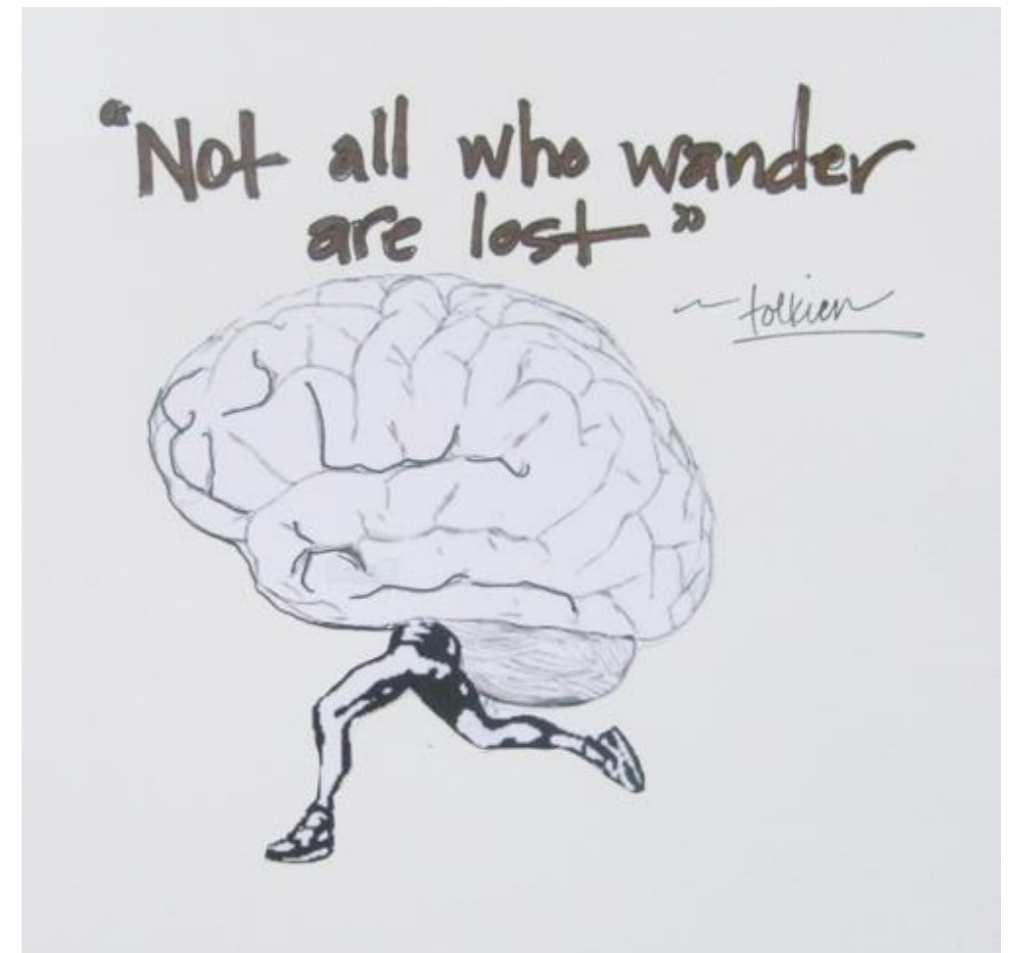
For a minute there, I lost myself... dosage dependent increases in mind wandering with prefrontal tDCS

Hannah Filmer, Ashleigh Griffin, Leo-Henry Marcus, & Paul Dux



Mind wandering

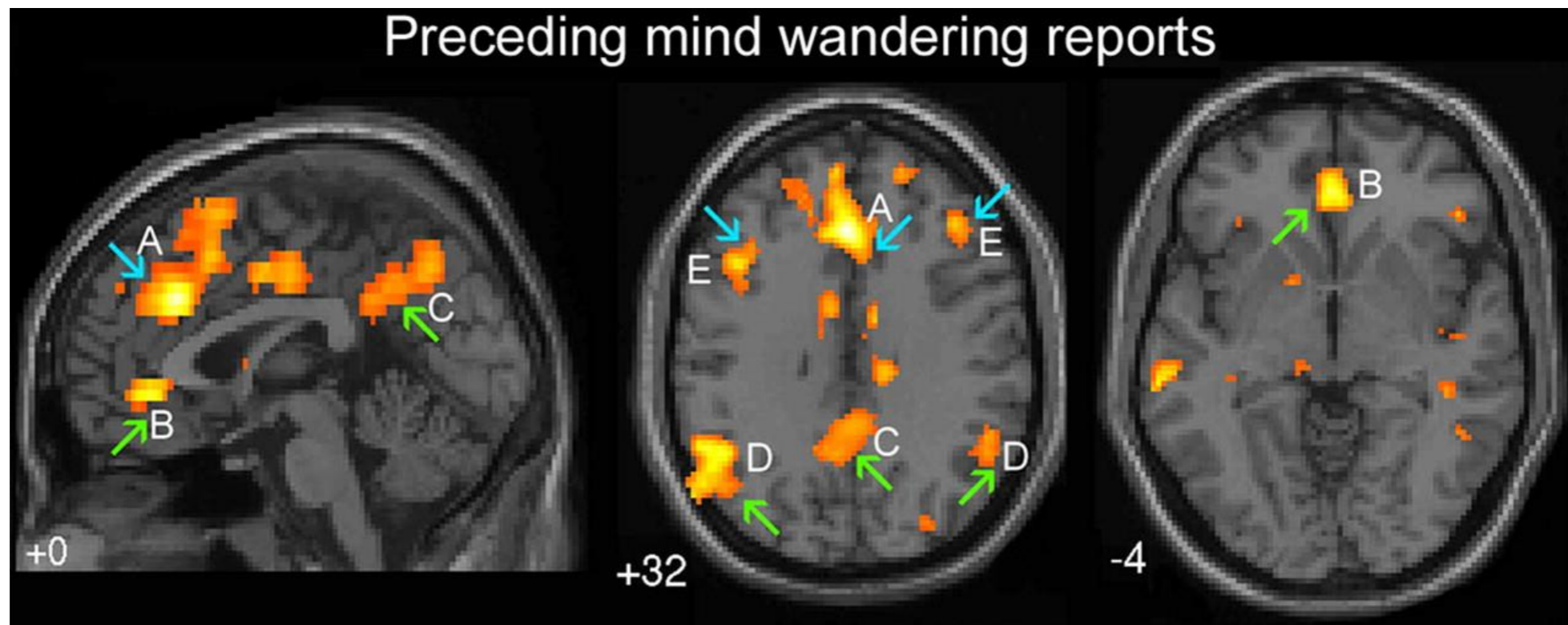
- The shifting of our attention to an internal state
- Lapses in concentration can have negative outcomes
- Often occurs without awareness or intention
- Frequent - possibly as much as 50% of time



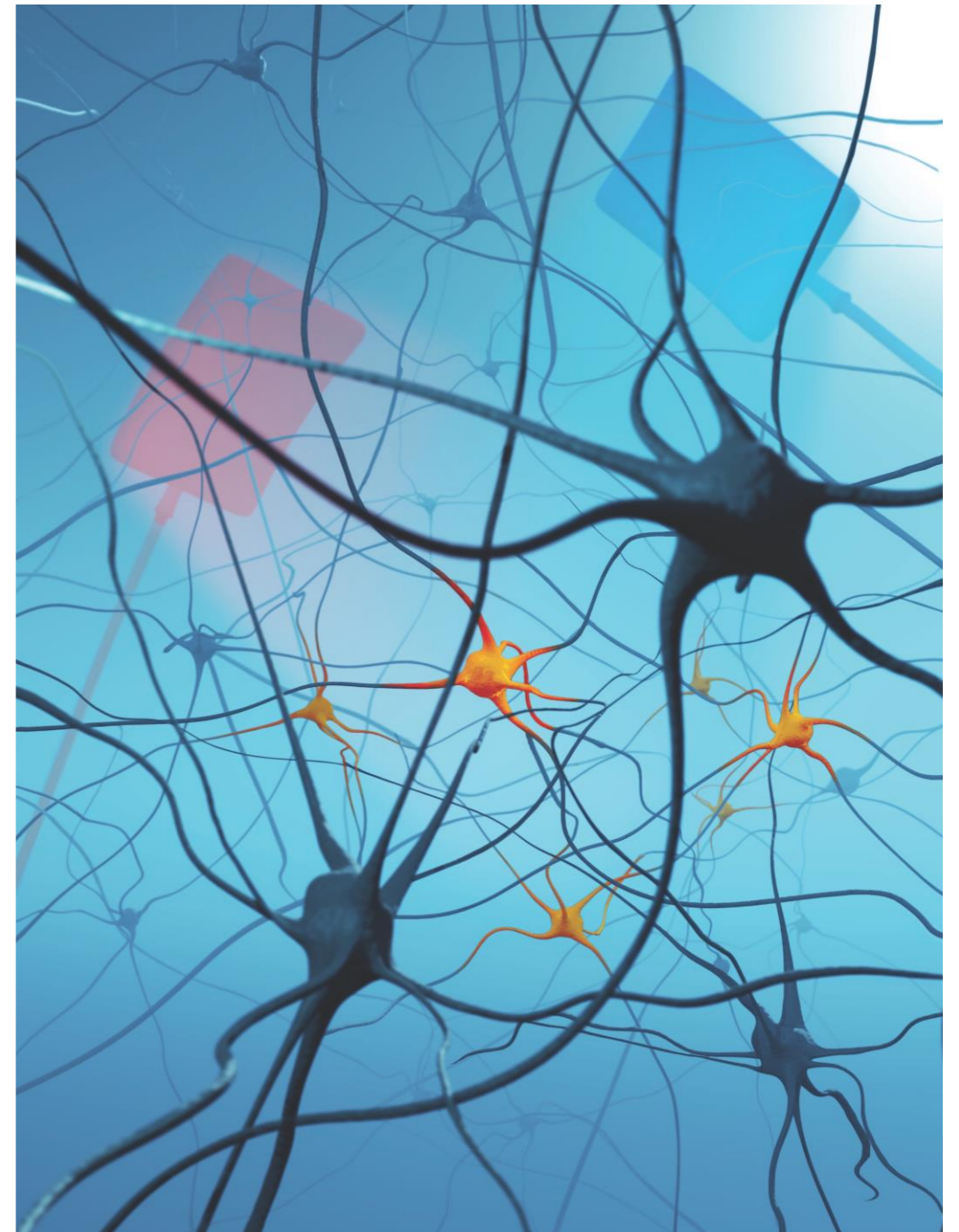
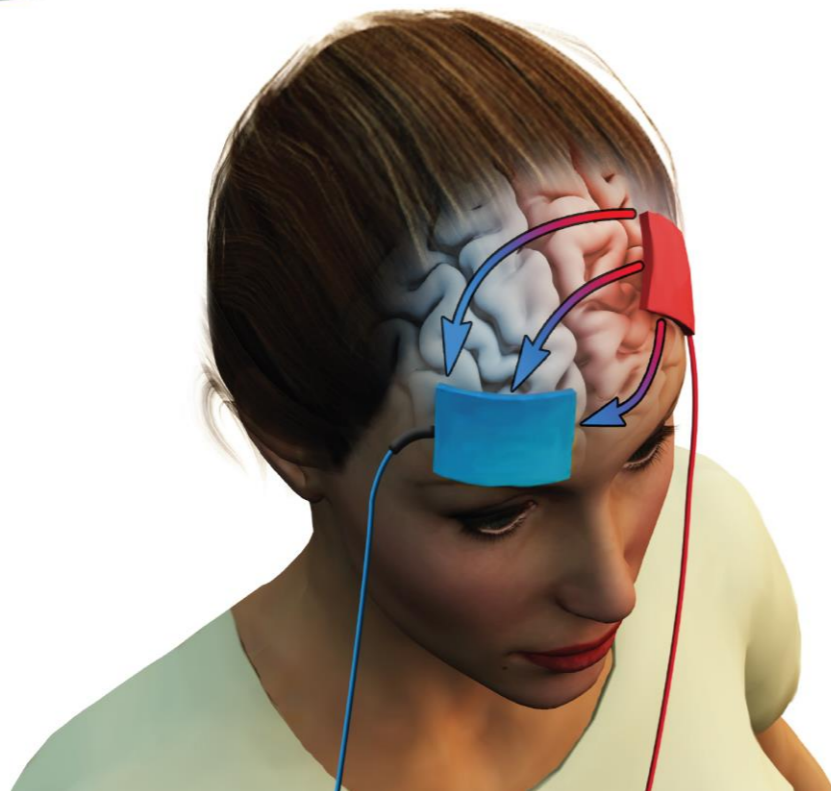
Overview

- Network of regions in mind wandering
- Causal approaches
- Dosage and polarity brain stimulation
- Role of stimulation polarity and dosage in modulating mind wandering
 - Two pre-registered studies
 - Large samples (150 subjects in each)

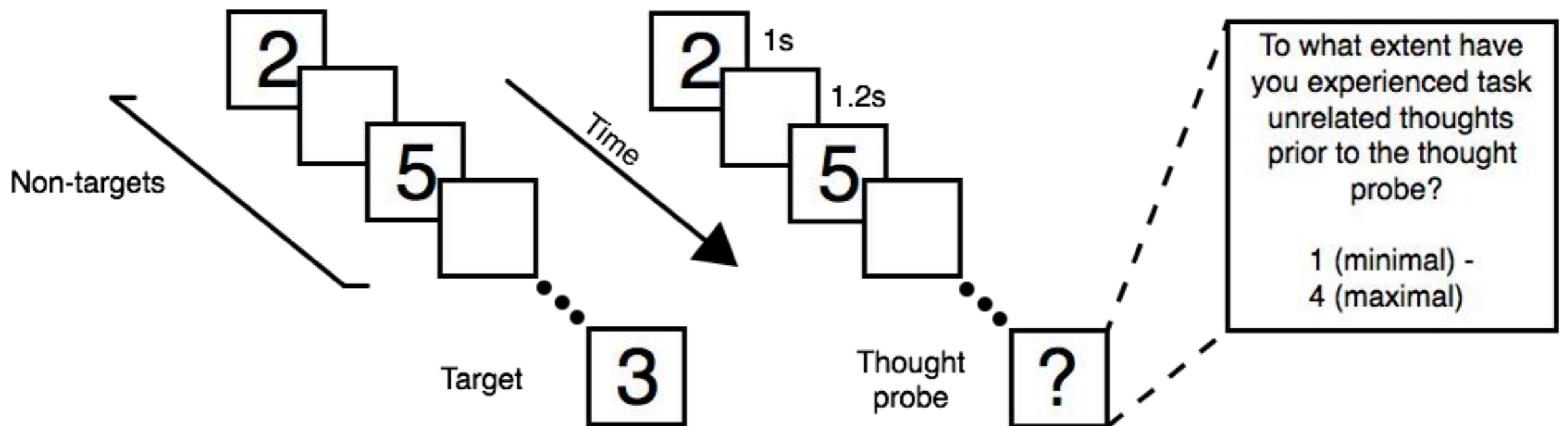
Imaging mind wandering fMRI



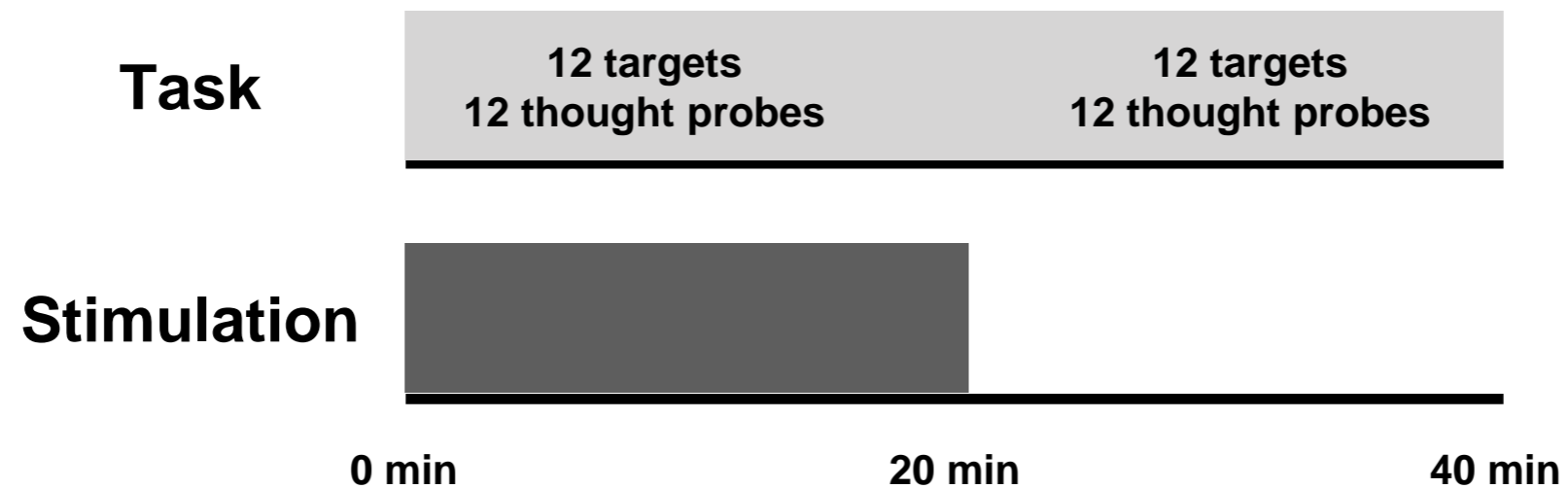
Transcranial Direct Current Stimulation



Modulating mind wandering with tDCS

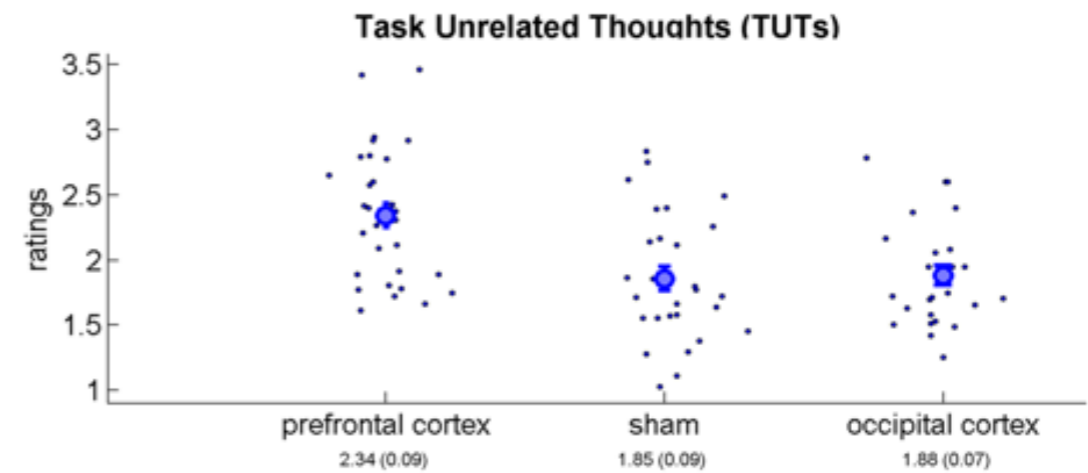
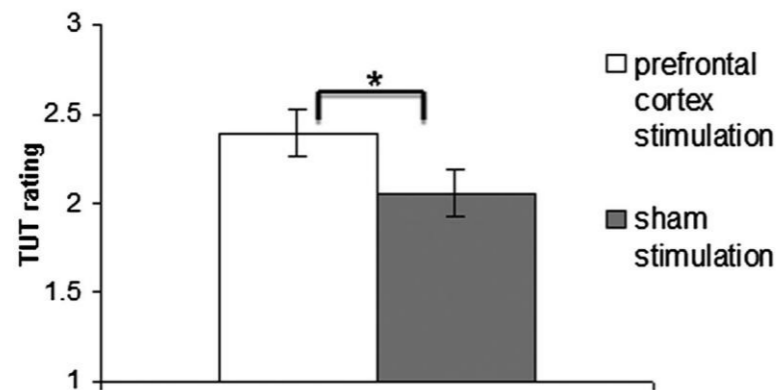


Modulating mind wandering with tDCS

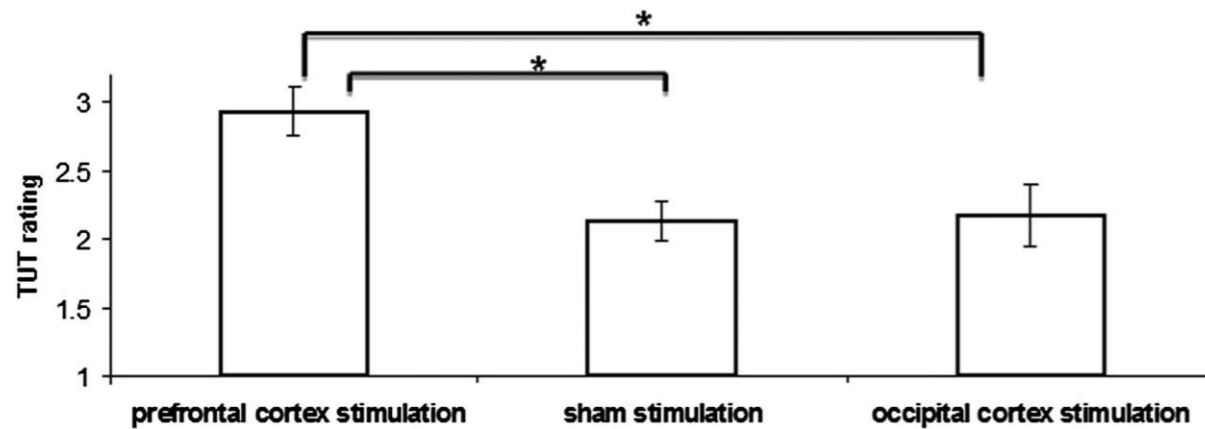


Modulating mind wandering with tDCS

**Experiment 1:
Task unrelated thoughts (TUT)**

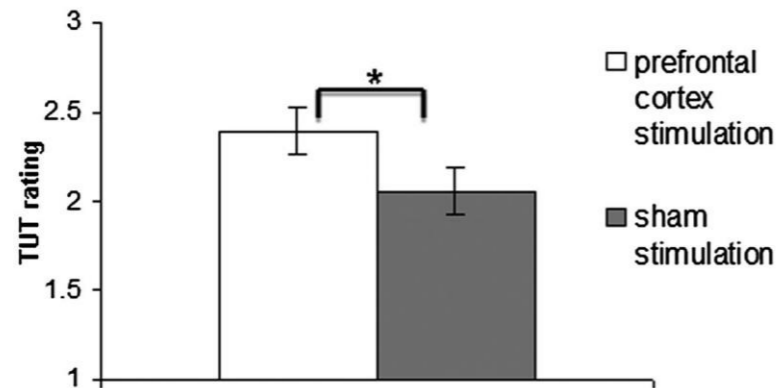


**Experiment 2:
Task unrelated thoughts (TUT)**

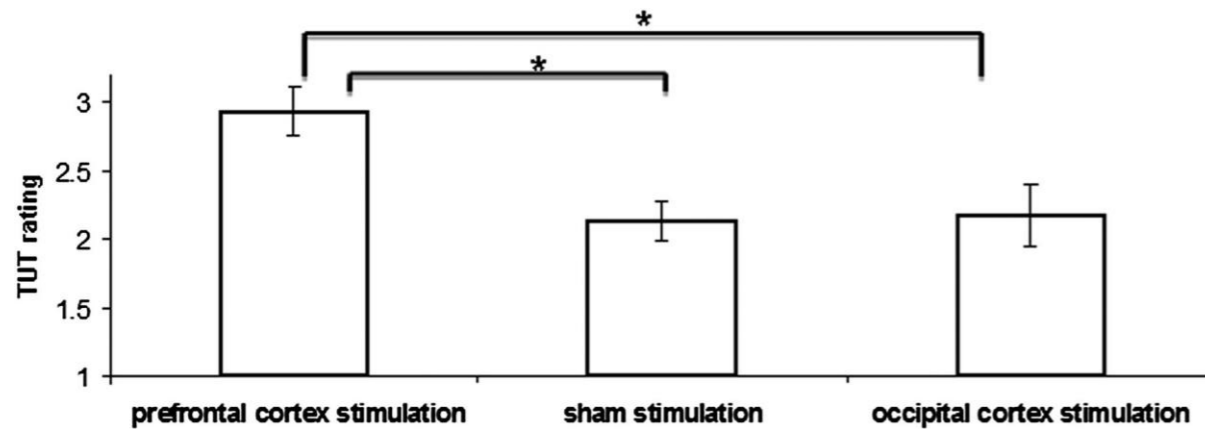


Modulating mind wandering with tDCS

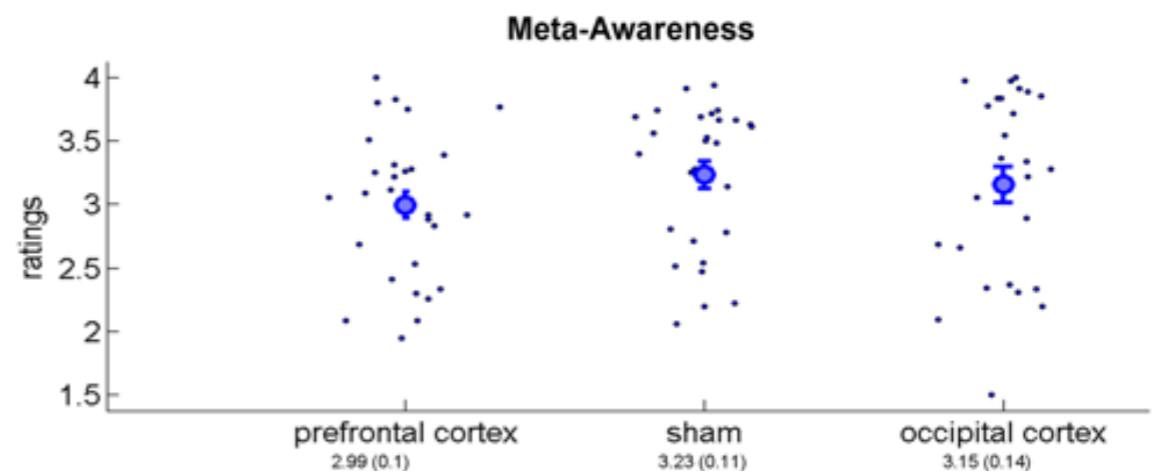
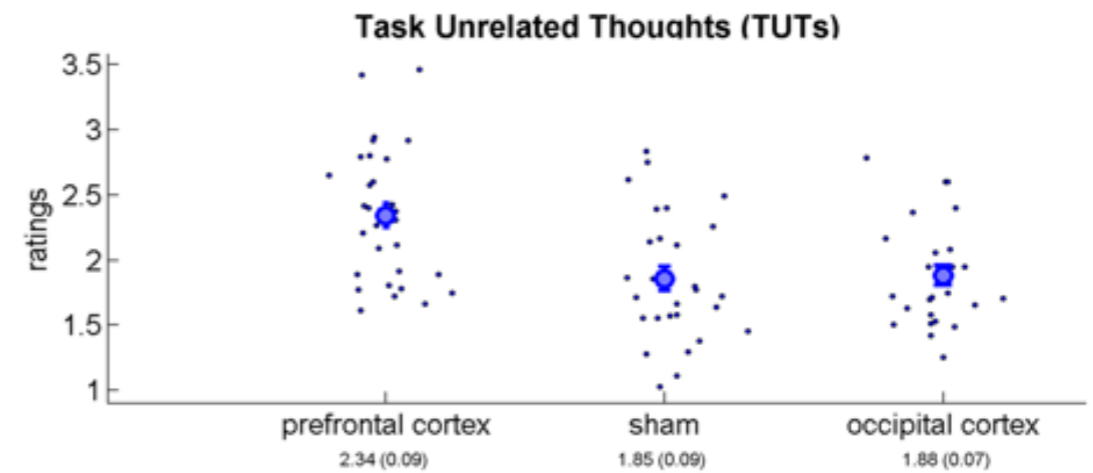
**Experiment 1:
Task unrelated thoughts (TUT)**



**Experiment 2:
Task unrelated thoughts (TUT)**



Axelrod et al., 2015, PNAS



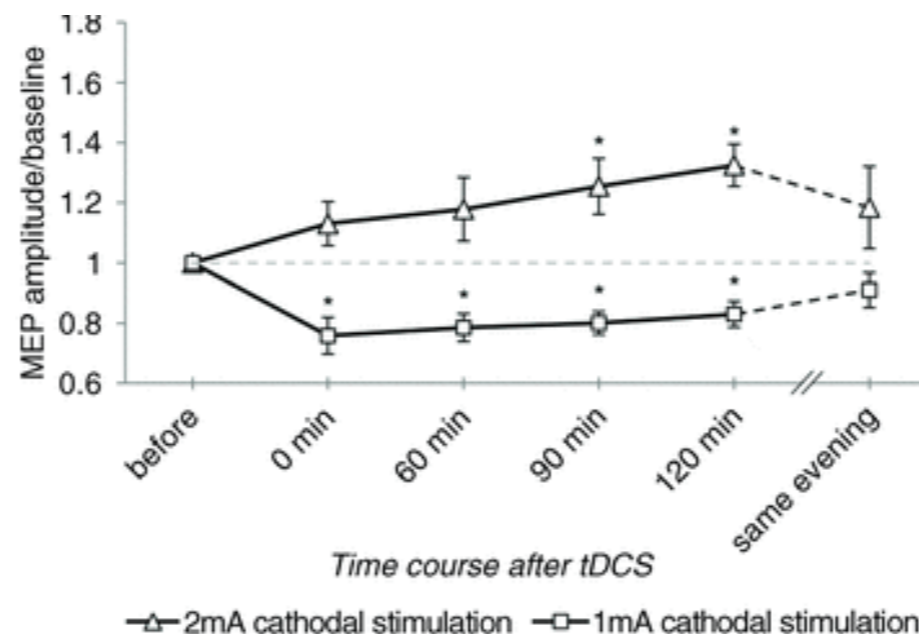
Axelrod et al., 2018, Scientific Reports

Modulating mind wandering with tDCS

- Targeting the prefrontal and parietal cortex simultaneously can decrease mind wandering

Stimulation dosage?

- Previous mind wandering papers used a standard dosage of 1-1.5 mA, with 5 x 7 cm electrodes
- But dosage of stimulation could be important, and not necessarily in a linear fashion

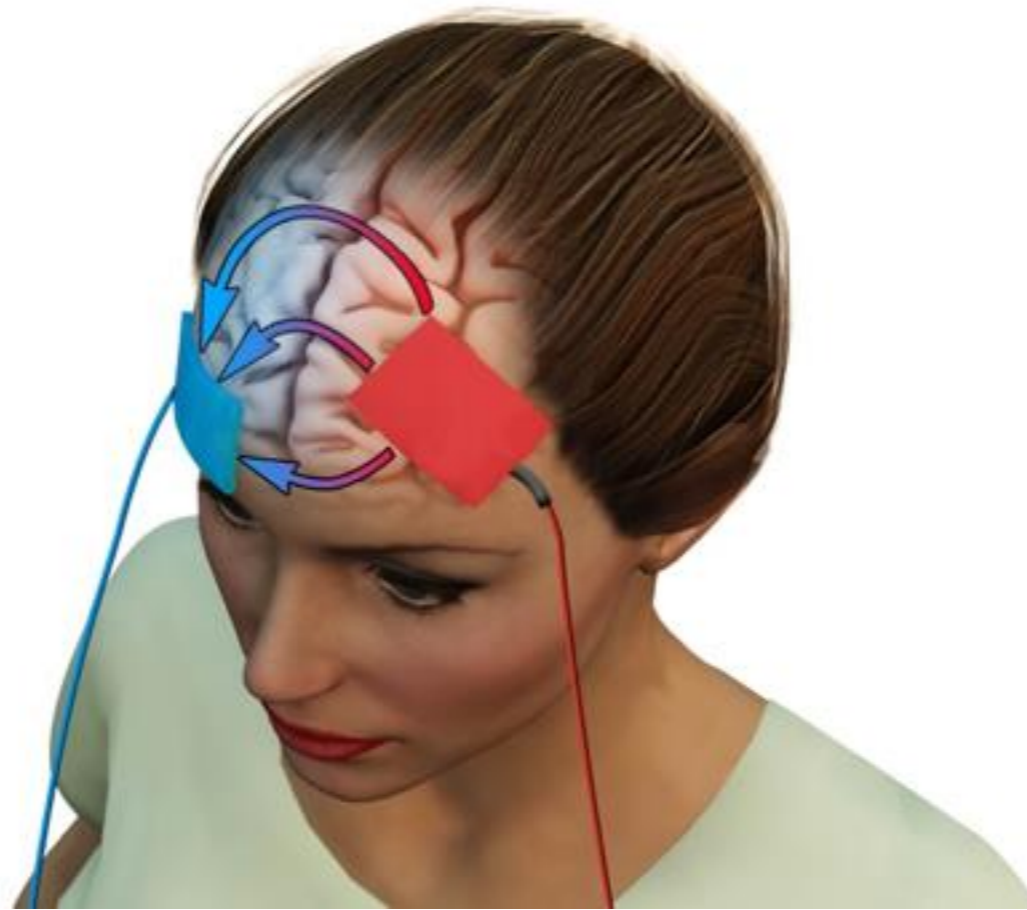


Is there an effect of stimulation polarity on mind wandering?

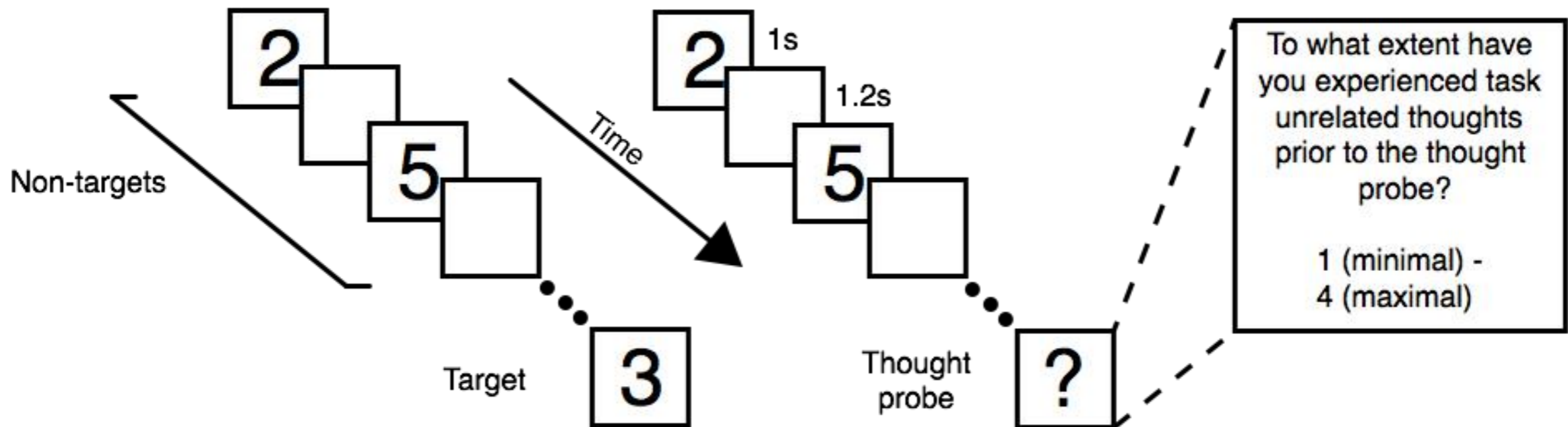
How do any modulations to mind wandering interact with dosage of stimulation?

What happens if the prefrontal AND parietal cortices are targeted simultaneously?

Experiment 1 - the prefrontal cortex



Task design



Session overview

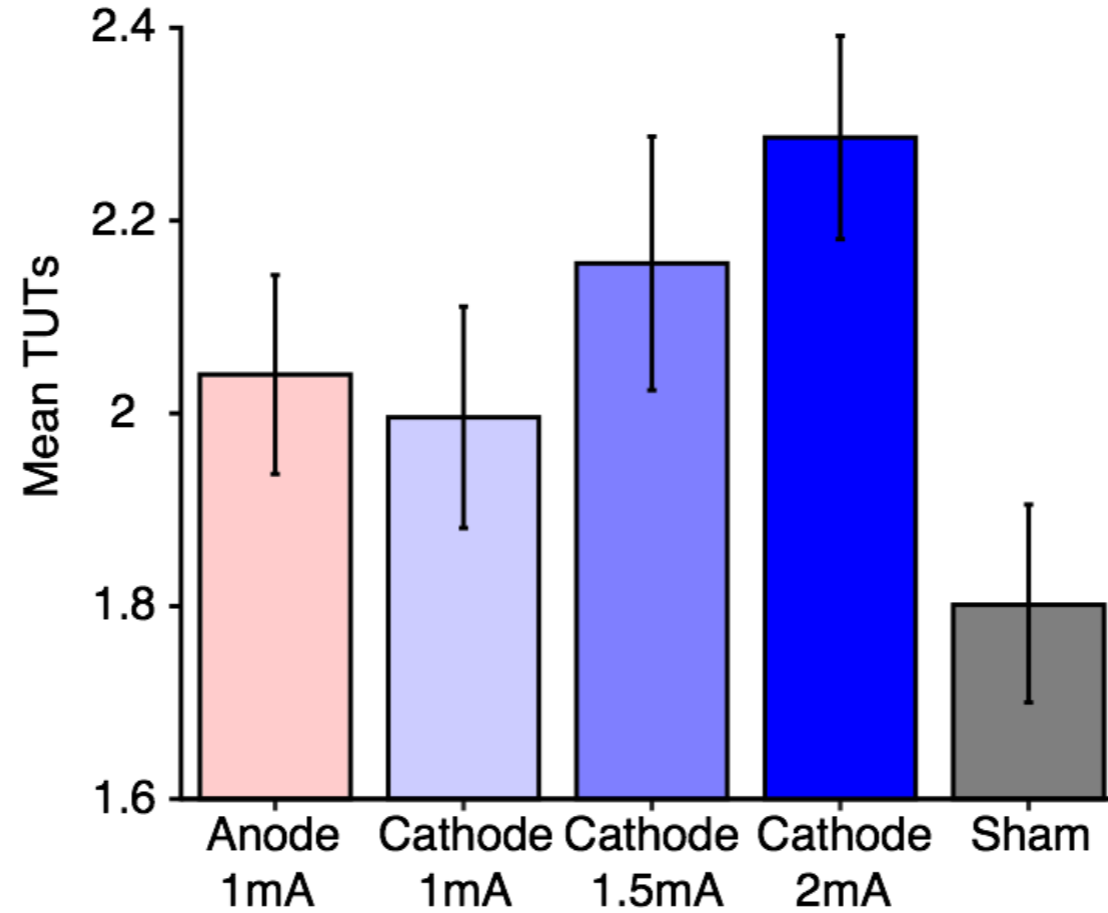
- Practice a target and a TUT trial
- Stimulate
- Complete task (~ 40 mins)

Stimulation & groups

- Offline stimulation, 20 mins, electrodes 5 x 5 cm
- Five groups (30 subjects per group):
 - Anodal, 1mA
 - Cathodal, 1mA
 - Cathodal, 1.5mA
 - Cathodal, 2mA
 - Sham



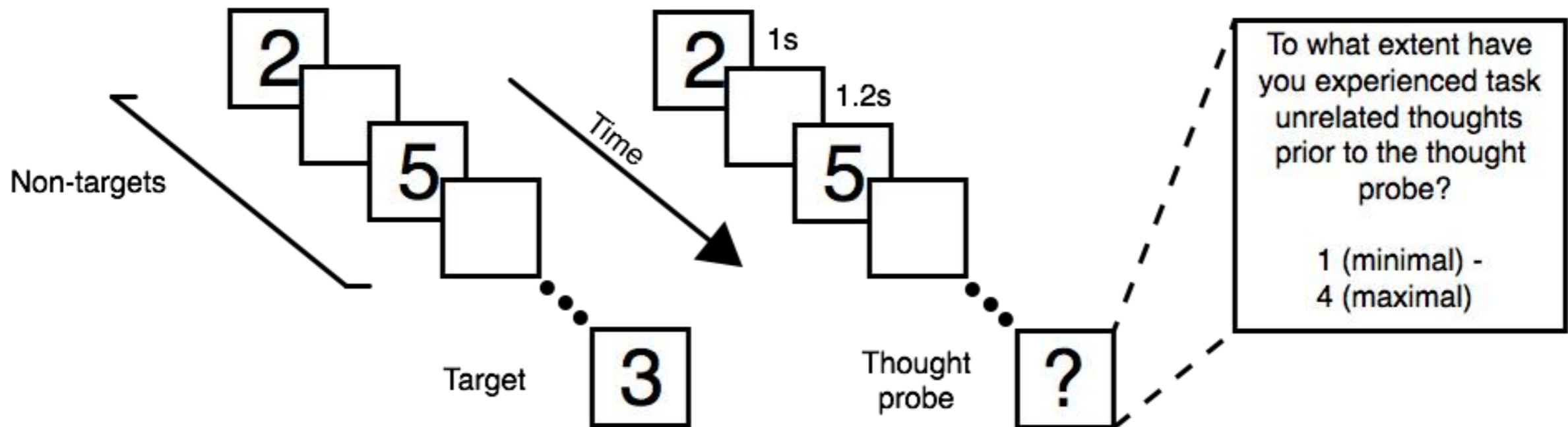
Mean TUT ratings



Experiment 2 - combined prefrontal and parietal stimulation



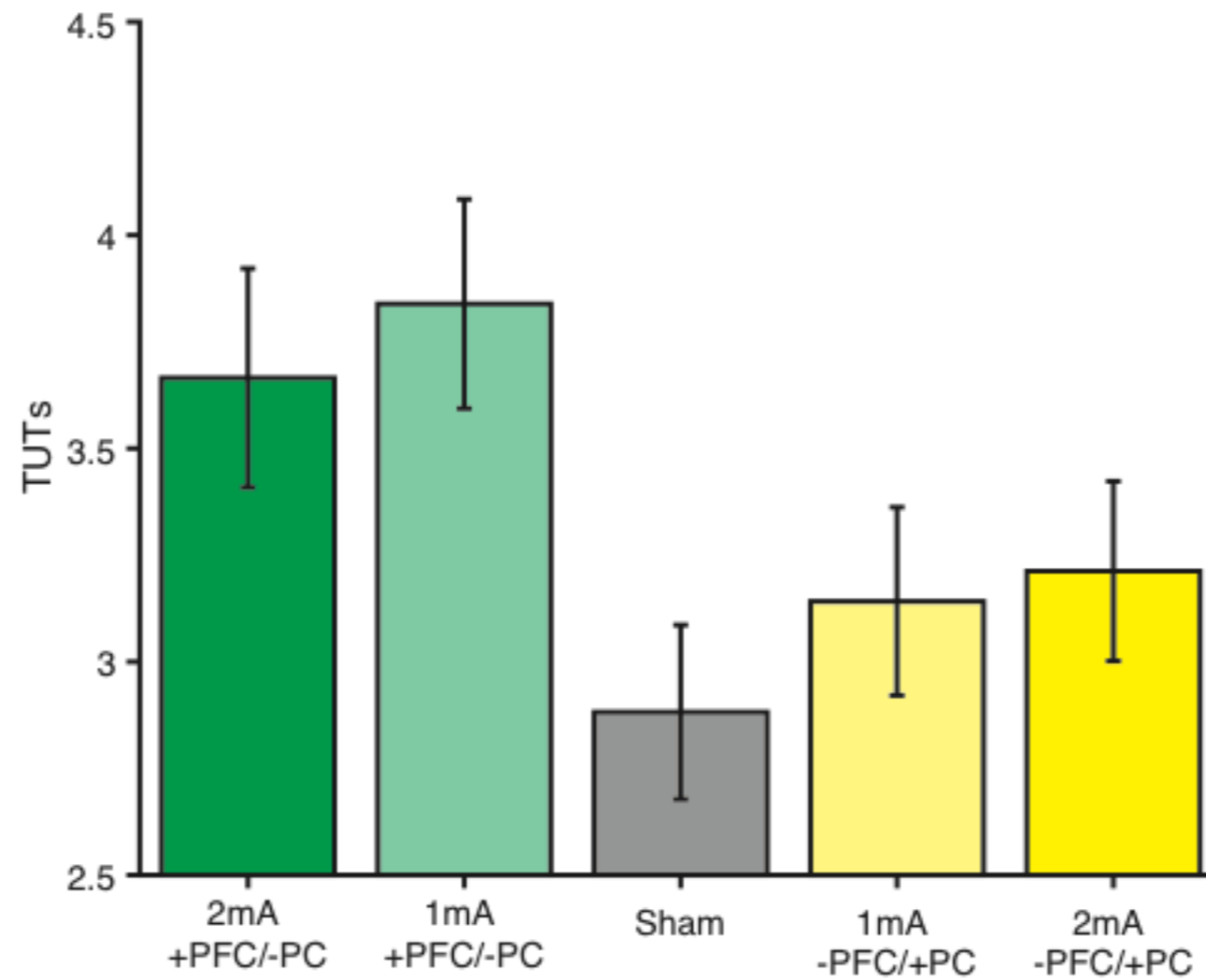
Task design



Design

- Identical to Experiment 1, with two differences:
 - The rating scale was increased to 1-7 (previously 1-4)
 - The groups were as follows:
 - 1mA anodal prefrontal, cathodal parietal
 - 2mA anodal prefrontal, cathodal parietal
 - 1mA cathodal prefrontal, anodal parietal
 - 2mA cathodal prefrontal, anodal parietal
 - Sham

Mean TUT ratings



Conclusions

- The dosage effect of stimulation to the prefrontal cortex alone was linear - stronger stimulation led to larger effects
- Cathodal tDCS to the prefrontal Cortex increased mind wandering, but only in the absence of parietal stimulation
- Anodal tDCS to the prefrontal, and cathodal to the parietal cortex, led to an increase in mind wandering that was relatively dose independent