

# Brain Research with People who Stammer

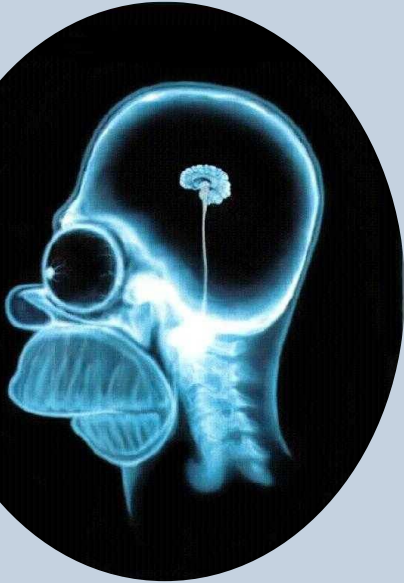
Kate Watkins  
Professor of Cognitive Neuroscience  
Fellow, St. Anne's College



# What I do:

## Brain Scanning

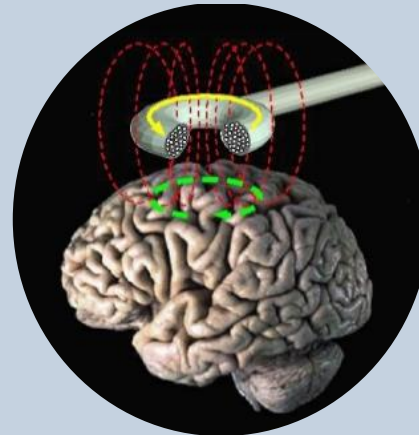
## Brain Stimulation



Structure



Function



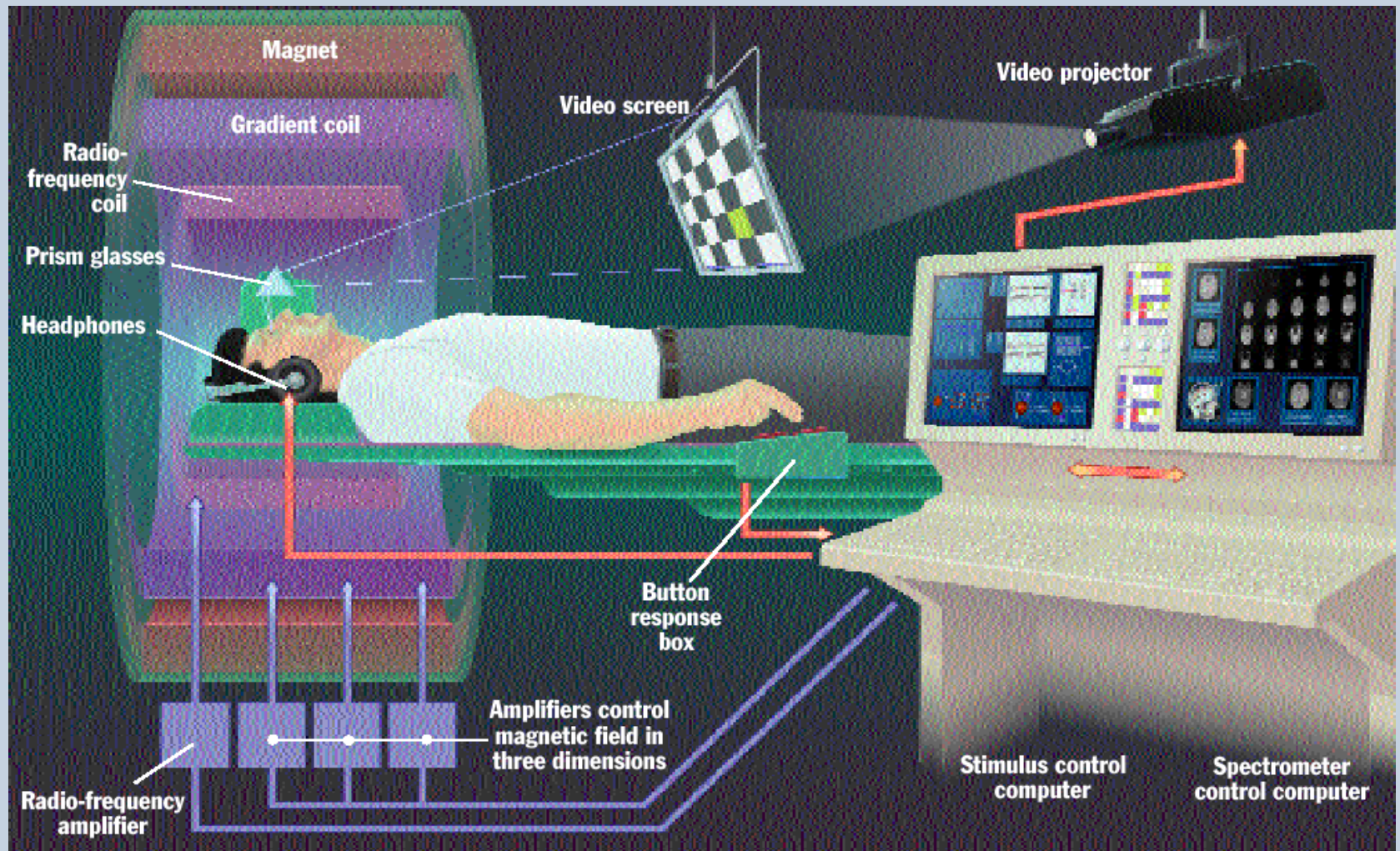
Magnetic



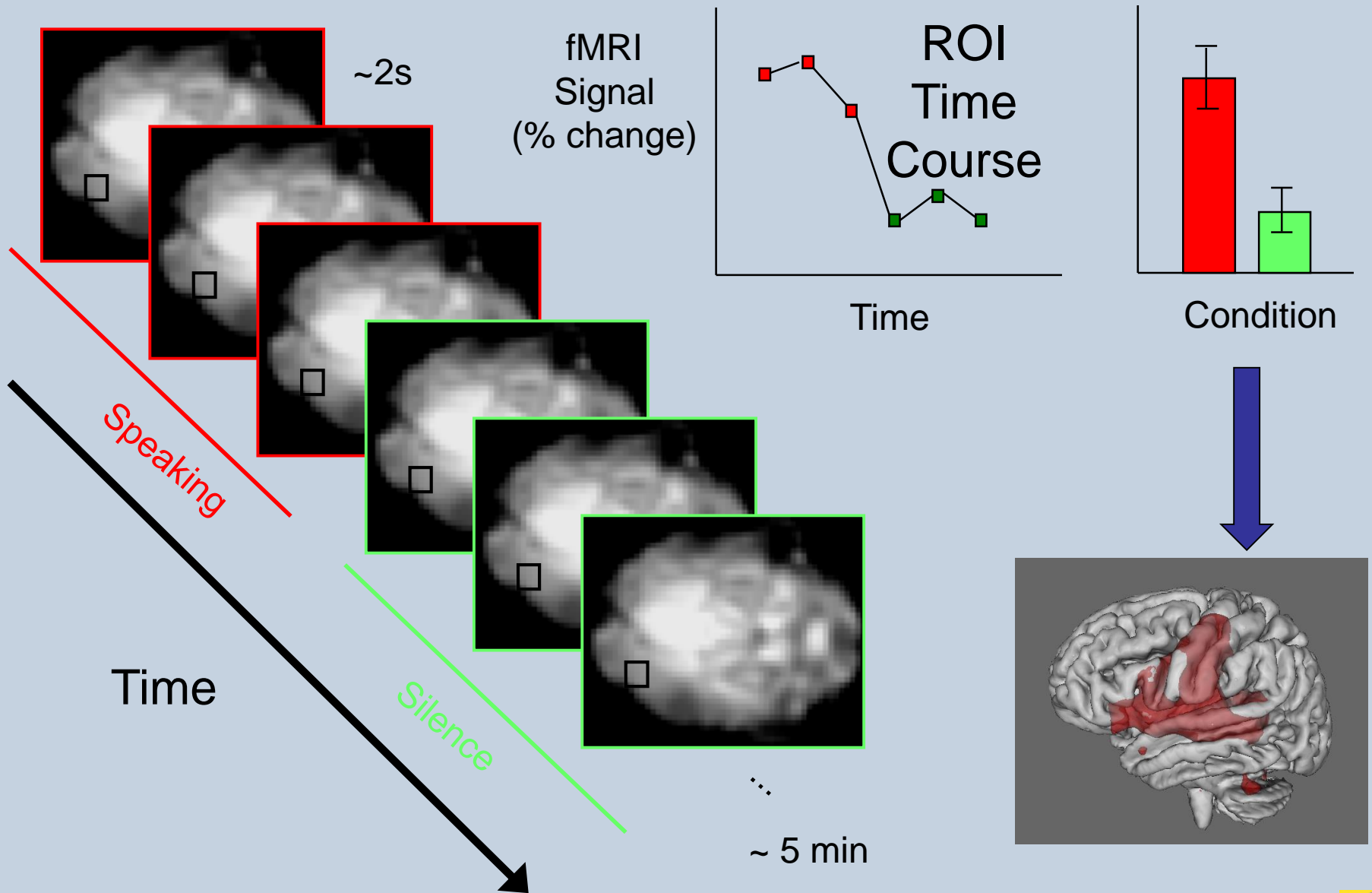
Electric

Methods applied in studies of children and adults who  
Stutter/Stammer, or with Developmental Language Disorder

# Brain Function: functional MRI



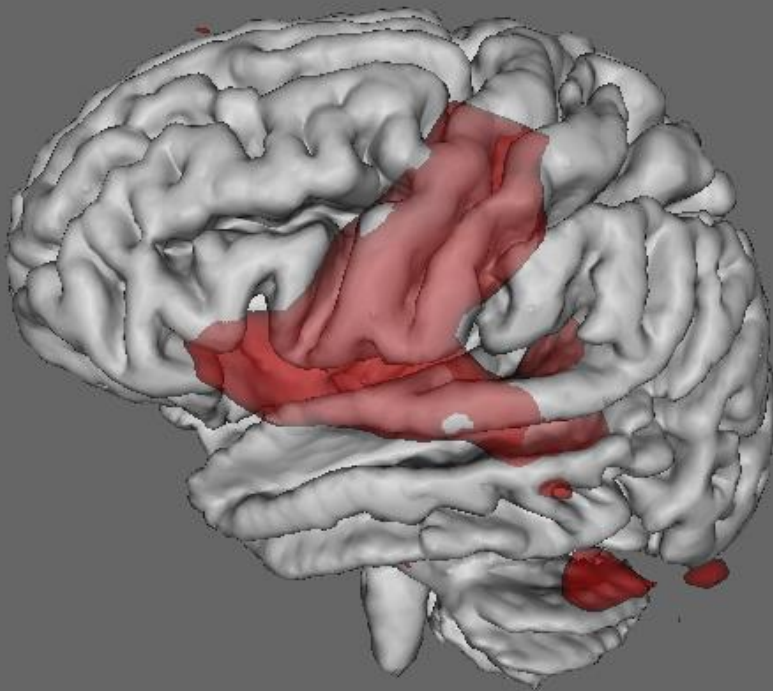
# fMRI – scanning brain activity



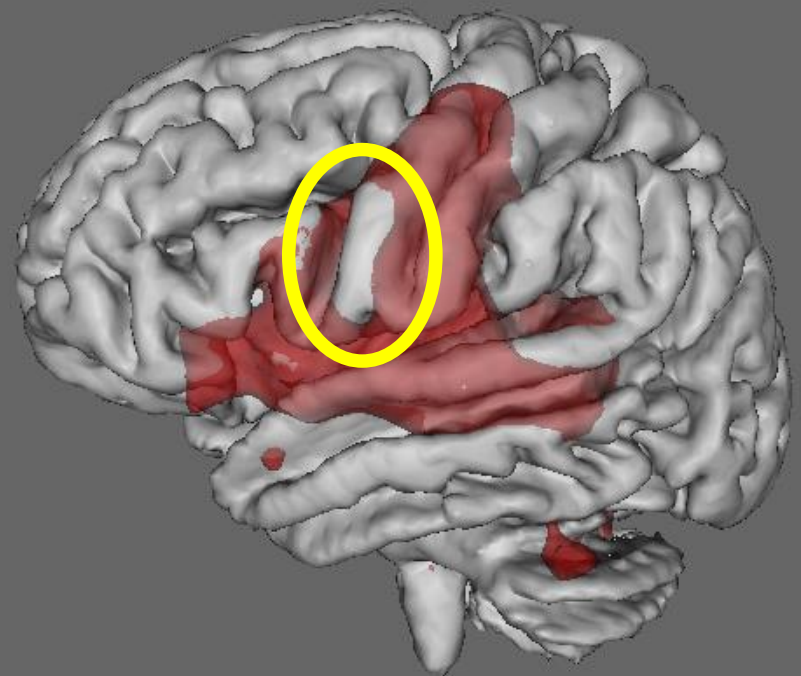


# fMRI scans of people who stammer:

Fluent Speakers

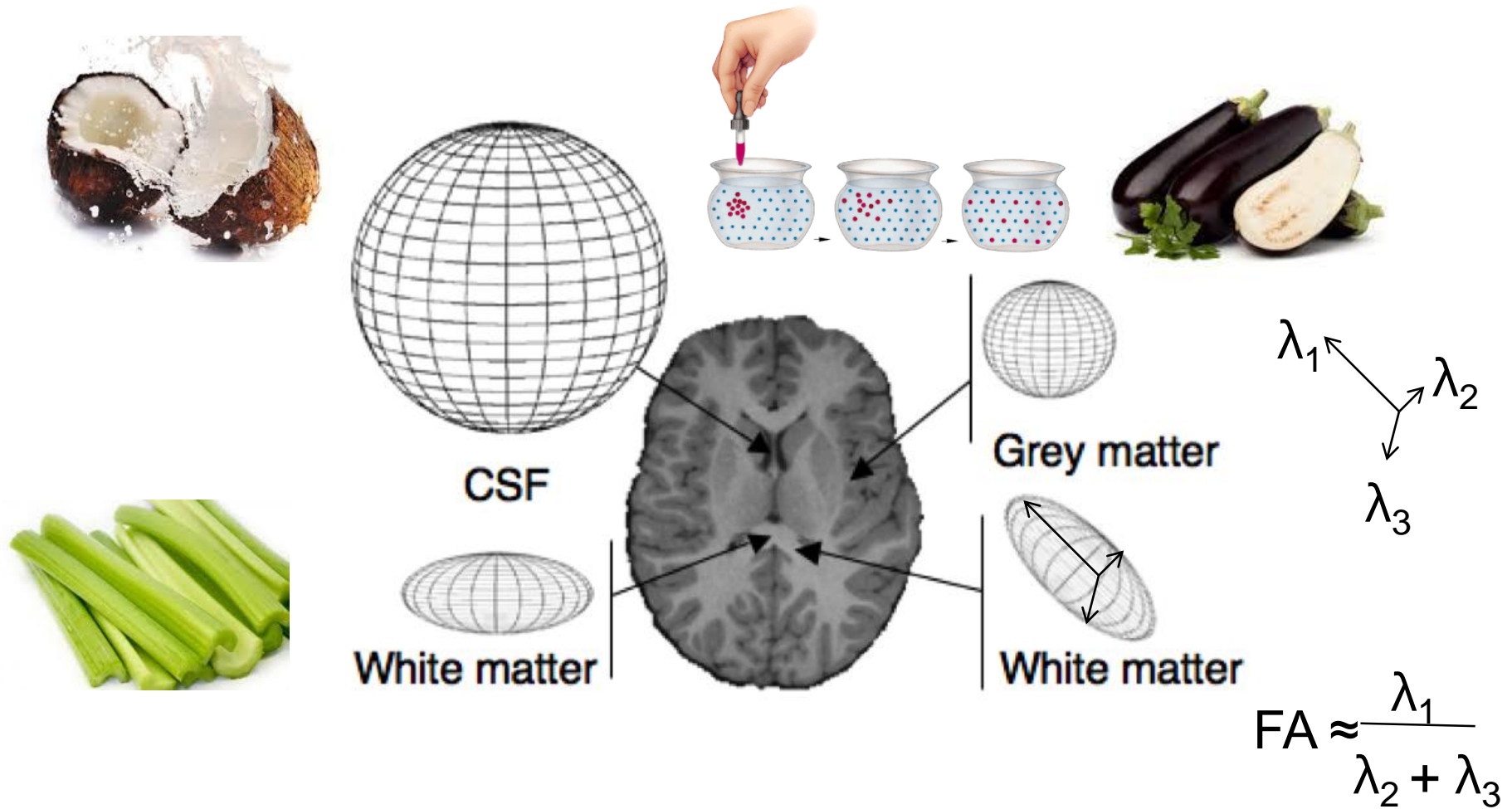


People who stammer



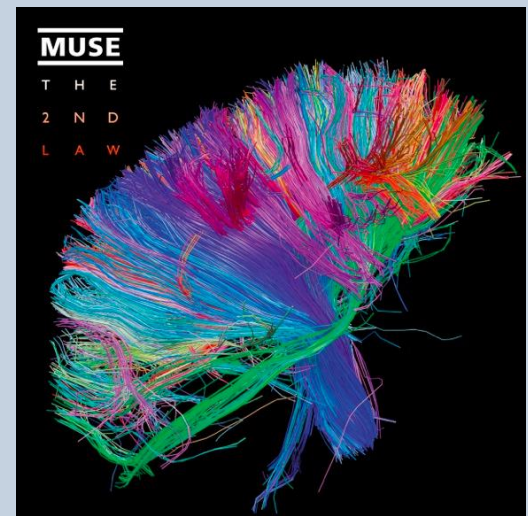
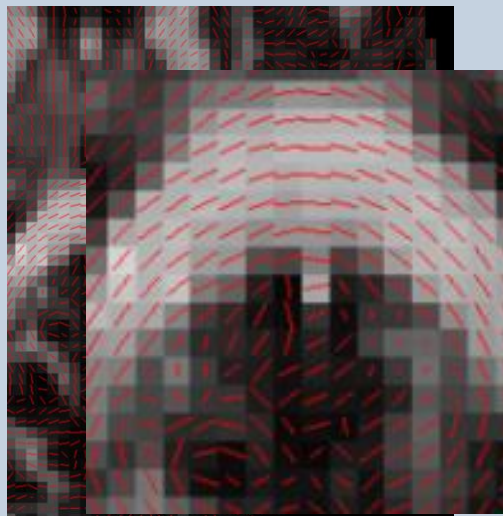
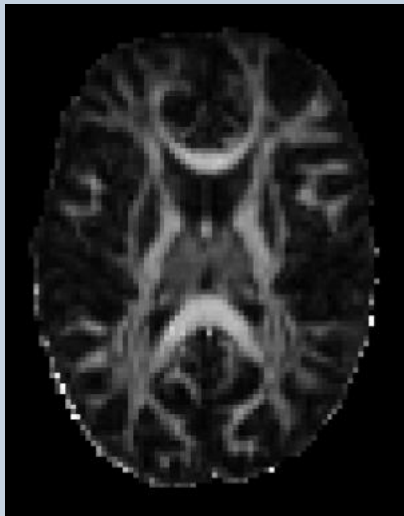
Red = Areas of the brain active when speaking

# White matter structure: Diffusion MRI

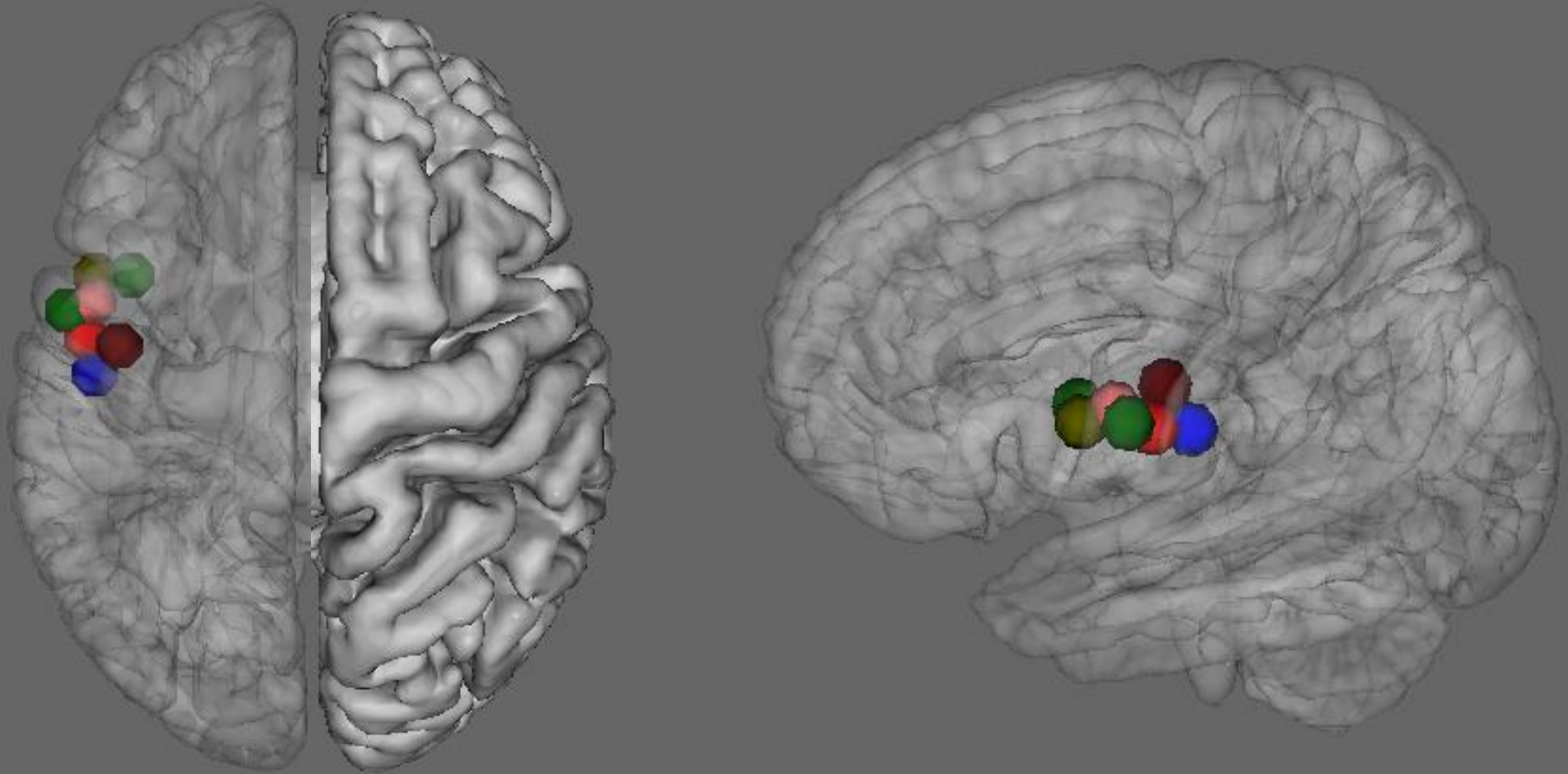


# Diffusion MRI

- Diffusion of water easiest along the long axis of fibres compared with across it
- From measuring diffusion of water in the brain we can infer the predominant direction of fibres

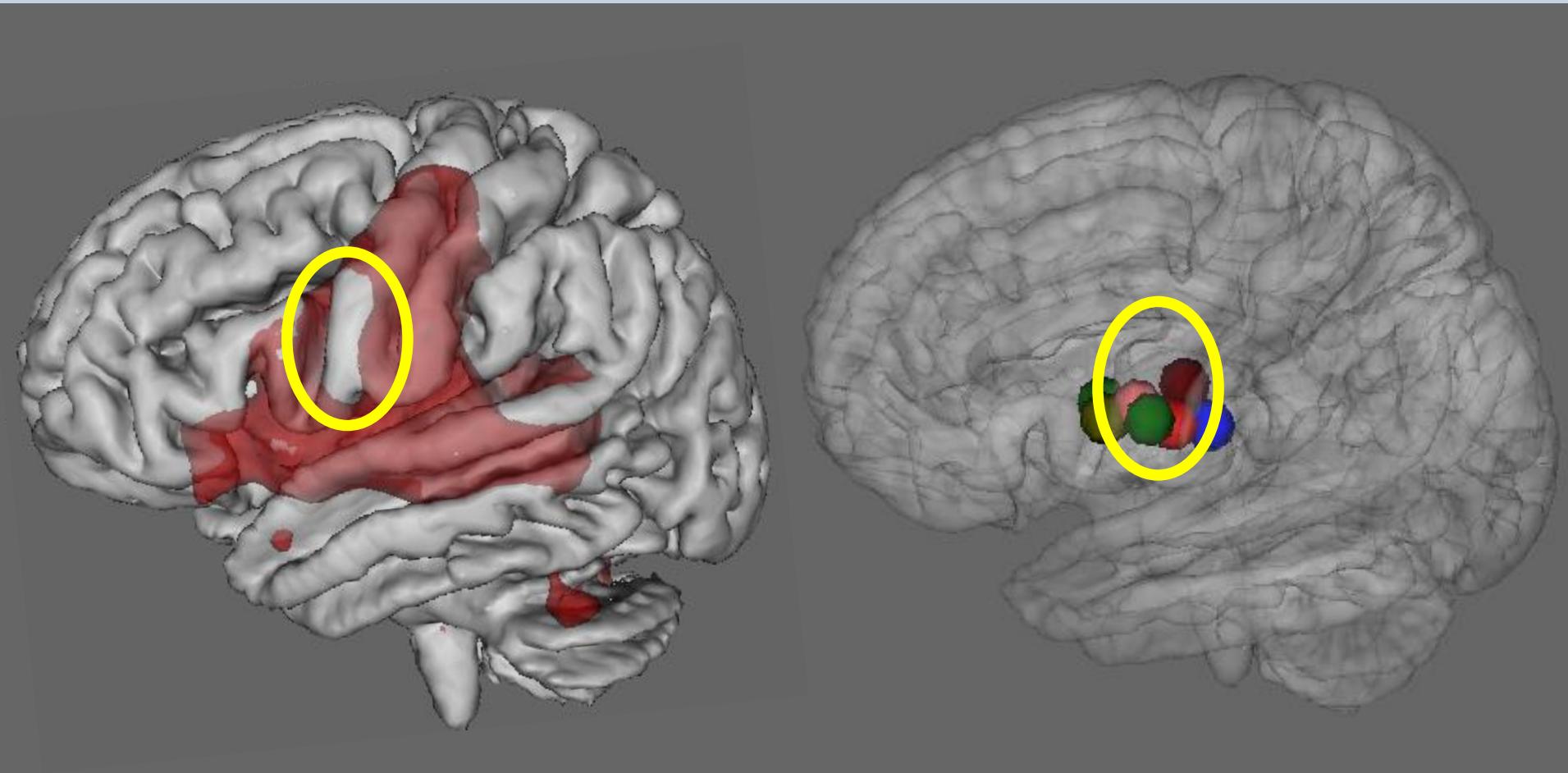


# Weak white matter connections in people who stammer (multiple studies)





# Weak white matter connections in people who stammer (multiple studies)



# Transcranial Direct Current Brain Stimulation (tDCS)

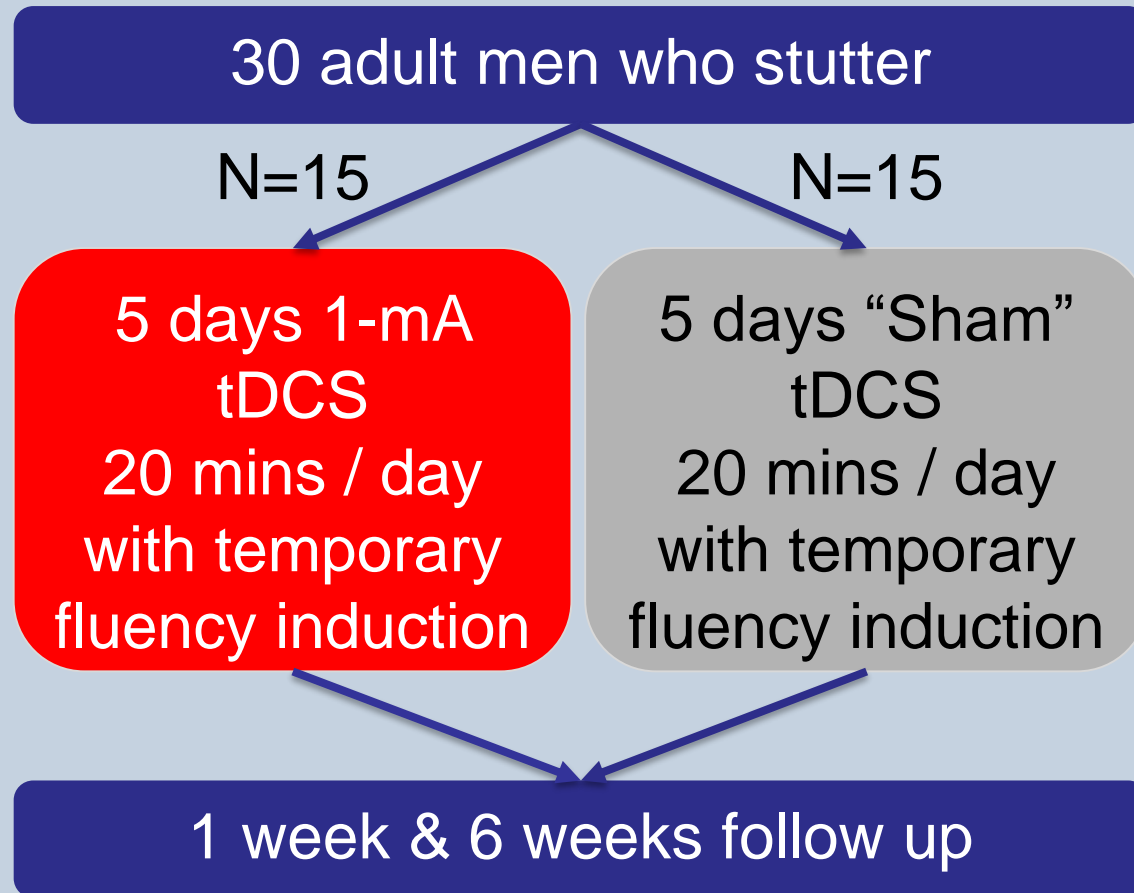


- Noninvasive
- Weak electric current passed between two electrodes placed on the scalp
- Mild tingling might be felt
- (able to control for placebo effects, therefore)
- Cheap, portable, safe
- Effective in combination with a task (therapy/treatment)
- Has no effect on its own

# Randomised Controlled Trial using tDCS

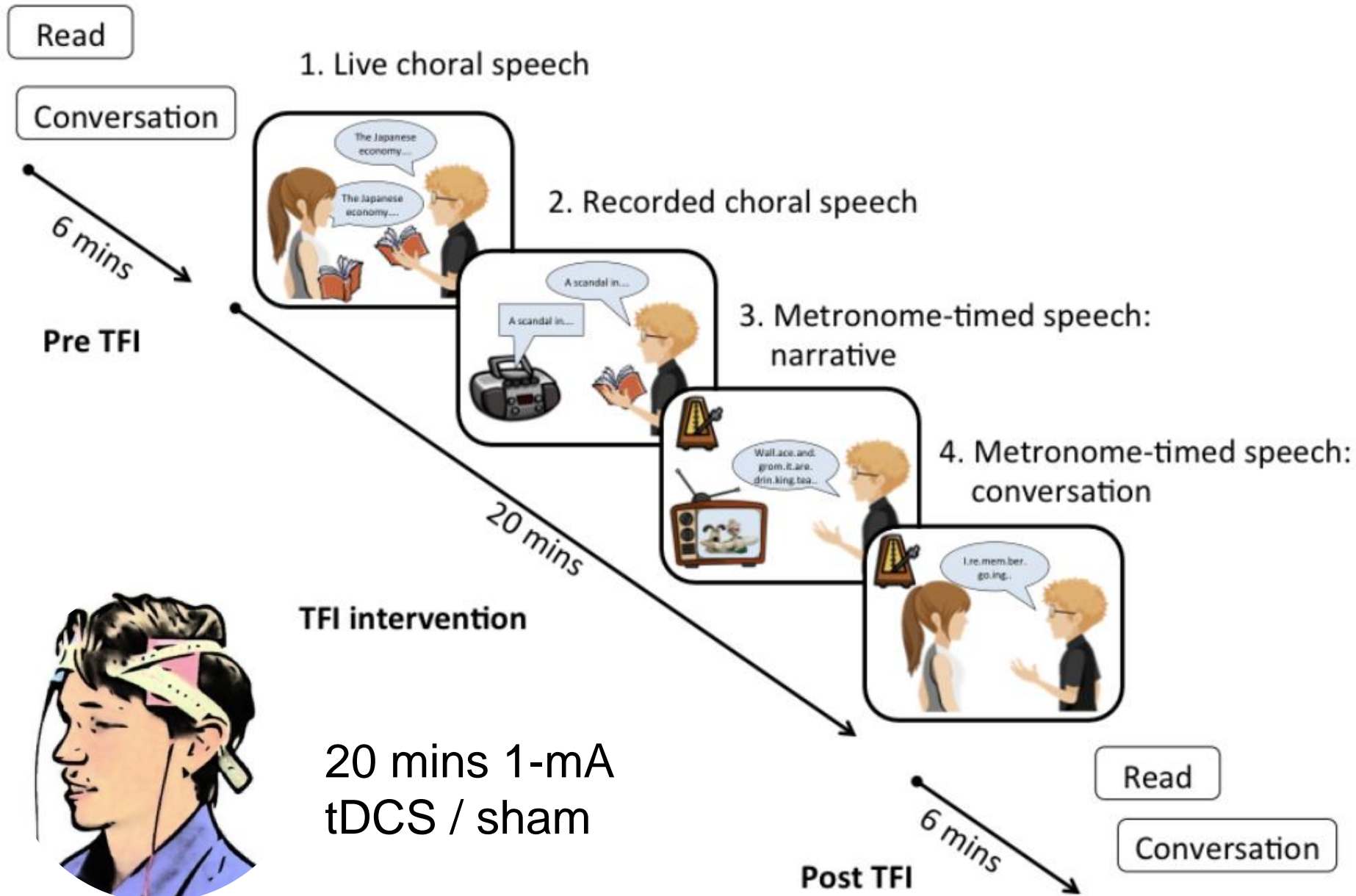


Jen Chesters



Registered with ClinicalTrials.gov number NCT02288598

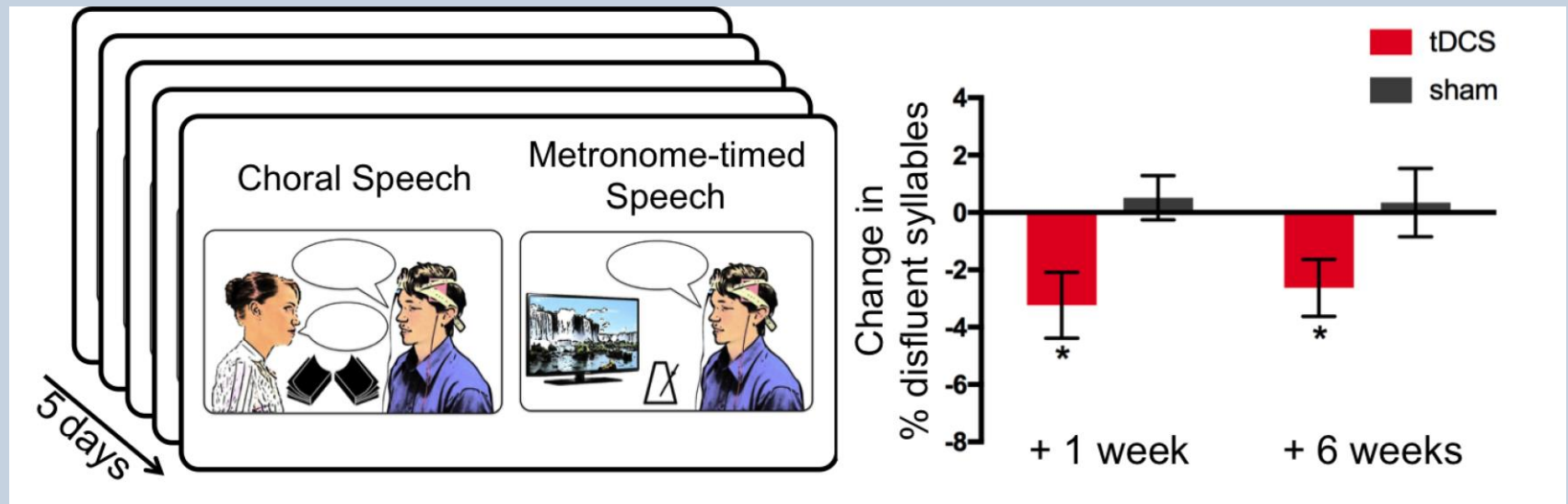
# Temporary Fluency Induction: 5 days





# DID IT WORK????

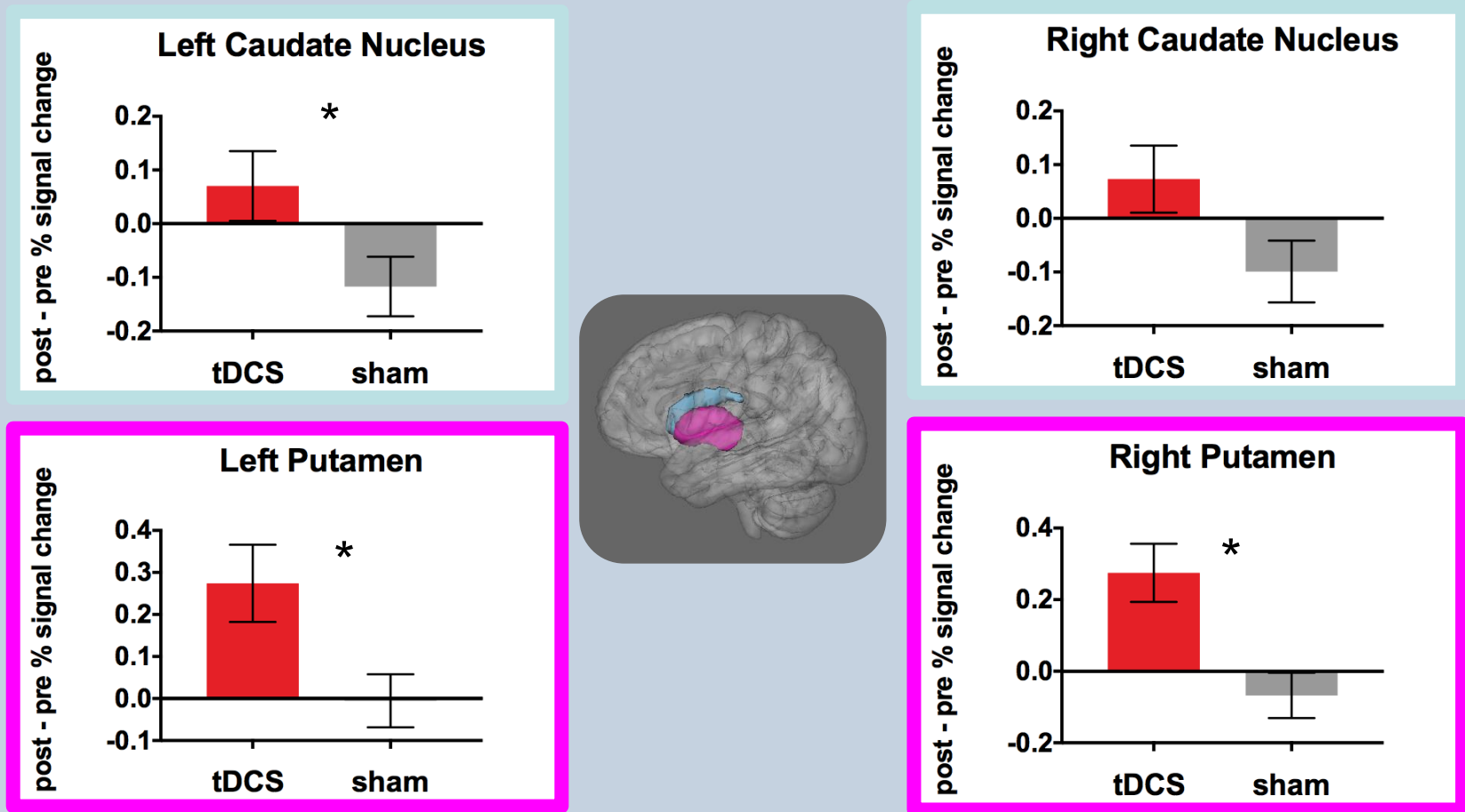
# YES!



Five consecutive days of tDCS with temporary fluency induction can produce longer-lasting improvements to fluency with a reduction of about one third in stuttering symptoms

Chesters, Mottonen & Watkins (2018) *Brain*

# Effects of tDCS on brain activity: changes from pre- to 1-week post-intervention

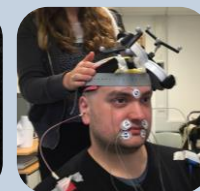
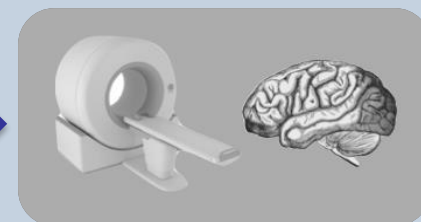
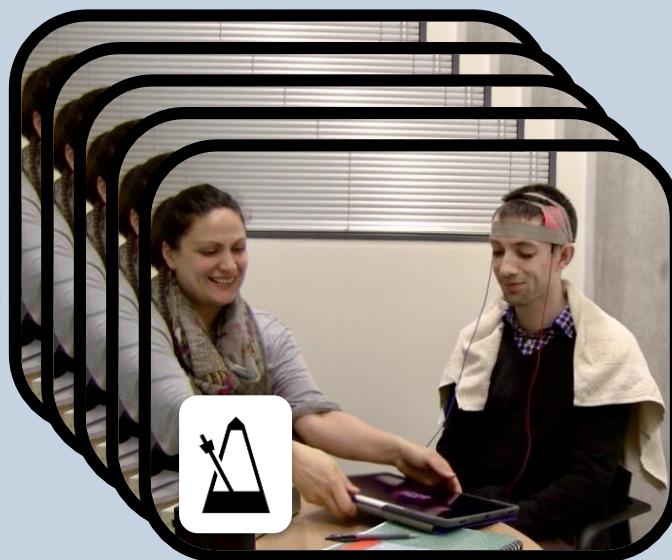
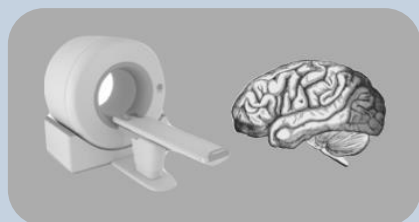


Significant increases in activity from pre- to post-intervention in the tDCS relative to sham group in the dorsal striatum

What next?



# New Trial!



Volunteers wanted!

<https://insteptrial.wordpress.com>  
[instep@psy.ox.ac.uk](mailto:instep@psy.ox.ac.uk) @InstepTrial

# Thank you!

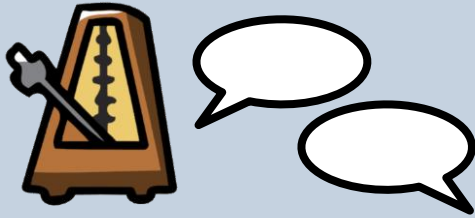
Jen Chesters, Riikka Mottonen,  
Mairead Healy, Charlie Wiltshire  
Experimental Psychology,  
Mark Chiew, Steve Smith,  
WIN, University of Oxford

Peter Howell, UCL



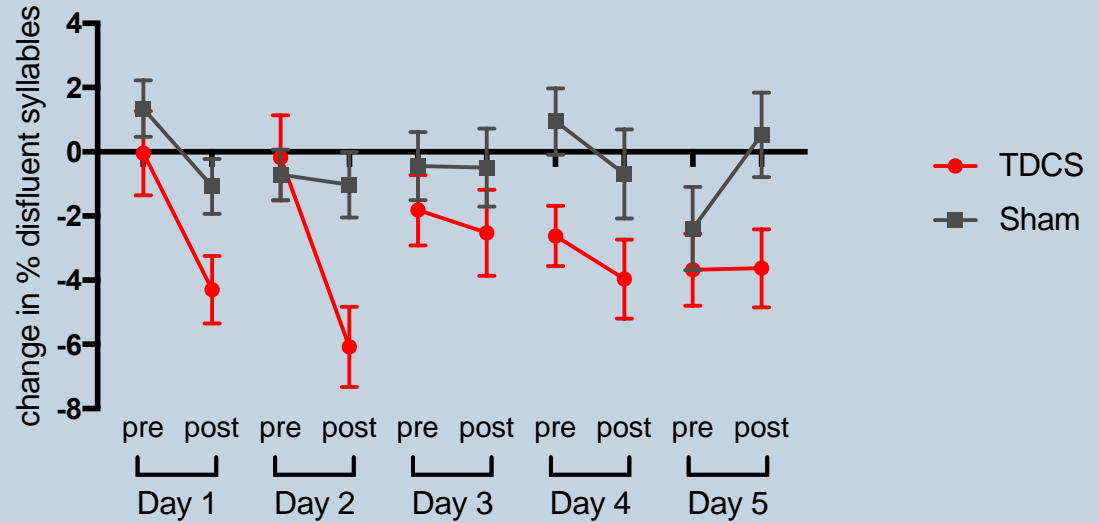


# Fluency before and after the intervention on each training day

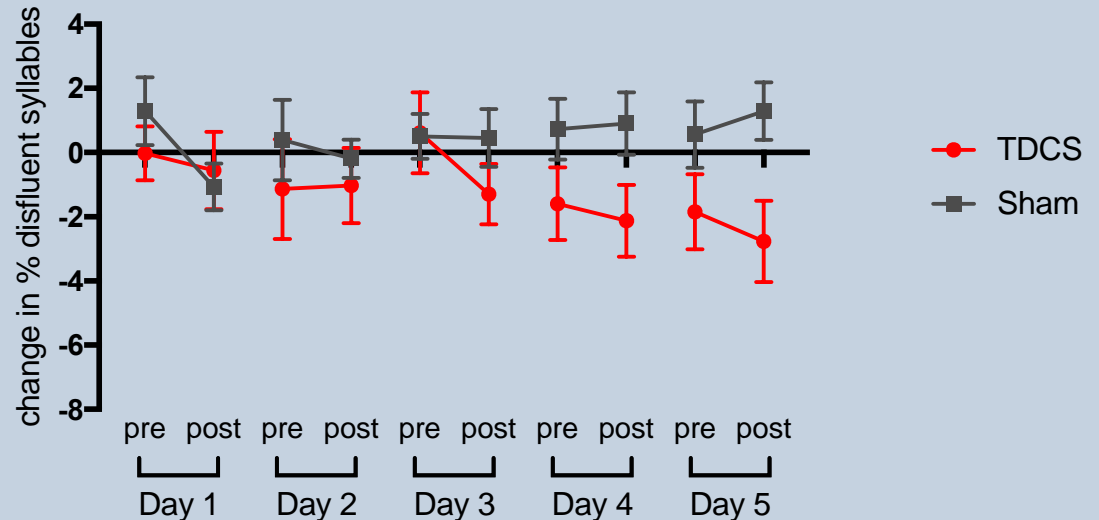


Both groups responded well to the temporary fluency inducers (< 1.5 % ds during the intervention)

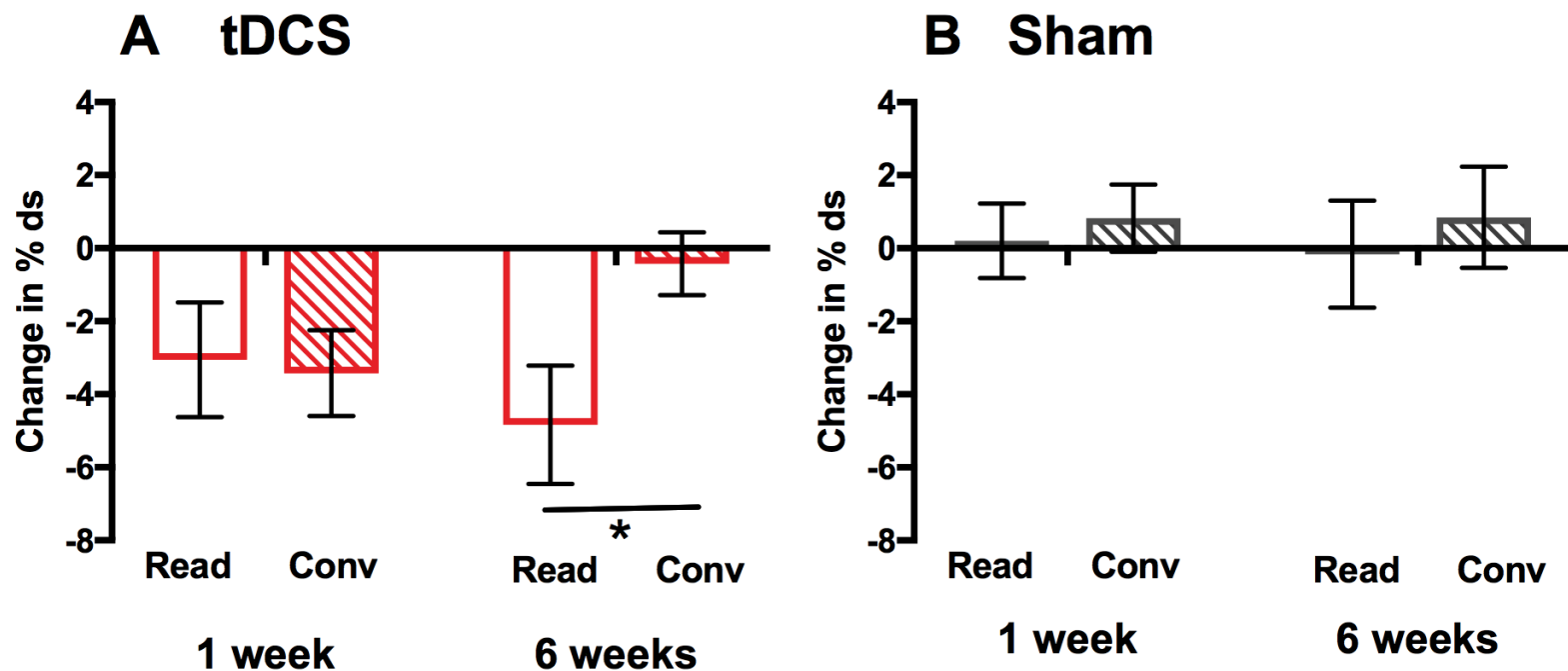
## Reading



## Conversation



# Reading vs. Conversation

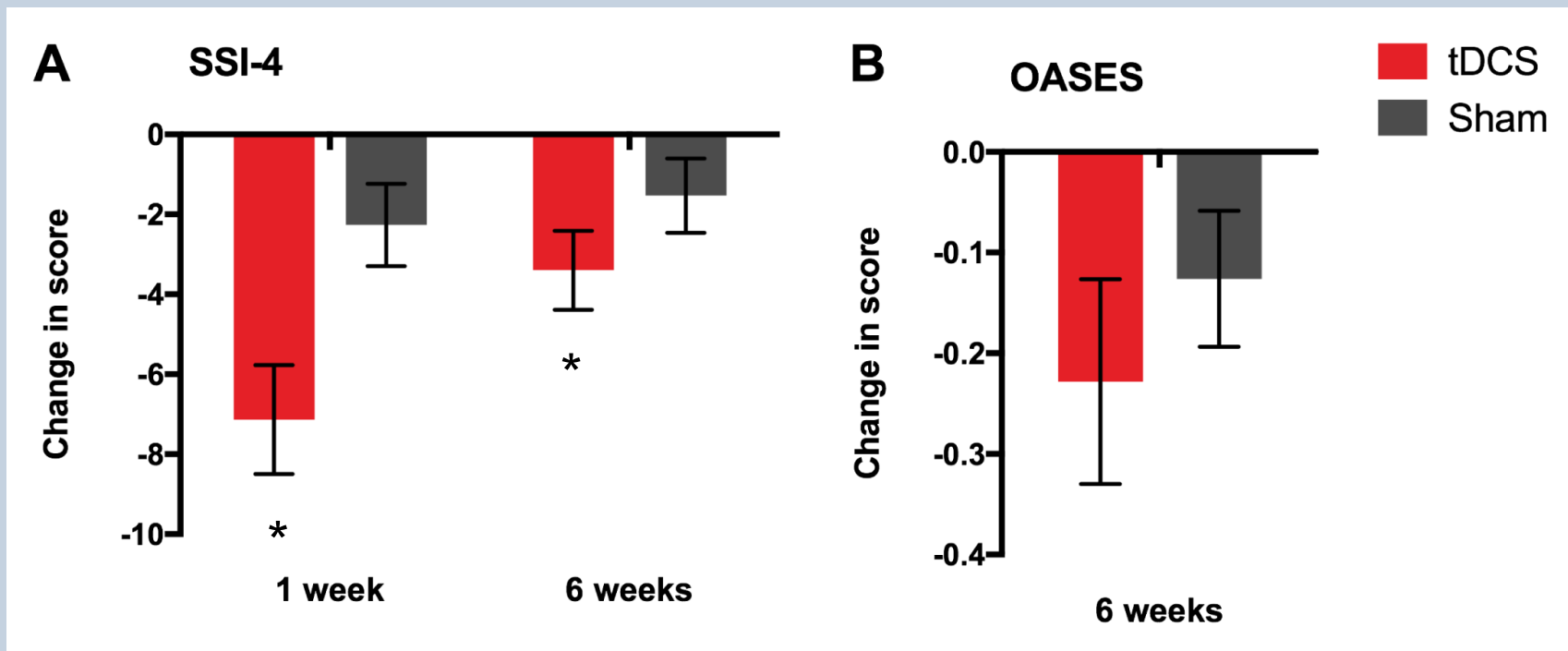


The effect of tDCS was evident in both reading and conversation samples 1 week after the intervention but only persisted for reading at 6 weeks

# Secondary Outcomes

## Clinical measure of stuttering severity

## Psychosocial Impact



tDCS significantly reduced stuttering severity score  
The effect was significantly smaller at 6 weeks  
Both groups showed a small reduction in the  
psychosocial impact of stuttering after the intervention

# Summary of RCT findings

- Five consecutive days of tDCS with temporary fluency induction can produce longer-lasting improvements to fluency
- One week after the intervention, fluency was improved (reduction in % disfluent syllables) for both reading -3.26% and conversation -4.25%
- Six weeks later, fluency remained improved for reading -4.68%; fluency during conversation had returned to baseline levels
- A clinical measure of stuttering severity (SSI-4) also showed significant improvement at both time points:
  - 1 week: -7.13; 6 weeks -3.40

Chesters et al., *Brain* 2018

