



tDCS Augmentation Trials in Neurorehabilitation

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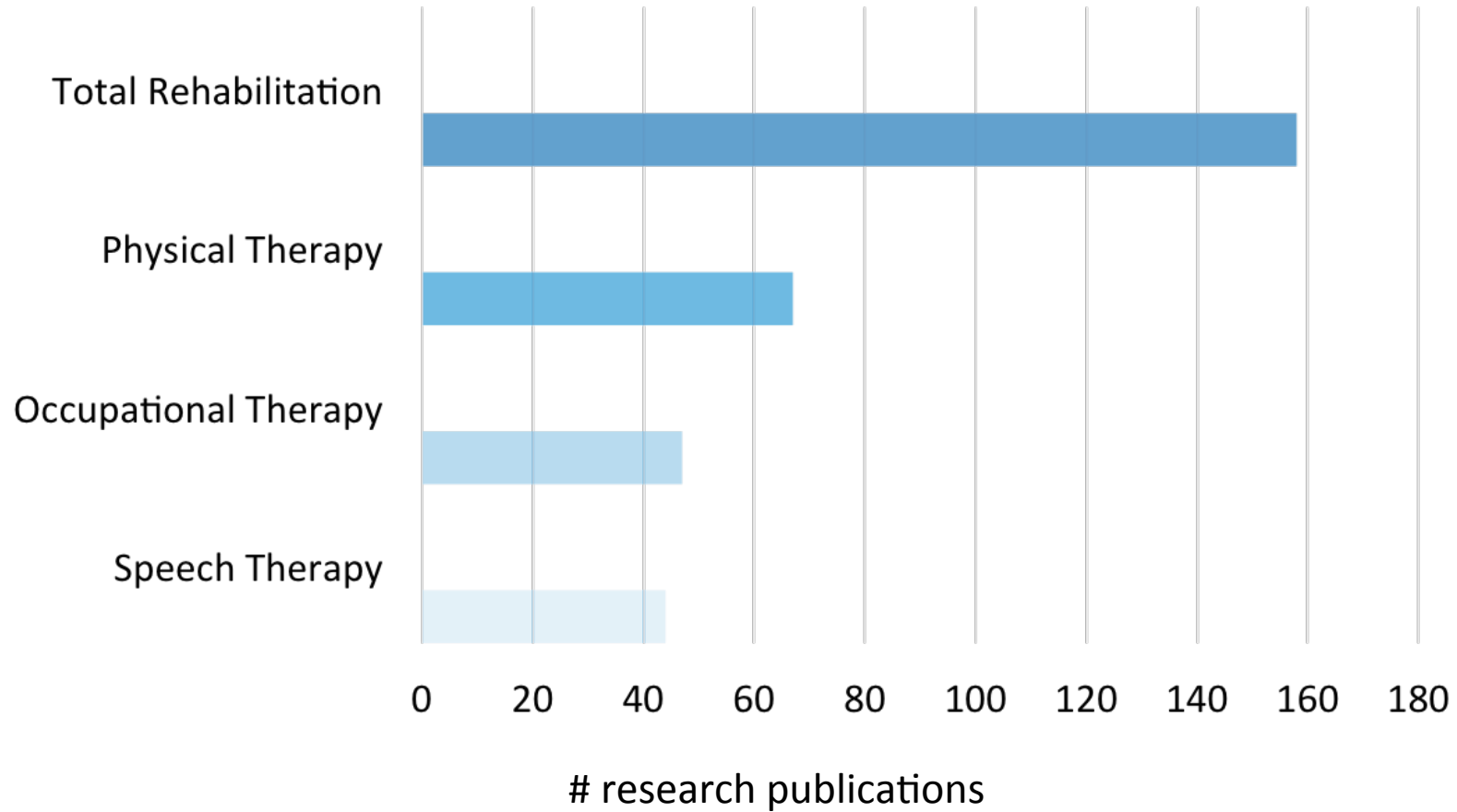
Neurorehabilitation & Neural Repair

Burke Rehabilitation Center, New York

Source: www.ncbi.nlm.nih.gov/pubmed hits 9/29/2016

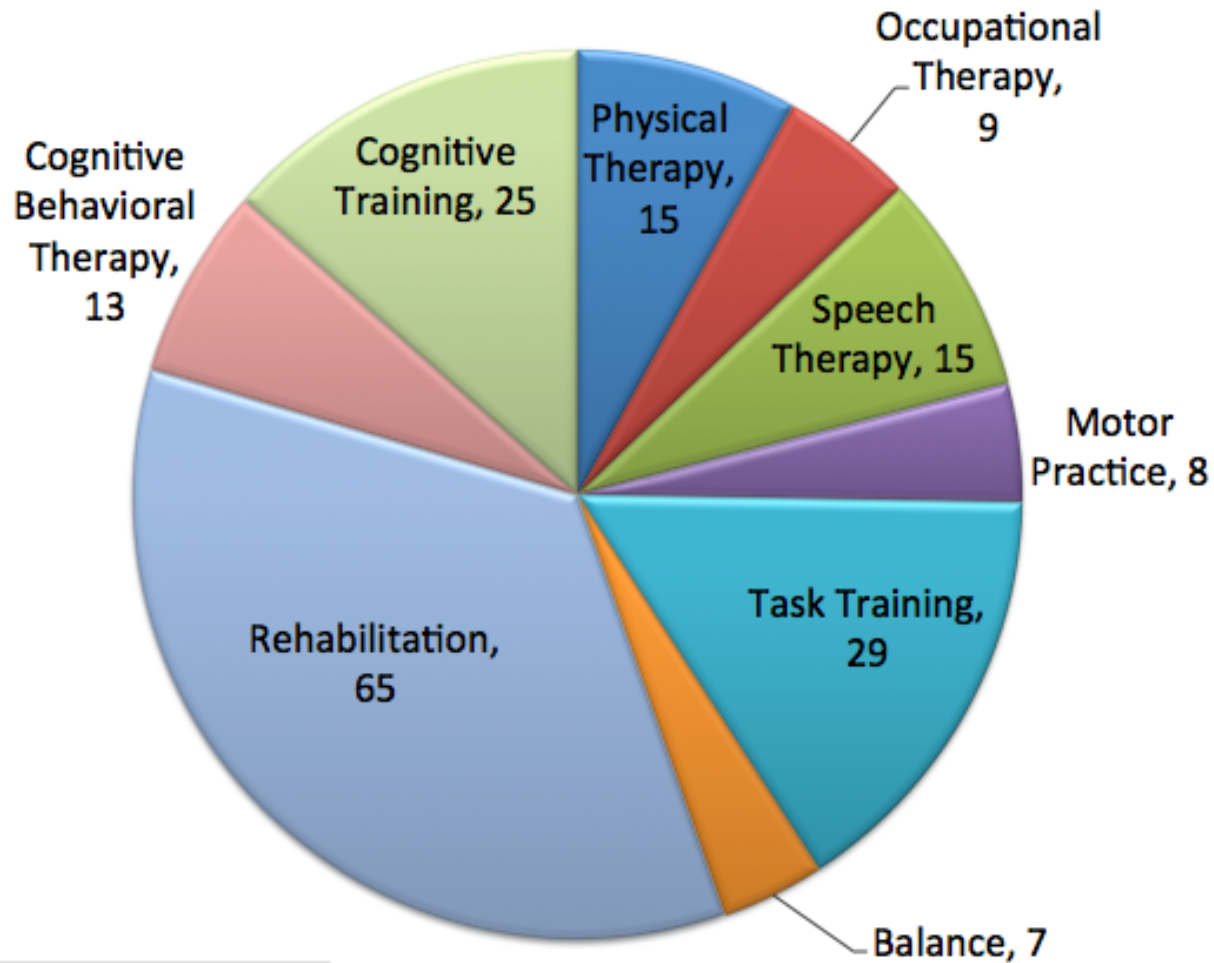
Neurorehabilitation-tDCS original studies

2007-2016



Source: clinicaltrials.gov hits 9/29/2016

Neurorehabilitation-tDCS registered trials

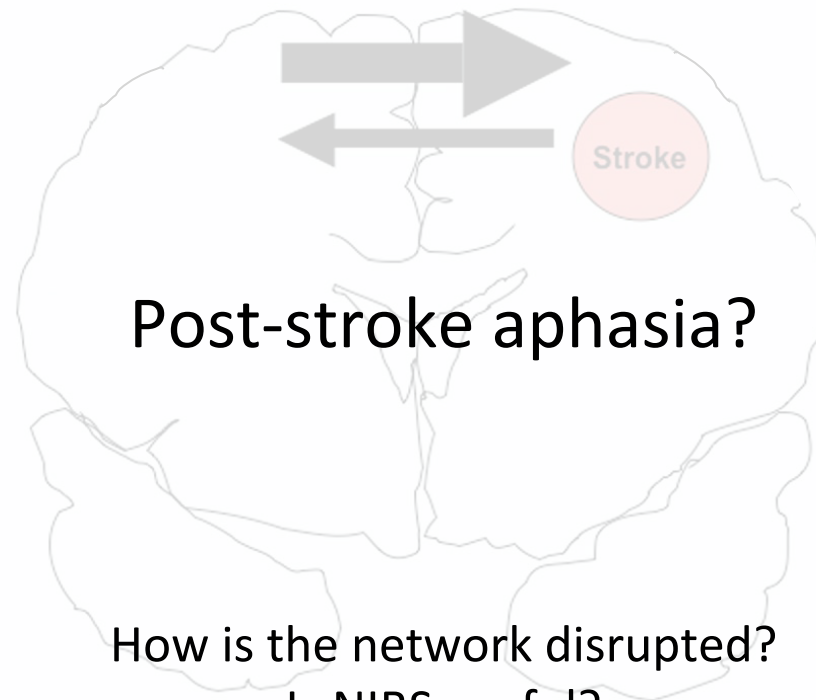


tDCS: 524 hits
Neurorehab. Related: 186

'tDCS and Transcranial direct current stimulation' + key words in chart

tDCS





Post-stroke aphasia?

How is the network disrupted?

Is NIBS useful?

Can it be effectively combined with SL therapy?

Evidence / Rationale



Elsner B, Kugler J, Pohl M, Mehrholz J (2013) Transcranial direct current stimulation (tDCS) for improving aphasia in patients after stroke (Review). Cochrane Database Syst Rev 6:CD009760.

No evidence for tDCS as useful adjunct
some merit in cathodal stimulation?

Stroke

JOURNAL OF THE AMERICAN HEART ASSOCIATION

Thiel et al (2013). Evidence of NIBS on language networks and recovery in early post-stroke aphasia.

R hem1 Hz rTMS + SL therapy improves language recovery
and favors L hem language network activation

Nexstim
4.3.0

Navigation | Stimulation | Digitization | Overlay | Settings | Graph Settings

Registration
Perform registration... | Add Stimulation target...

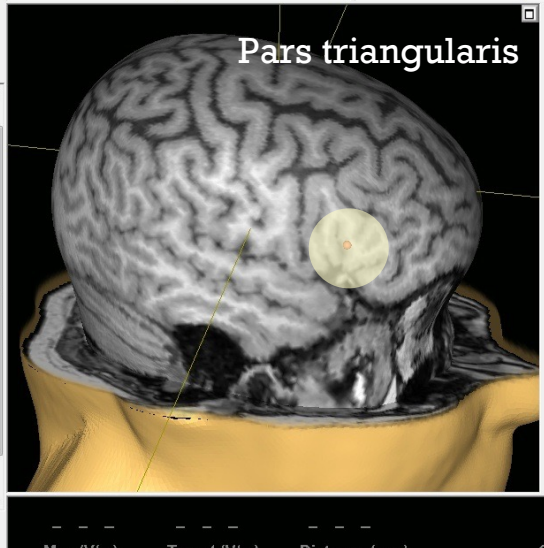
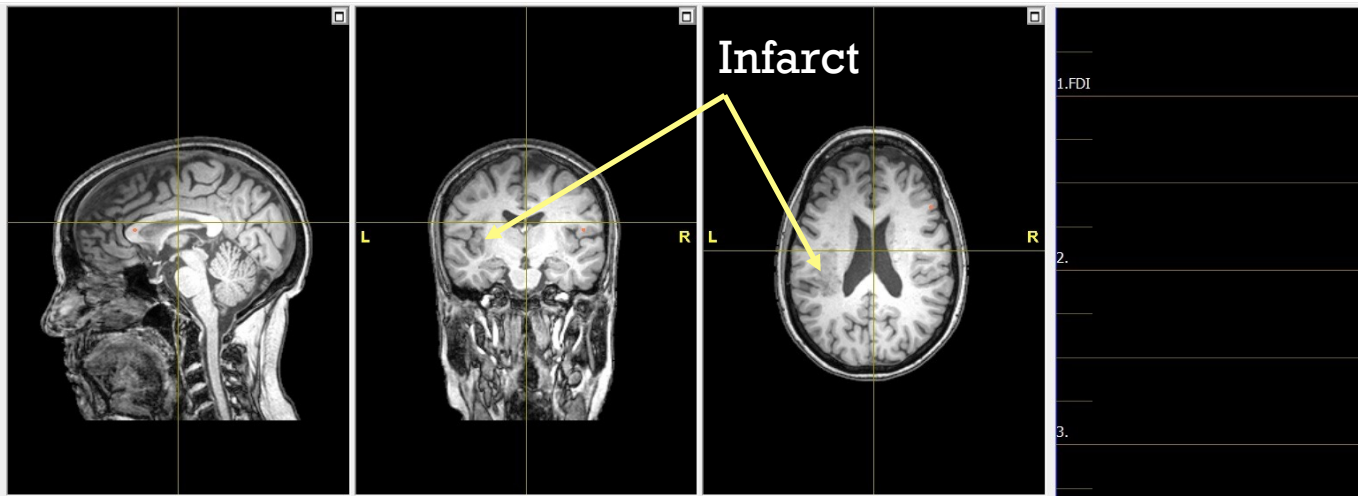
Slice scan (mm)
Sagittal | Coronal | Axial
Depth (mm) | Axial depth (mm)

Navigation control
Head tracker | Stimulation coil | Digitizing pen | Registration performed | Tracking unit state | Enable Tracking unit

Display control
Original (F5) | Crosshair (F1) | Pan (F2) | Zoom (F3) | Rotate (F4)

MRI information: MCNULTY^JUDITH^^^
MRI landmarks
Scalp landmarks
Stimulation targets
Stimulation exams
1. Stimulation Exam: 2015/09/11 09:51:32
2. Stimulation Exam: 2015/09/12 09:36:01
3. Stimulation Exam: 2015/09/12 09:45:06
4. Stimulation Exam: 2015/09/14 09:42:33
5. Stimulation Exam: 2015/09/15 09:46:49
6. Stimulation Exam: 2015/09/16 09:49:54
7. Stimulation Exam: 2015/09/17 09:40:20
8. Stimulation Exam: 2015/09/18 09:47:33
9. Stimulation Exam: 2015/09/19 09:45:09
10. Stimulation Exam: 2015/09/21 09:41:34
11. Stimulation Exam: 2015/09/22 09:49:08
12. Stimulation Exam: 2015/09/23 09:50:35
Researcher: Jennie
Description: ...
12.1. Stimulus Sequence
12.2. Stimulus Sequence
12.3. rTMS Sequence
Description:
Sequence parameters
12.3.1 rTMS reference Stimulus (not visible)
rTMS Sequence details

Analysis exams
New session | Open session | Close session | Quit



- Parameters:**
- 2 runs of 20 minutes of cathodal stimulation
 - Electrode placement
 - Cathode – R pars triangularis
 - Anode – L supraorbital region
 - Real – direct current of 2 mA
 - Sham – direct current of 0.1 mA
 - Worn during speech therapy

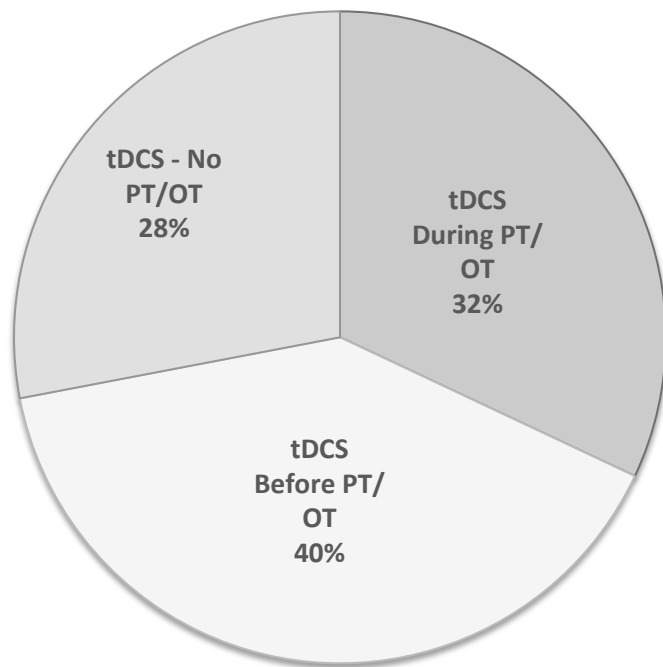
Northstar Trial

tDCS for aphasia rehabilitation

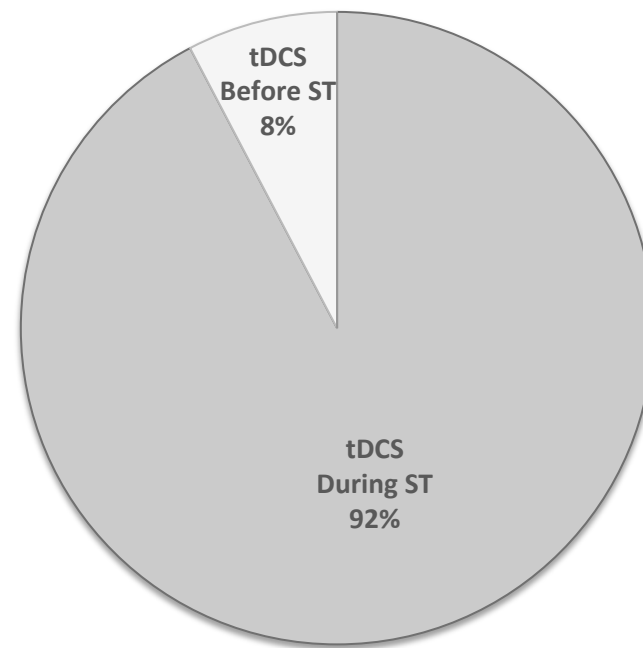
- primarily studied as a complement to speech therapy

2014-2015 Publications

Motor



Aphasia



Anodal tDCS favors clinical improvement in stroke motor...

A Meta-analysis of the Efficacy of Anodal Transcranial Direct Current Stimulation for Upper Limb Motor Recovery in Stroke Survivors

Butler et al. J Hand Ther. (2012)

Invited Review

Does anodal transcranial direct current stimulation enhance excitability of the motor cortex and motor function in healthy individuals and subjects with stroke: A systematic review and meta-analysis

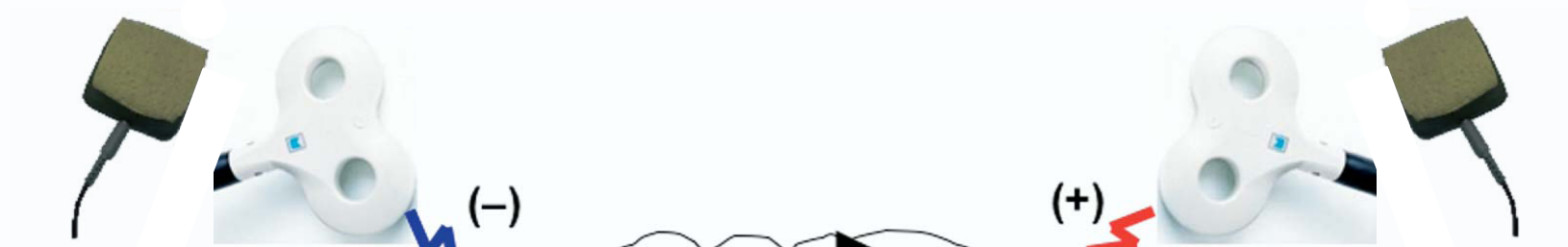
A. Bastani, S. Jaberzadeh * Clin Neurophys (2013)



Transcranial direct current stimulation (tDCS) for improving function and activities of daily living in patients after stroke

Elsner et al (2013)

Corticomotor excitability in stroke



Takeuchi, et al, 2008
 Boggio et al, 2007
 Fregni et al., 2006
 Fregni et al., 2005
 Mansur et al., 2005
 Takeuchi et al., 2005
 Boggio, et al., 2006
 Werhahn, et al., 2003

Yozbatiran et al, 2009
 Malcom et al, 2007
 Hummel et al, 2007
 Talelli et al., 2007 Kim
 et al., 2006 Hummel et
 al, 2006 Khedr et al.,
 2005 Hummel et al,
 2005

Webster et al (2006)

**IMPROVED CORTICOMOTOR OUTPUT FROM IPSI-LESIONAL
 M1 & IMPROVED MOTOR BEHAVIOUR**

Is coupling tDCS with training good?

If...

Motor Training = improvement in function 'X'

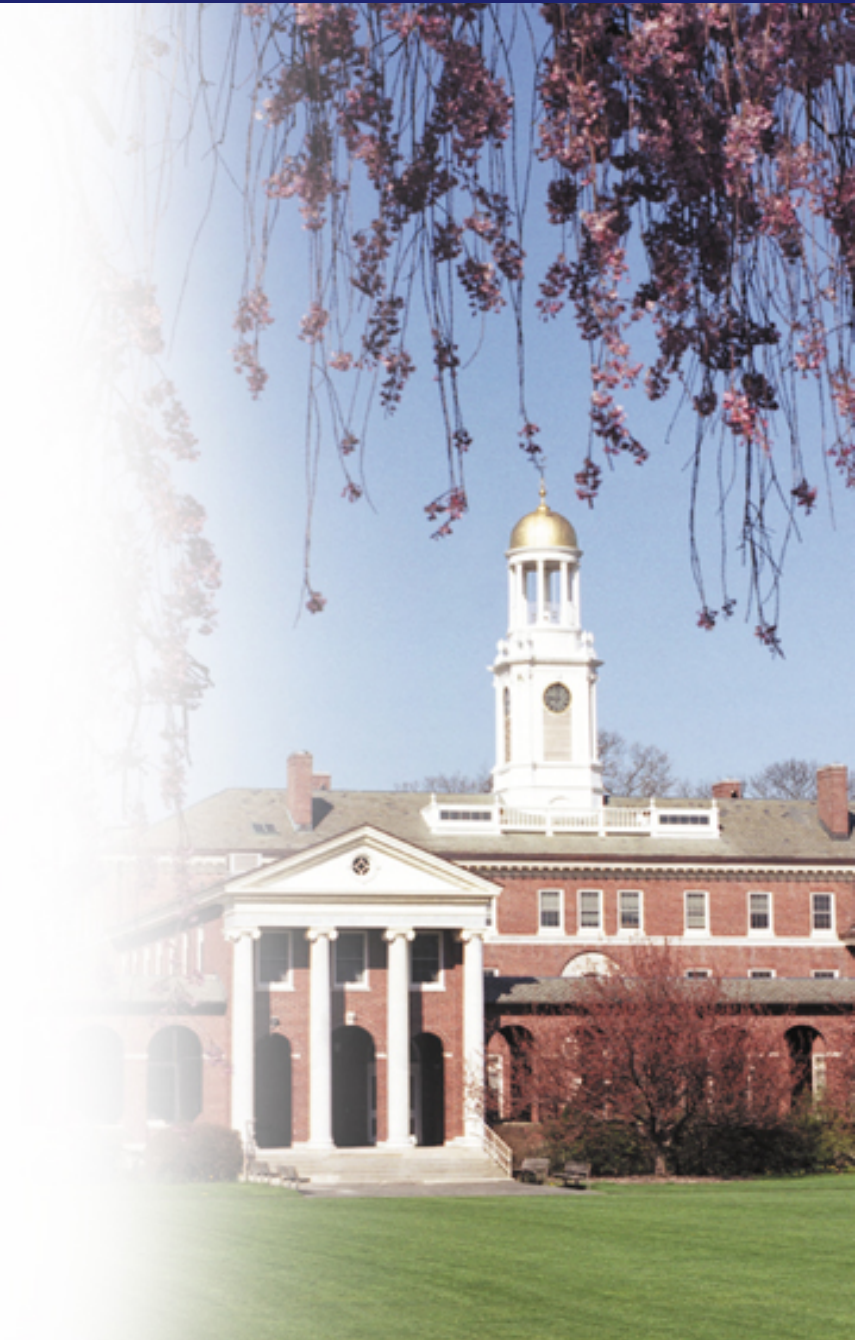
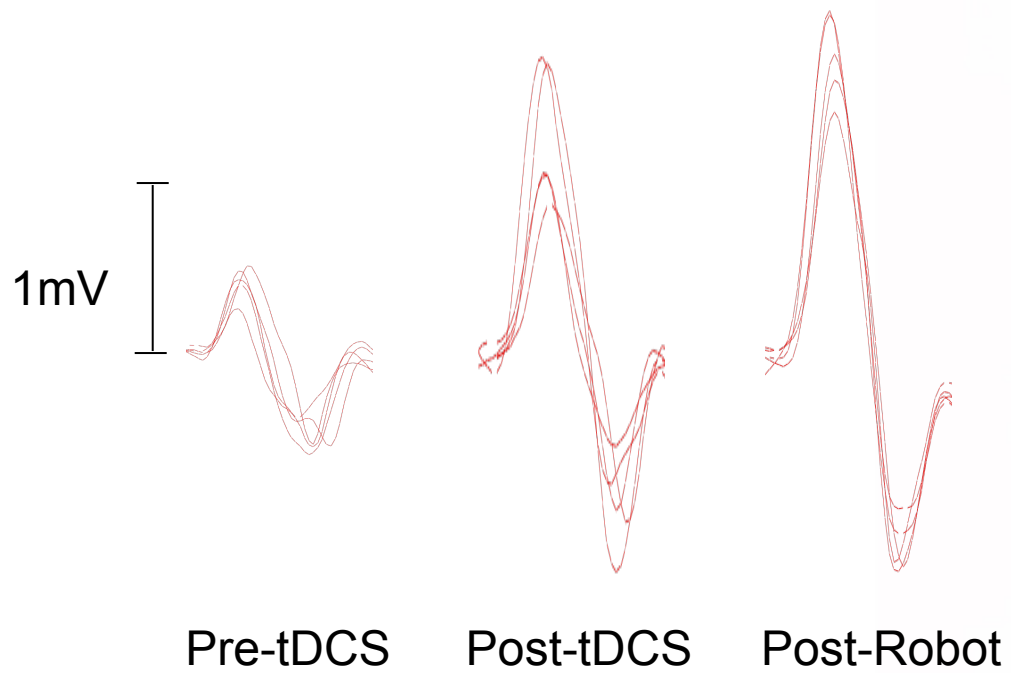
and...

tDCS = improvement in function 'X'

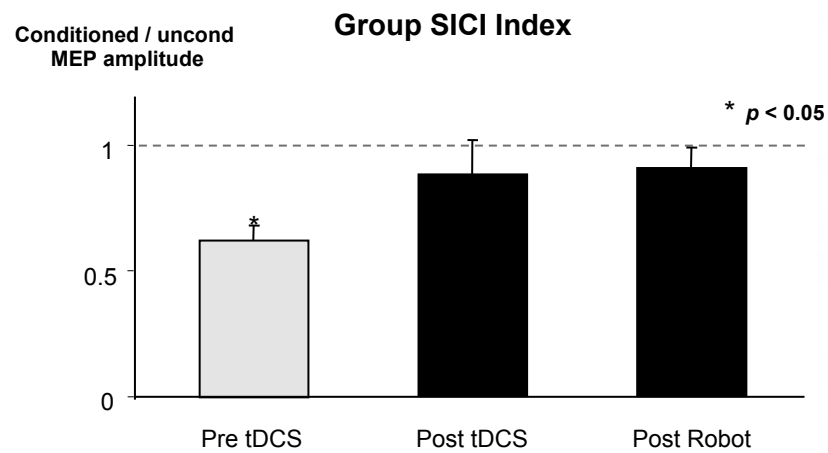
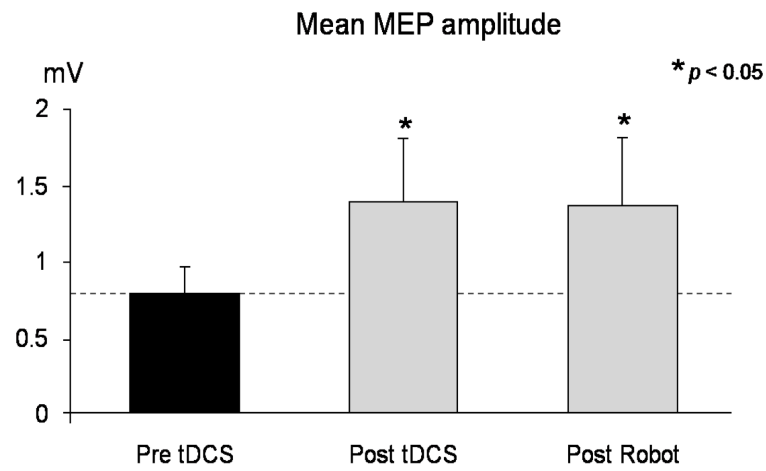
does...

Motor Training
+
tDCS = improvement in function
2X, X², or 0??

Anodal tDCS combined with robotic motor training

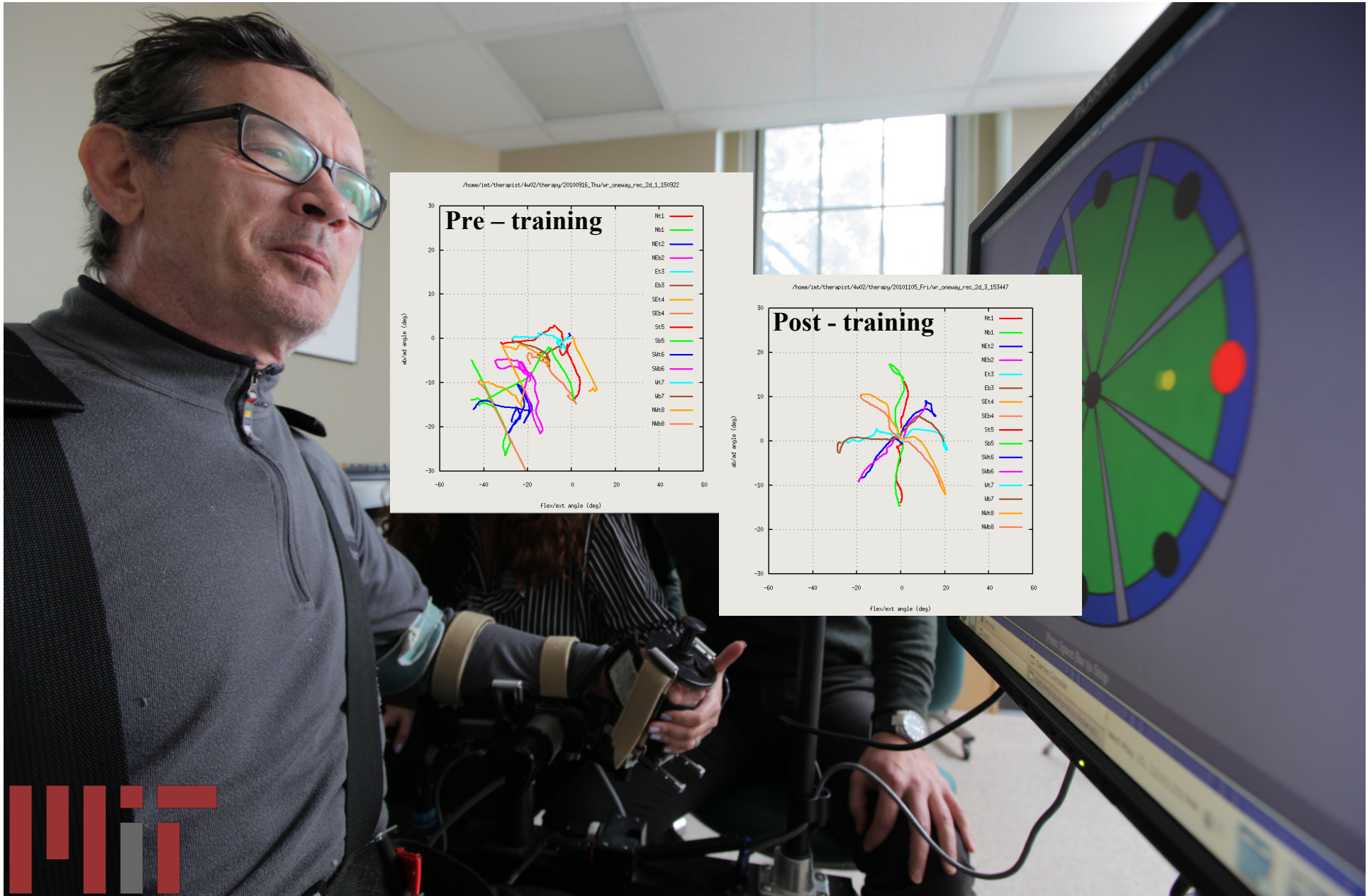


Anodal tDCS combined with robotic motor training



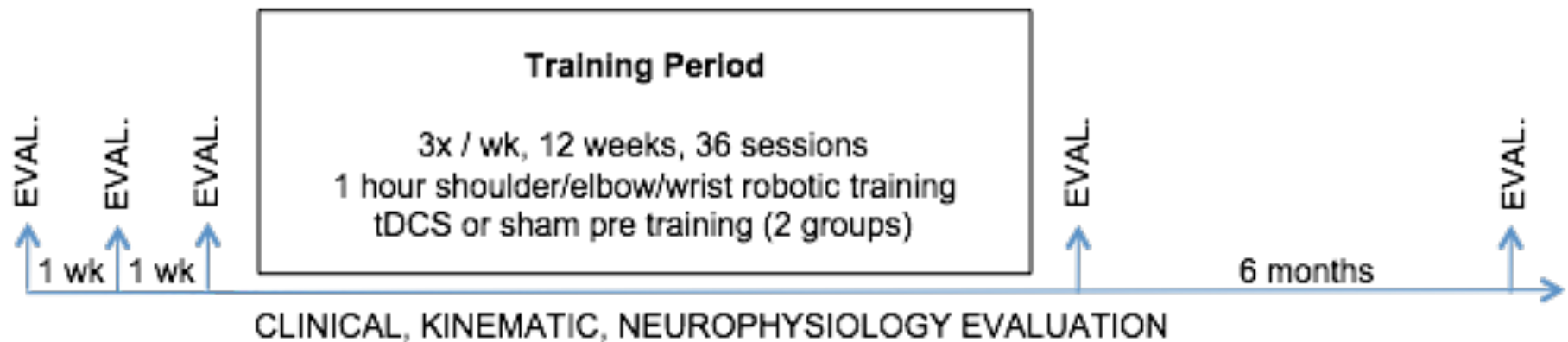
Edwards et al (2009)

Robotics for kinematics assessment & training

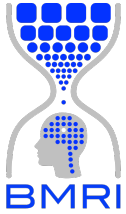


NIH funded study 2012-2017 – tDCS and robotic motor training in stroke

Combined tDCS-Robotic Training Study Design



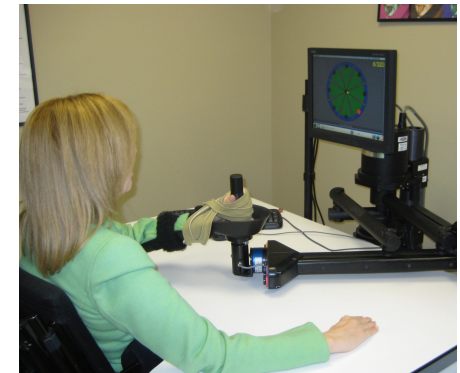
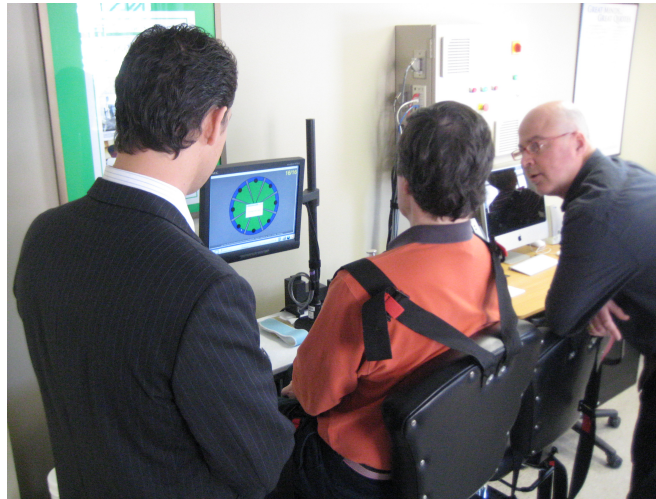
- 60 patients, Right hemiparesis
- >6mnths post first ischemic stroke
- Robotic protocol alternates S/E-wrist robot across sessions
- tDCS 2mA, 35cm², 0.9% NaCl soaked sponges



Upper limb robotics at Burke-Cornell, New York



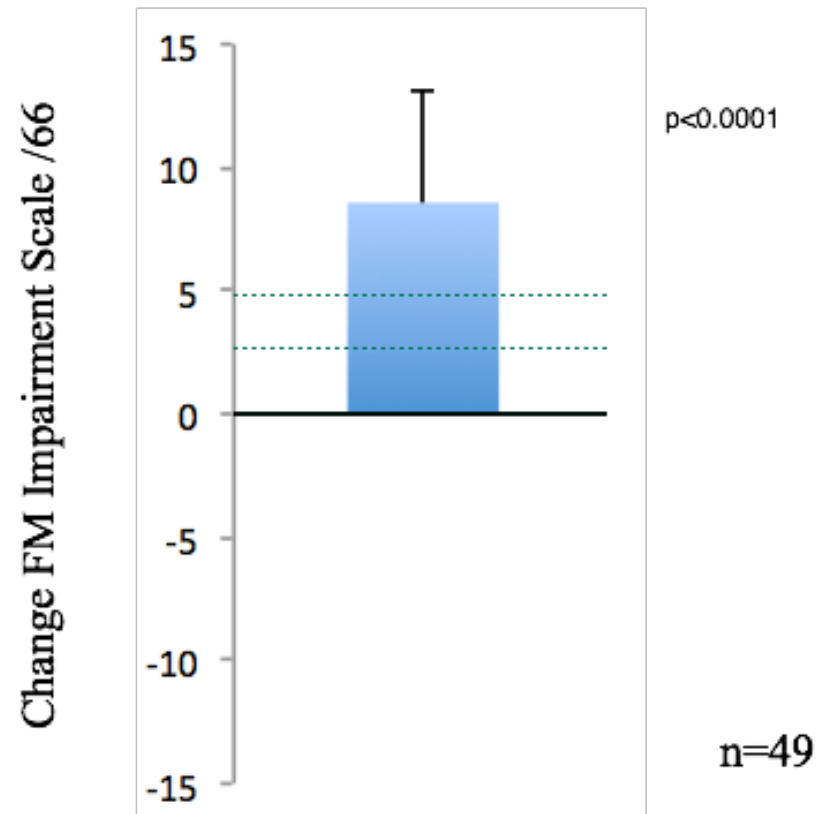
Edwards PI: R01 HD069776



Robotics with brain stimulation in patients with motor dysfunction

Mean clinical (Fugl-Meyer) improvement robot/sham tDCS + robot/real tDCS groups

PRELIM. RESULTS



* Full results in prep

Summary



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