Effects of sham-controlled double blind transcranial direct current stimulation in patients with disorders of consciousness

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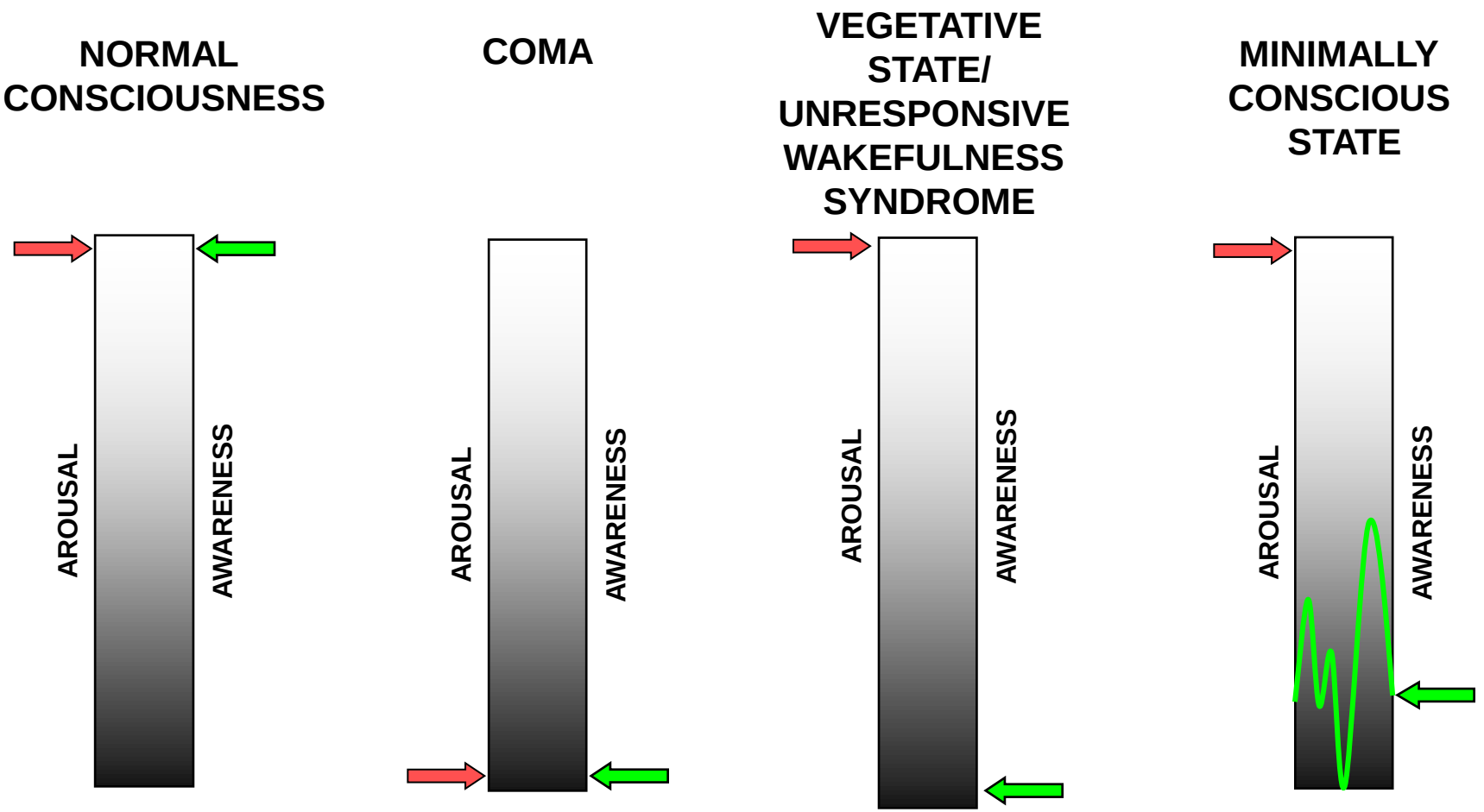
Patients



Laureys, Owen and Schiff Lancet Neurology, 2005
Laureys et al, BMC Medicine 2010
Demertzi et al, Exp Rev Neurother, 2008

Why direct current stimulation?

Stimulation	Population	Effects	Authors
Prefrontal cortex	Healthy subjects	Memory	Marshall et al, J Neurosci 2004
	Alzheimer's patients	Memory	Ferrucci et al, Neurology 2008
	Stroke patients	Attention	Jo et al, Am J Phys Med Rehabil 2009
	Aphasic patients	Language	Baker et al, Stroke 2010

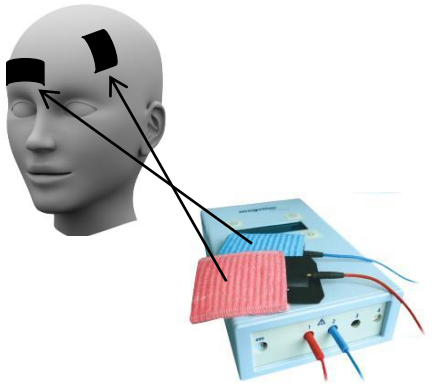
- Non-invasive
- Easy to apply
- Cheap equipment

AIM of the study

To assess tDCS effects on cognition in patients with disorders of consciousness

Methods

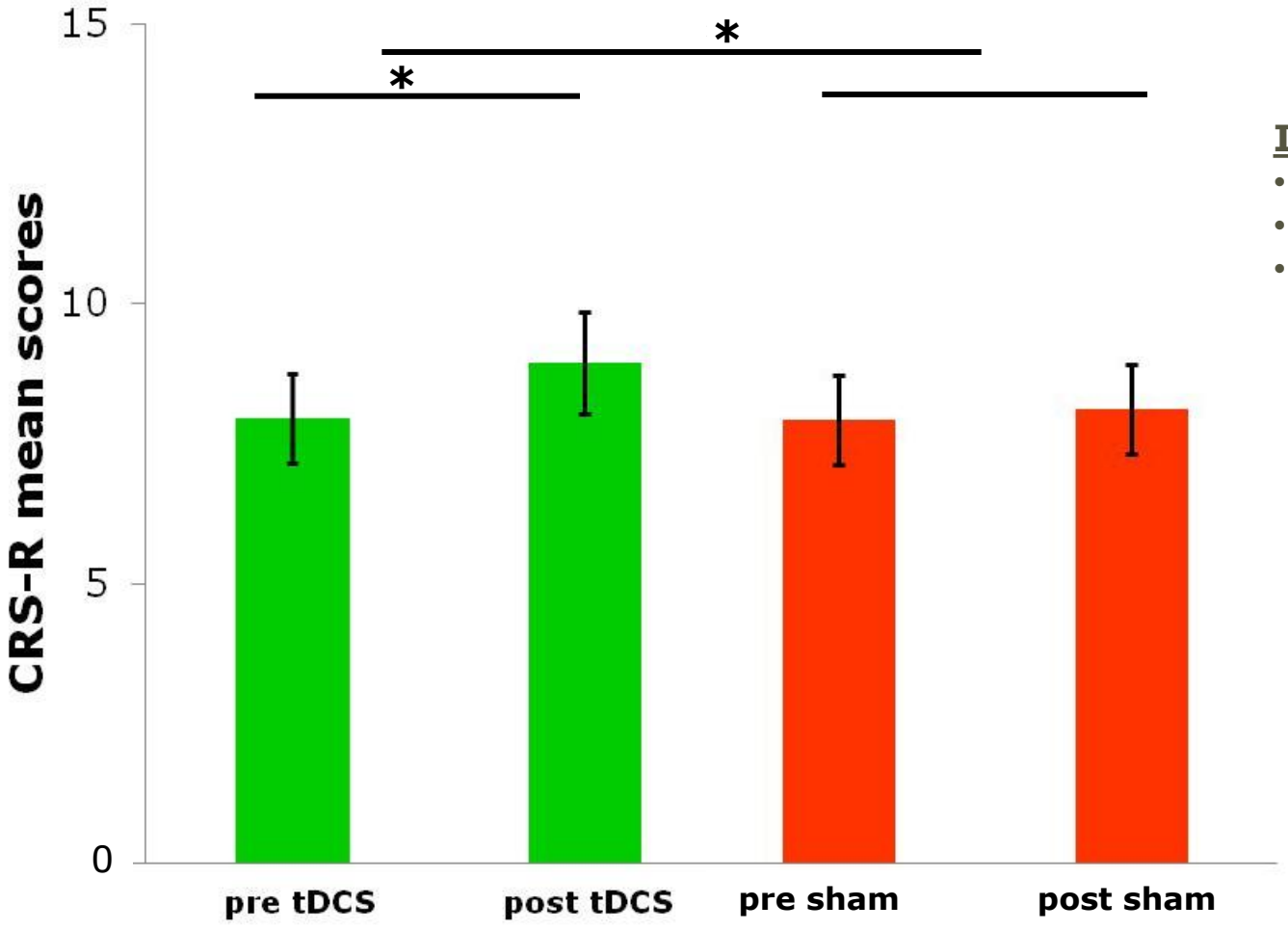
- Design: sham-controlled double blind
  - 4 CRS-R: pre-post tDCS/pre-post sham
- Patients
  - 55 patients (16 women; aged 43 ± 18 y)
  - 25 VS/UWS, 30 MCS
  - 25 traumatic / 30 non-traumatic



DC Stimulator Plus

- Outcome measure
  - Coma Recovery Scale-Revised (CRS-R, Giacino 2004)
- Hypothesis: tDCS responders:
  - CRS-R total tDCS > pre-tDCS, sham, pre-sham
- Statistical analysis: ANOVA (Stata)

Group data (n=55)

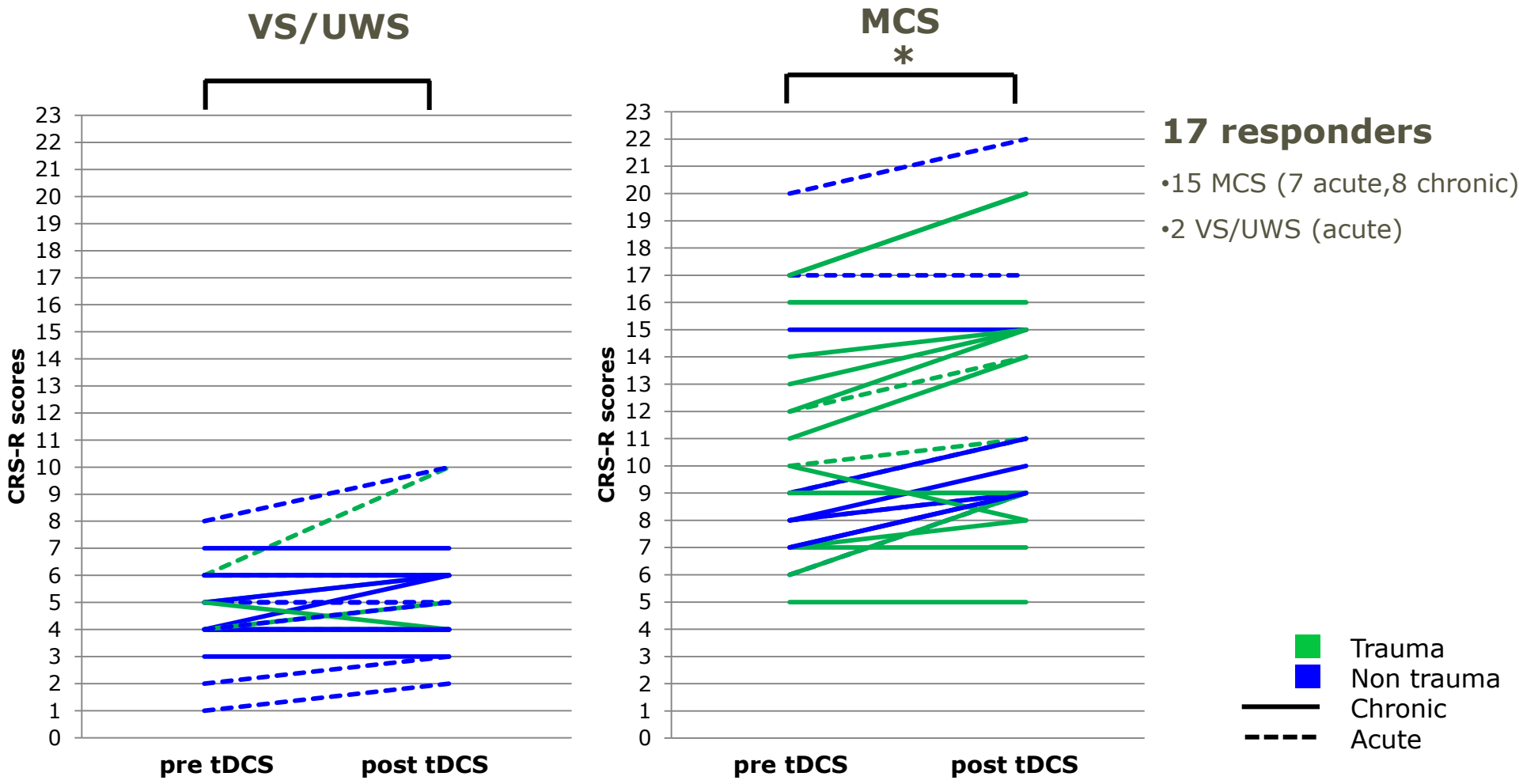


Interactions

- MCS>VS, p=0.026
- Acute> chronic, p=0.004
- Etiology, p=0.37

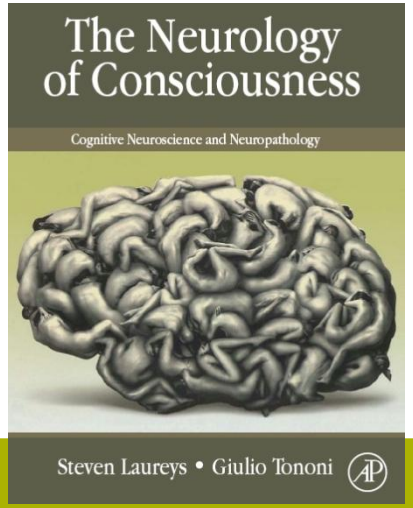
** p<.001
* p <.05

VS/UWS vs. MCS


VS/UWS
MCS
*
CRS-R scores
0
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
pre tDCS
post tDCS
17 responders
•15 MCS (7 acute,8 chronic)
•2 VS/UWS (acute)
Trauma
Non trauma
Chronic
Acute

Conclusions

- Deep Brain Stimulation (Schiff et al., Nature 2008)
- Amantadine (Schnakers, 2008)
- Non-invasive non-pharmacological class A evidence for tDCS induced cognitive improvement in MCS



THANK YOU

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Questions to: athibaut@chu.ulg.ac.be

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Responders

25 VS/UWS ⟶ 2 responders

2/11 VS/UWS acute

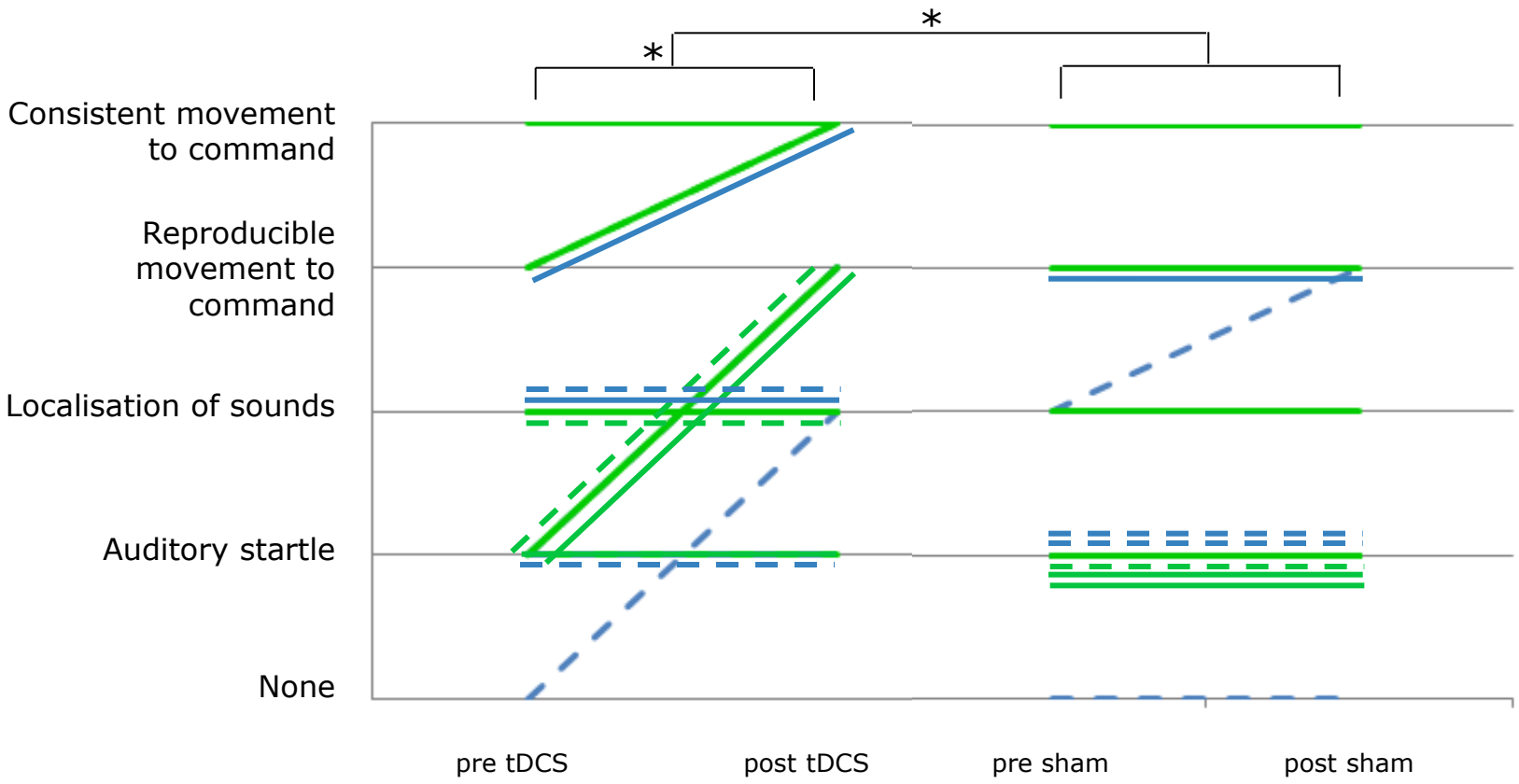
0/14 VS/UWS chronic

30 MCS ⟶ 15 responders

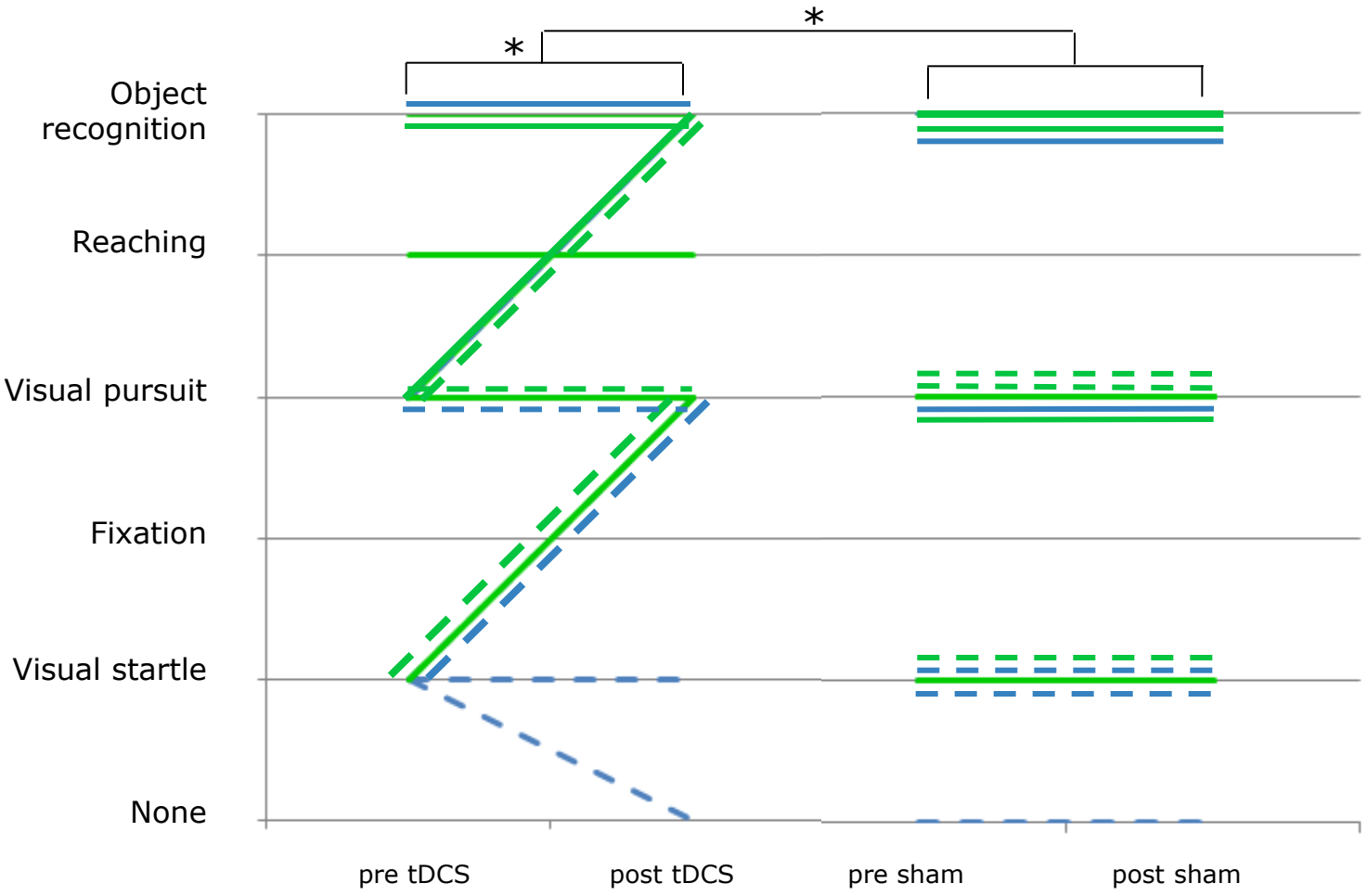
7/9 acute

8/21 chronic

Responders: audition subscale



Responders: subscales - visual



tDCS parameters and safety

Intensity: 2mA

Time: 20 minutes

Voltage: max 26V

Electrodes: 35cm²

Max: 0.1mA/cm²

U=R*I

2mA et 10kOhm
= 20V OK

2mA and 20kOhm
= 40V STOP

tDCS presumed mode of action

Direct effects

Modification of neuronal excitability

Long term effects

Modification of ion channels (Na^+, Ca^{2+})

Modification of NMDA receptors efficacy

Modification of inter-neurons

⇨ still hypothesis

Nitsche et al., J Physiol 2000
Nitsche et al., Neuroscientist 2010

tDCS critisisms

Limitations:

- Short term effect
- Moderate clinical change
- Unknown physiological effects (cathode)
- Improve electrode position?