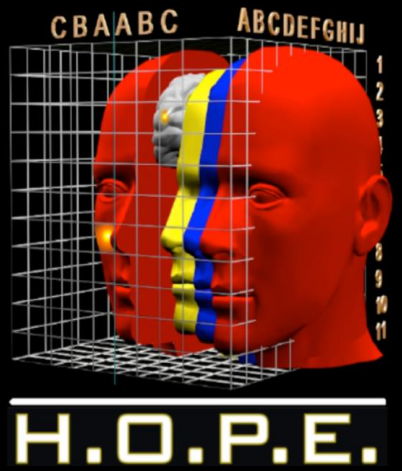
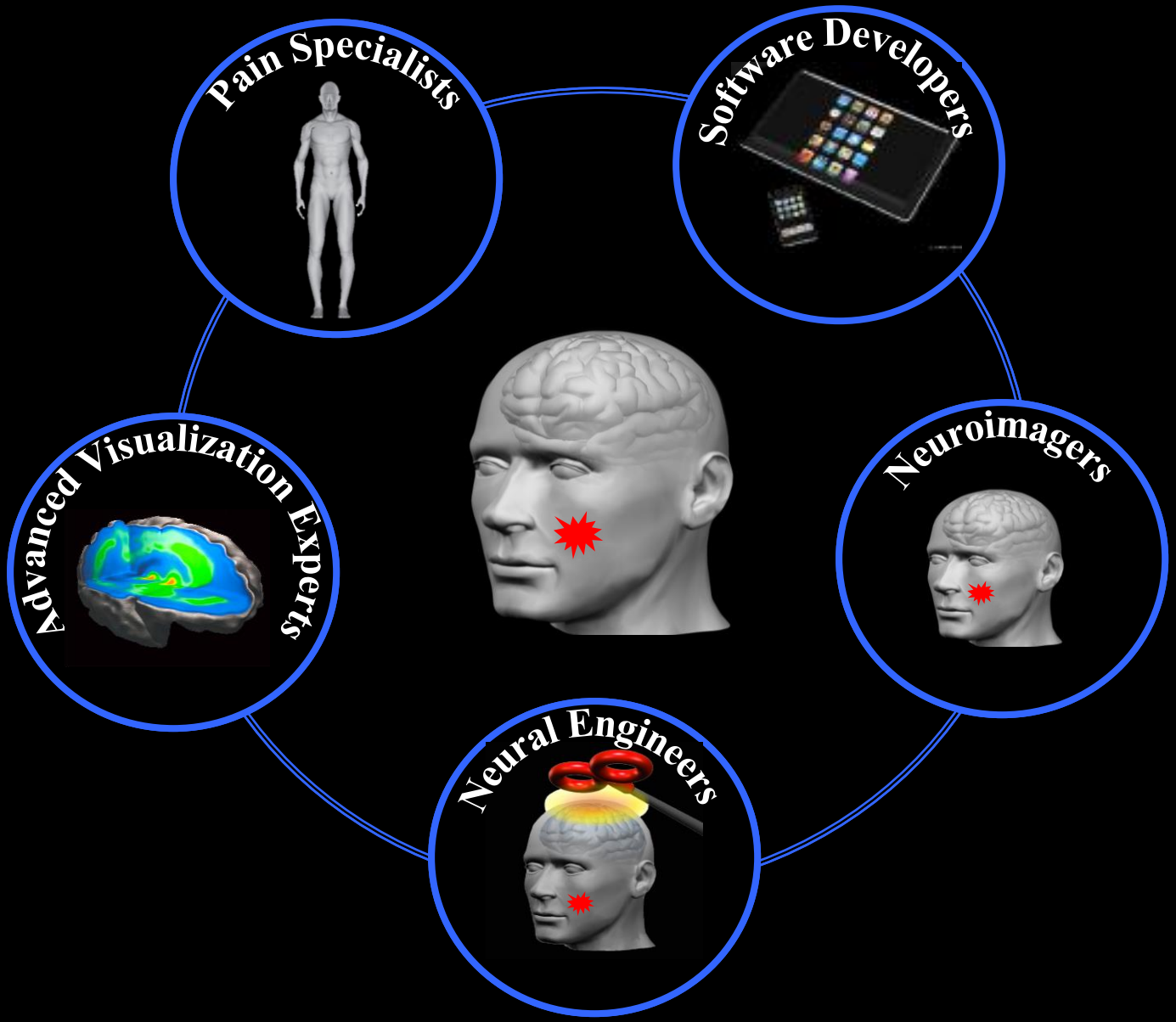
UNIVERSITY OF MICHIGAN



Developing Models For New Treatment Technologies Bringing Precision to the Pain Field

Alex DaSilva, DDS, DMedSc
Director, Headache & Orofacial Pain Effort (H.O.P.E.)
Co-Director, fNIRS Laboratory, Center for Human Growth & Development (CHGD)
Founder, Michigan Clinical Augmented Reality for Pain unit (M-CARP unit)
Biologic & Materials Sciences Department, University of Michigan School of Dentistry

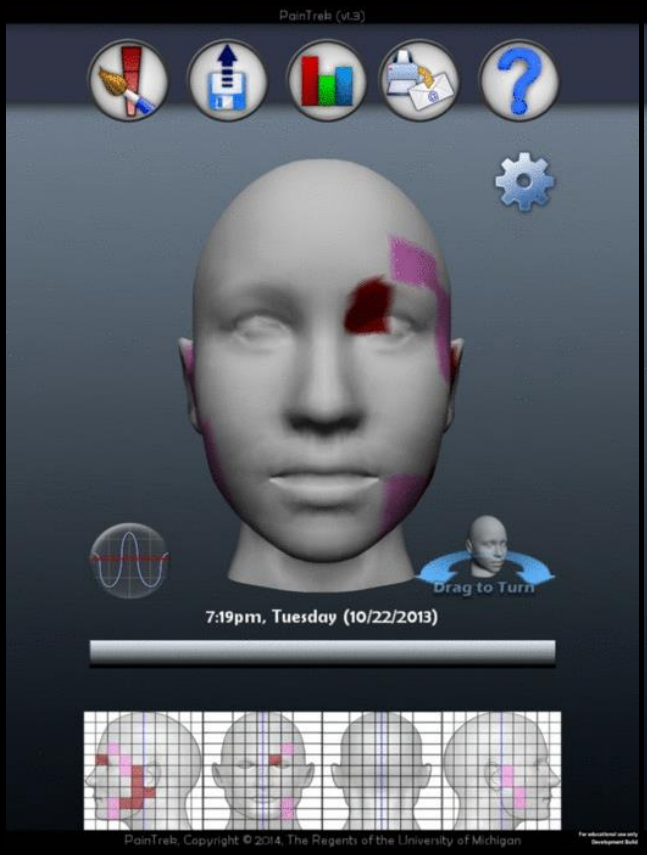
Disclosure: MoxyTech LLC (Co-Founder)

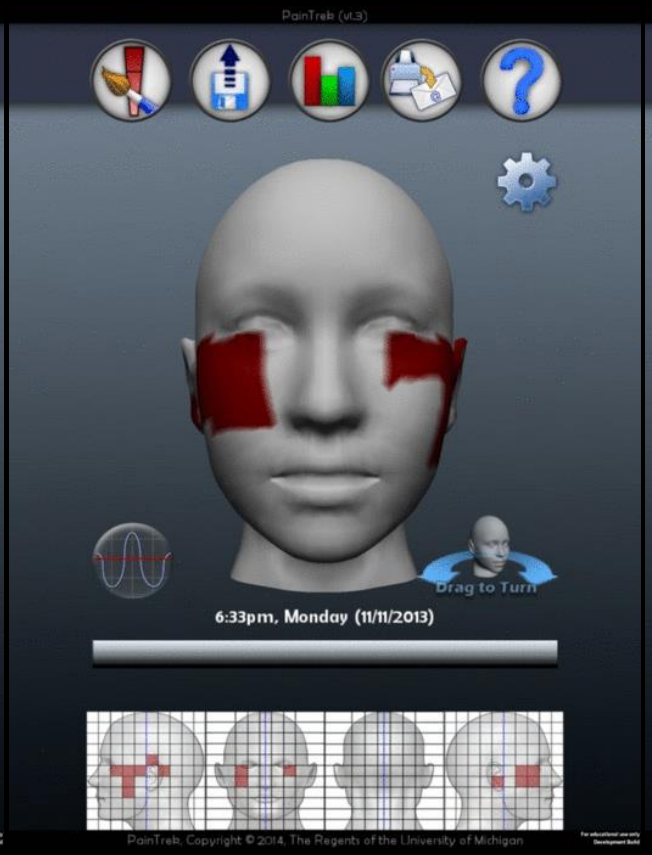

Pain Specialists
Software Developers
Advanced Visualization Experts
Neuroimagers
Neural Engineers

116 Million Americans With Chronic Pain

Costs $635 billion a year

Costs per patient additional $4.5-7.7 thousand in health care expenditures





VAS	5.9	6.3	5.7
PainTrek Average	1.4	2.0	2.1
PainTrek Pain Area	7.3%	5.5%	36.4%
PainTrek P.A.I.N.S.	3.5%	3.6%	25.7%

Customize for You

Sam Johnson
01/09/1978

Language
English (United States)

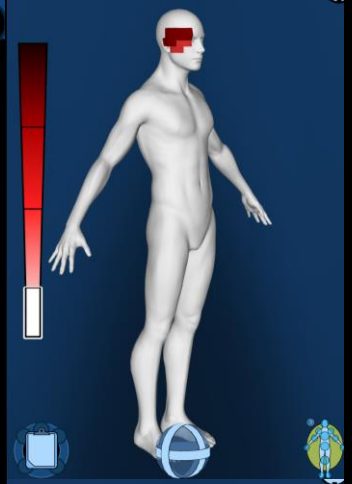
49

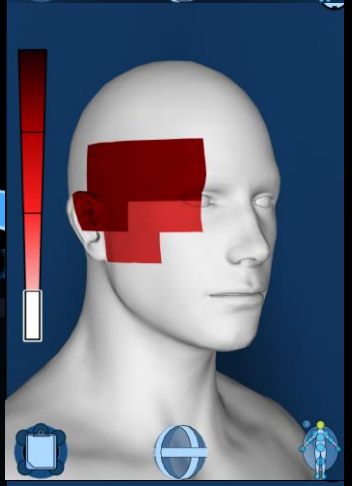
FPS: 8.99
PainTrek (C) HealthTrek Solutions, L.L.C., 2015

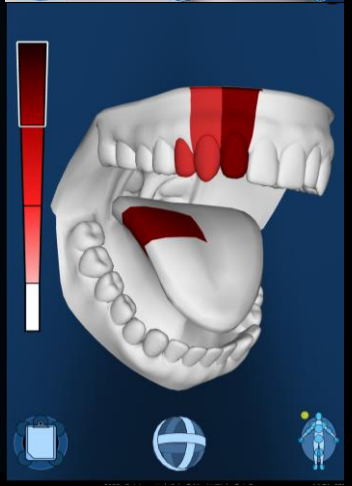
Focus on Area

December 21, 2015 @ 21:43

FPS: 12.27
PainTrek (C) HealthTrek Solutions, L.L.C., 2015







Overview

(coming soon)

49

10 Mouth

93 Head

43 Body

49

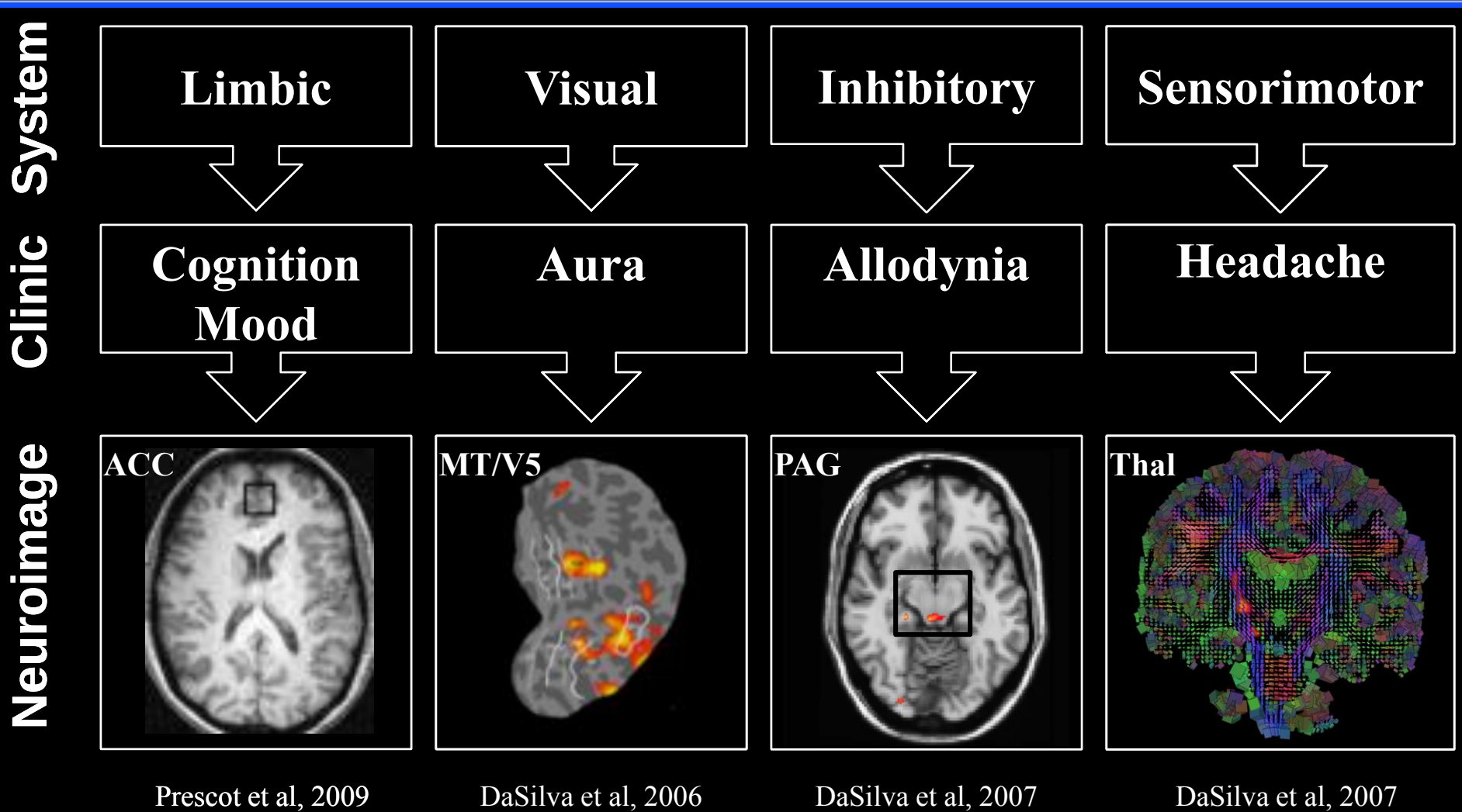
FPS: 13.64
PainTrek (C) HealthTrek Solutions, L.L.C., 2015

EHR Collaboration

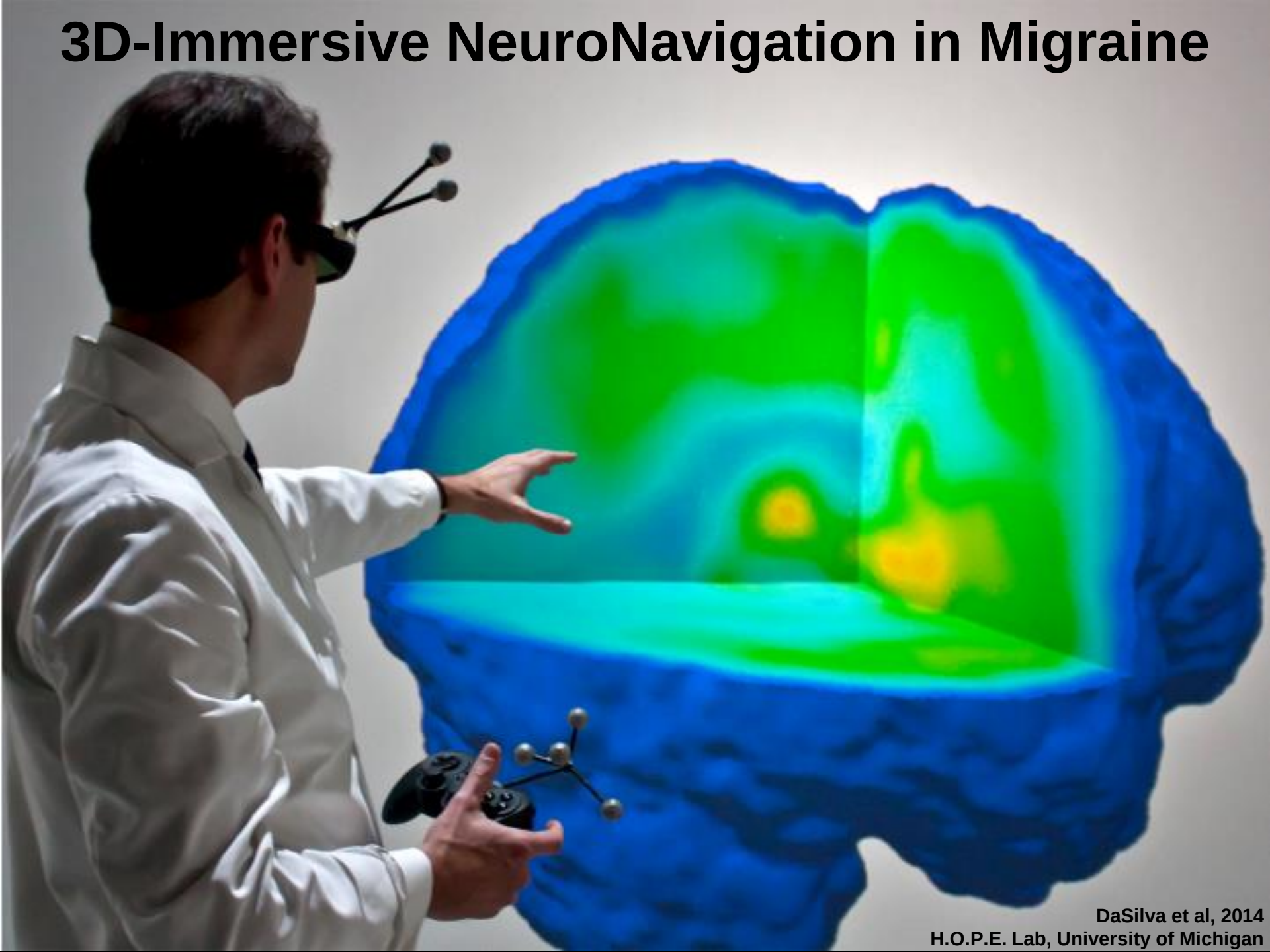
Internet2 NET+

What are the Targets in our Brains for Pain Relief?

Neuroplasticity in Migraine



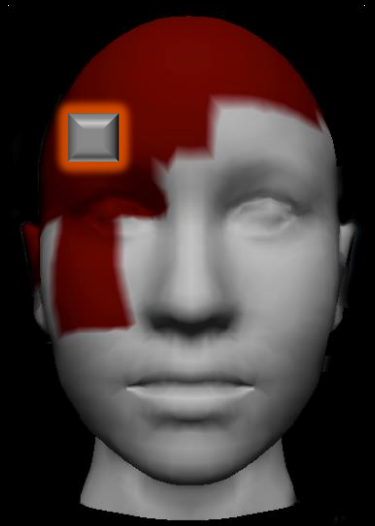
3D-Immersive NeuroNavigation in Migraine

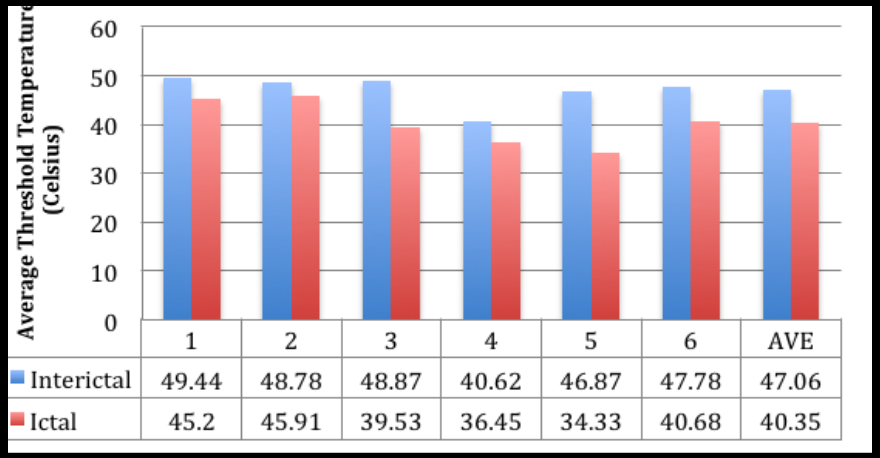


DaSilva et al, 2014
H.O.P.E. Lab, University of Michigan

Spontaneous Migraine Attacks Mu-Opioid Activation during Allodynia

Migraine Allodynia





	1	2	3	4	5	6	AVE
Interictal	49.44	48.78	48.87	40.62	46.87	47.78	47.06
Ictal	45.2	45.91	39.53	36.45	34.33	40.68	40.35

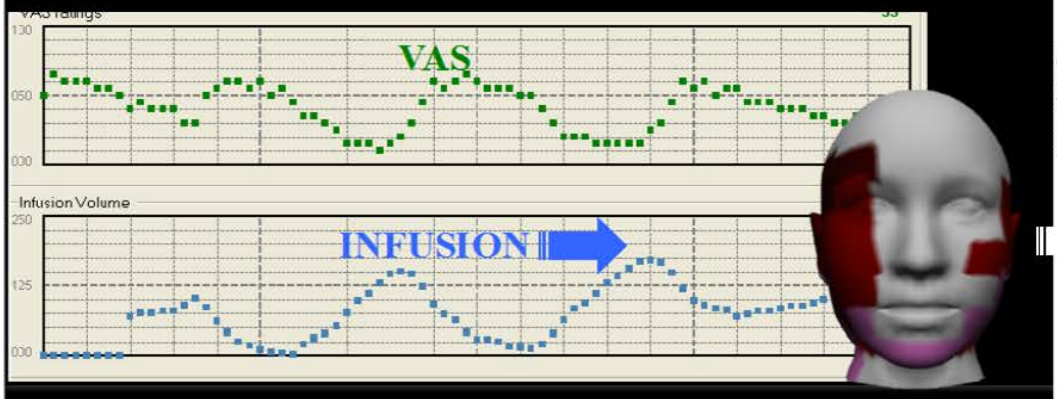
μ-Opioid Activation

NIH-NINDS K23 NS062946
NIH-NINDS R01 NS094413
DANA Foundation's Brain Award
Migraine Research Foundation

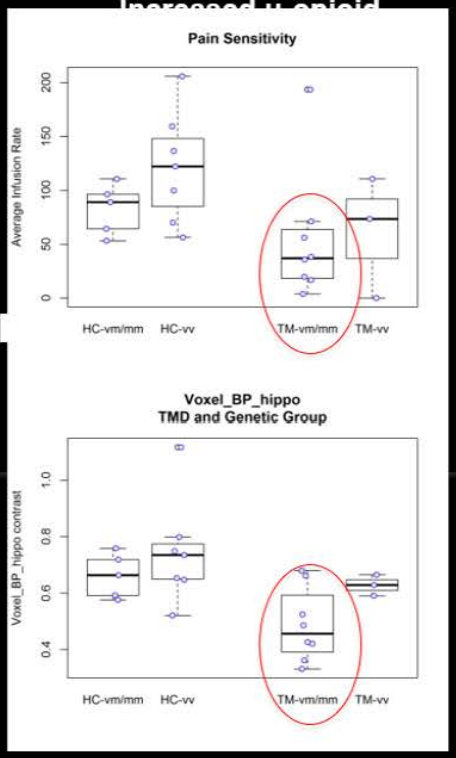
DaSilva et al, 2014
Nascimento et al, 2014
H.O.P.E. Lab, University of Michigan

Chronic TMD
Mu-Opioid Activation during Masseteric Pain

Masseteric Pain Challenge



COMT Genotype

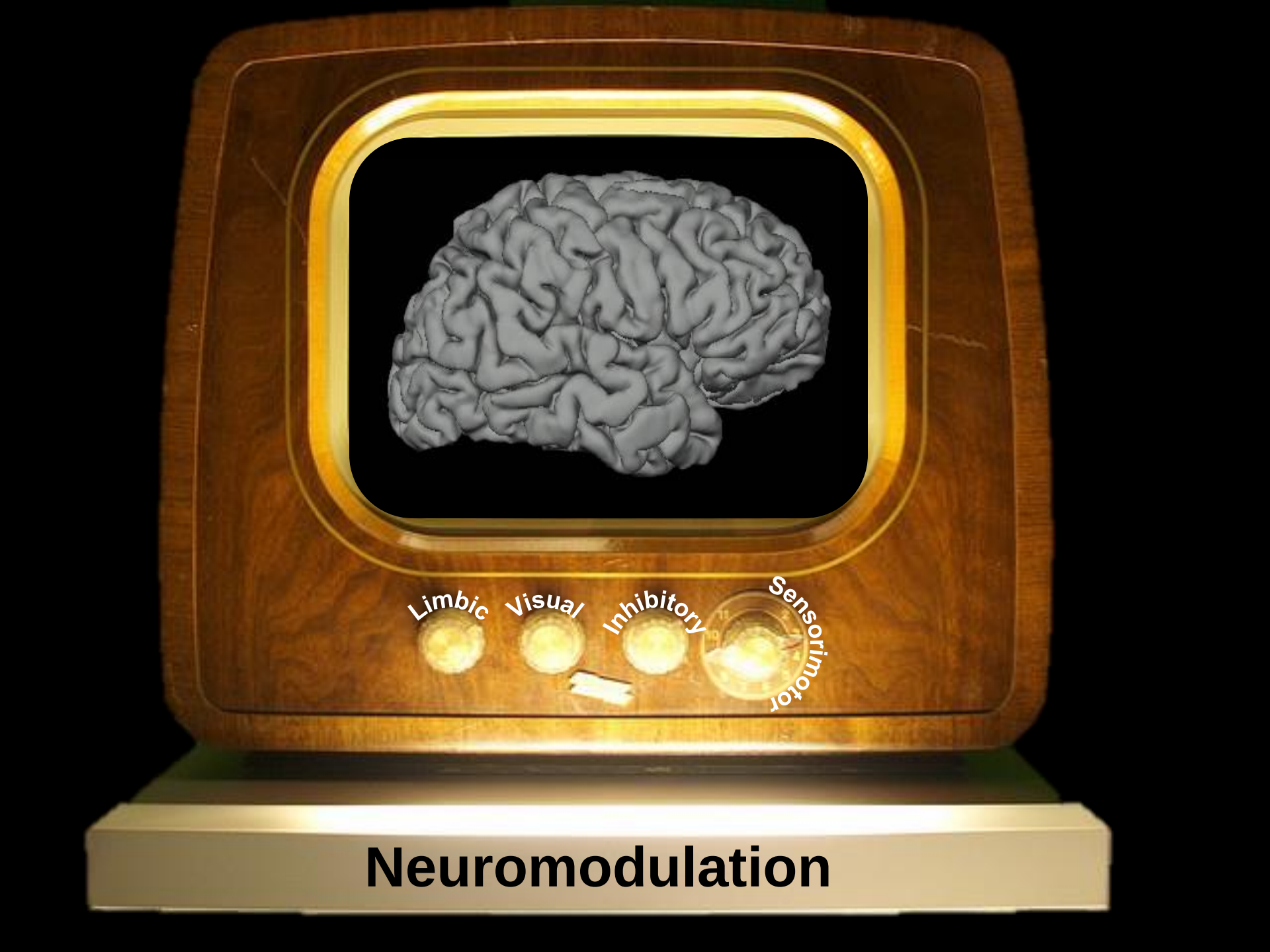


NIH-NIDCR R56 DE022637
NIH-NIDCR R01 DE025633

Under Review
H.O.P.E. Lab, University of Michigan

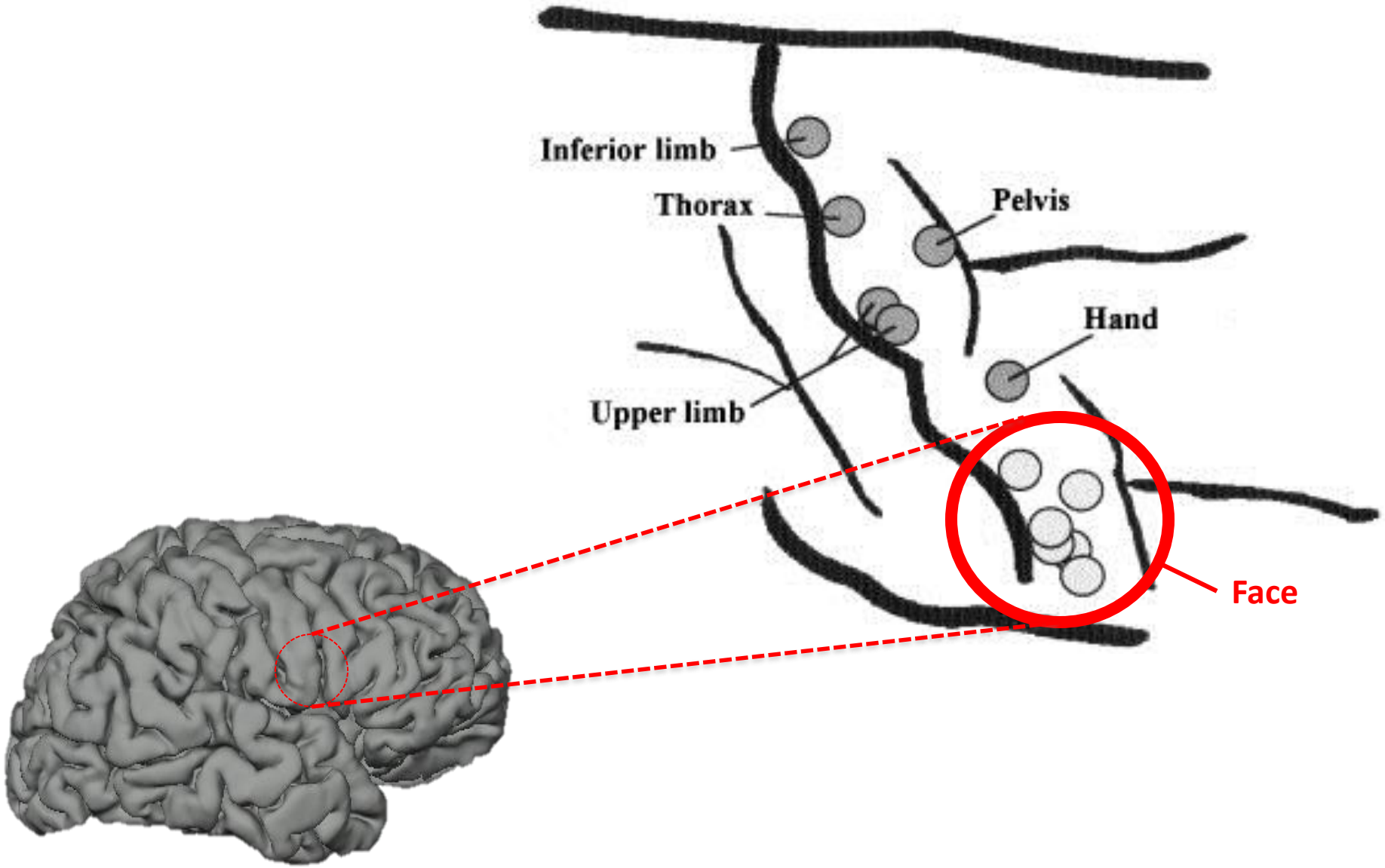
So what?

Can you do something to help me?



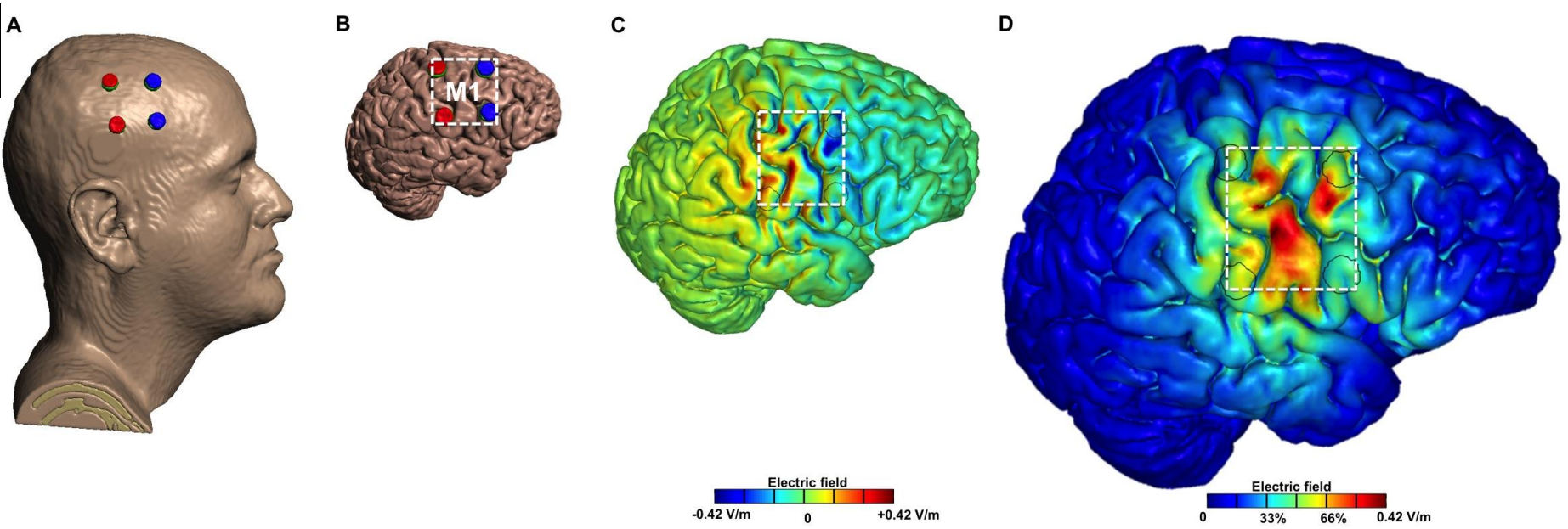
Neuromodulation

INVASIVE Motor Cortex Stimulation In The Treatment Of Chronic Pain.



Nguyen et al, PAIN, Volume 82, Issue 3, 1999, 245 - 251

Non-Invasive H.O.P.E. lab M1 HD-tDCS Montage for Chronic Pain.



Donnell et al, 2015
H.O.P.E. Lab, University of Michigan

TMD: MONTH FOLLOW-UP

VAS 50% Responders from Week 1 to Week 6			
Group	Active	Sham	Total
<50% VAS decrease	3	8	11
≥50% VAS decrease	9	4	13
Total	12	12	24

Chi-Square X^2=4.1958 p=0.04

Donnell et al, 2015
H.O.P.E. Lab, University of Michigan

Location	Time Frame	Effect	Pain Sum	Ave Pain	Pain Area
Bilateral	Study	Week	0.0042	<0.0001	0.0027
		Group	0.0851	0.9845	0.1057
		Week*Group	0.3450	0.6252	0.3403
	Treatment	Day	0.0071	<0.0001	0.0052
		Group	0.1186	0.4078	0.0977
		PrePost	0.2945	0.0084	0.2237
		PrePost*Group	0.6300	0.1176	0.3567
Ipsilateral	Study	Week	0.0132	<0.0001	0.0095
		Group	0.1170	0.6522	0.1623
		Week*Group	0.3136	0.8908	0.2470
	Treatment	Day	0.1713	0.0013	0.0139
		Group	0.2058	0.6991	0.1932
		PrePost	0.2871	0.7001	0.4564
		PrePost*Group	0.2107	0.9903	0.3297
Contralateral	Study	Week	0.0083	<0.0001	0.0045
		Group	0.0735	0.9820	0.0758
		Week*Group	0.3852	0.0924	0.4903
	Treatment	Day	0.0005	<0.0001	0.0057
		Group	0.0747	0.4471	0.0553
		PrePost	0.0007	<0.0001	0.0035
		PrePost*Group	**0.0118**	**0.0012**	**0.0088**

*p-value is for Type 3 test of fixed effect from linear mixed model for particular time frame (over study or over treatment) of particular dependent variable.

Donnell et al, 2015

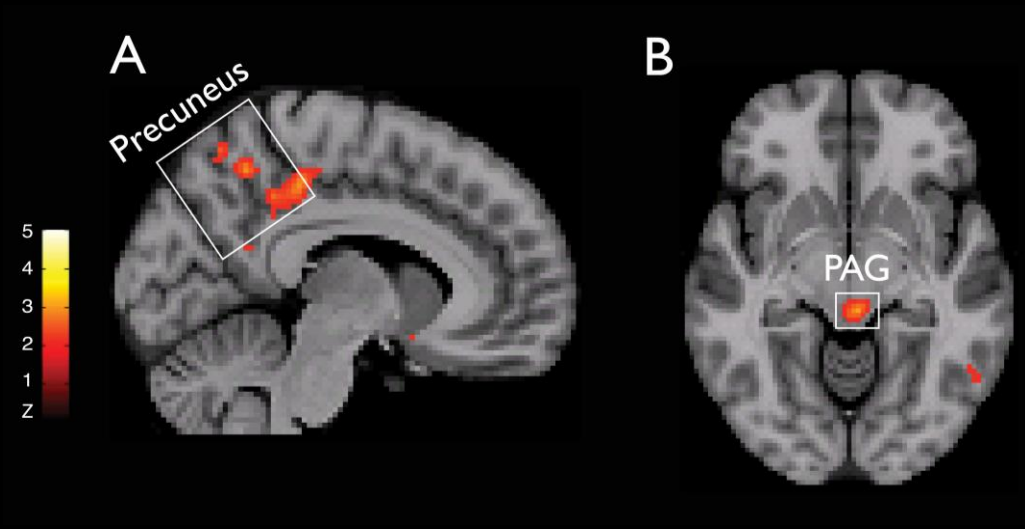
H.O.P.E. Lab, University of Michigan

Donnell et al, 2015
H.O.P.E. Lab, University of Michigan

Neuromodulation
+
Molecular Neuroimage

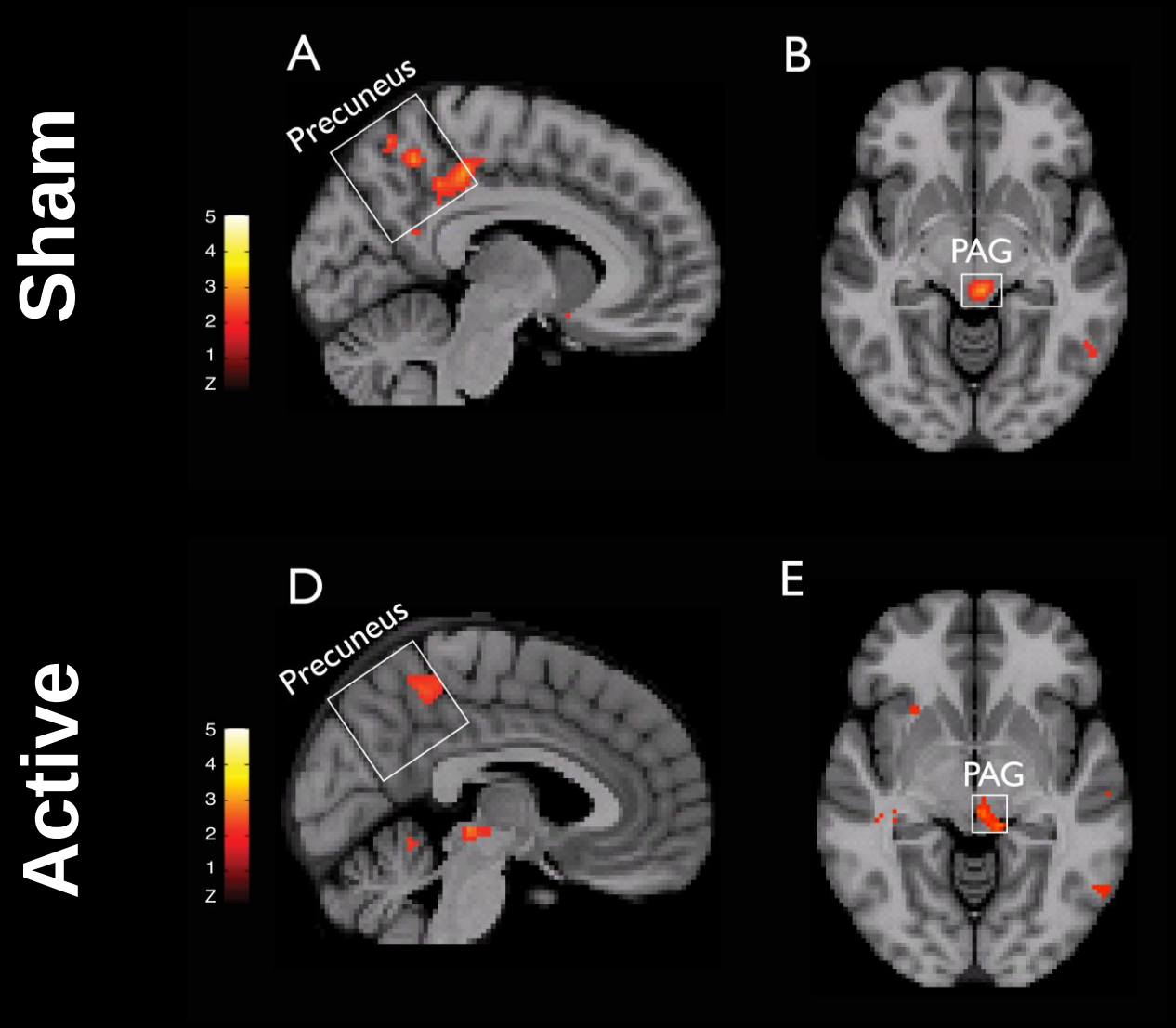
μ-Opioid Activation During tDCS

Sham



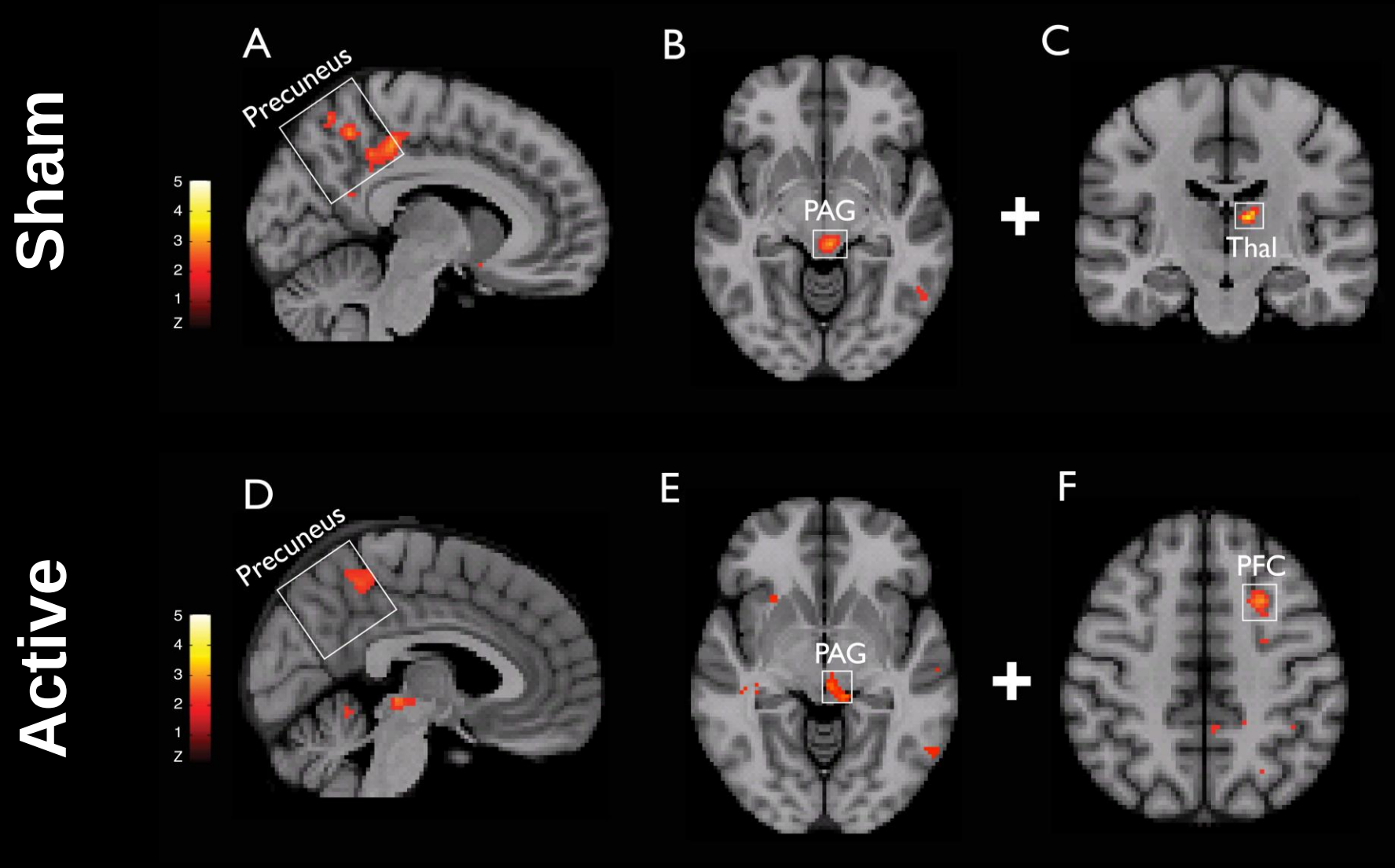
DosSantos et al, 2014
H.O.P.E. Lab, University of Michigan

μ-Opioid Activation During tDCS



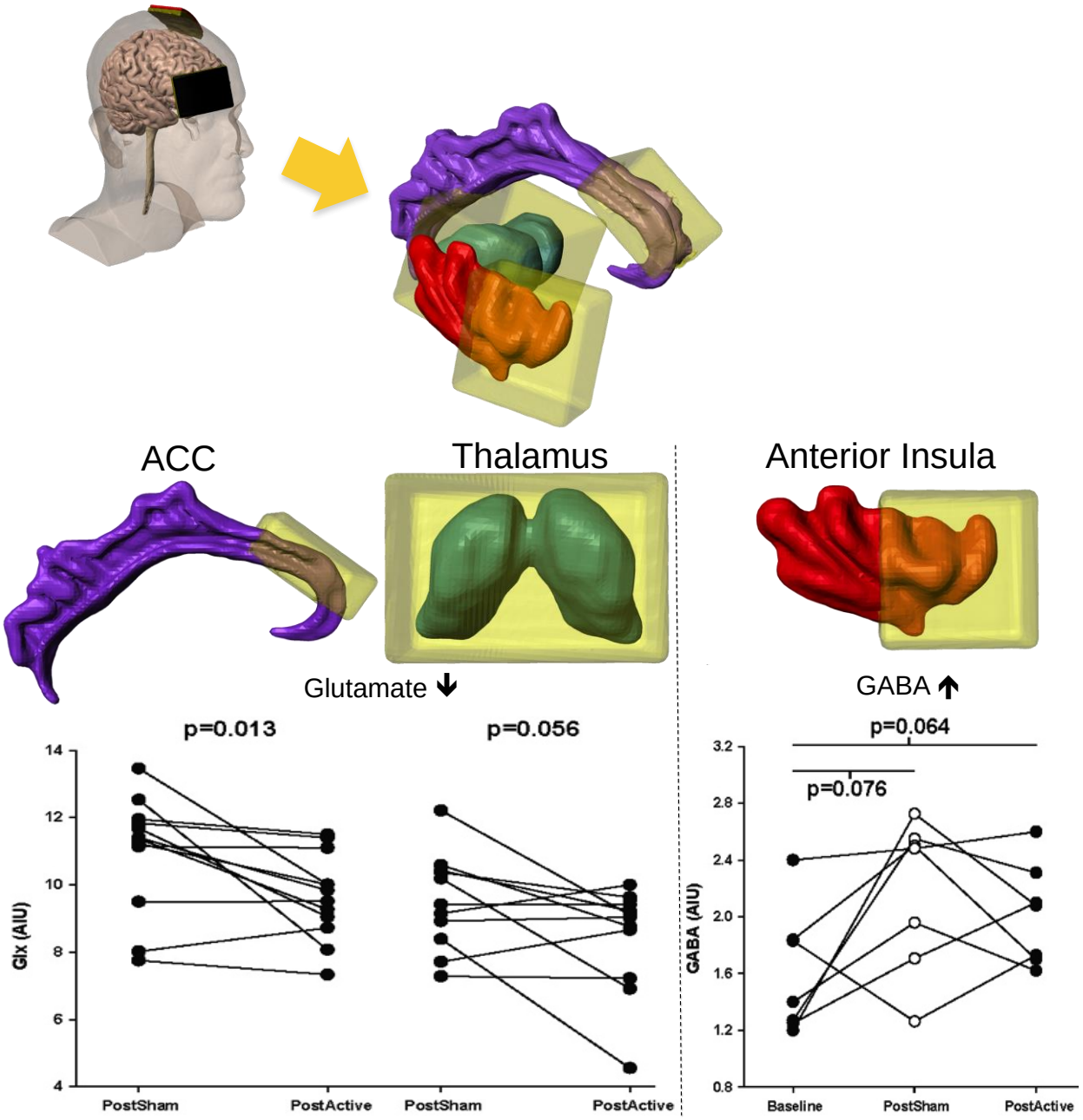
DosSantos et al, 2014
H.O.P.E. Lab, University of Michigan

μ-Opioid Activation During tDCS



DosSantos et al, 2014
H.O.P.E. Lab, University of Michigan

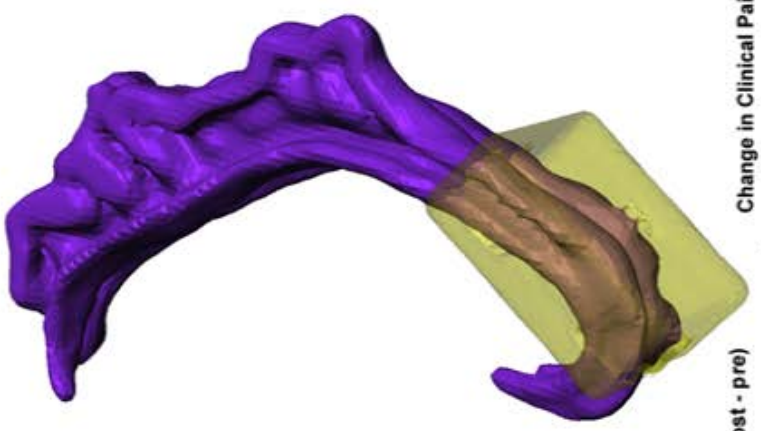
What is the Chronic Effect of Sham and Active Neuromodulation?

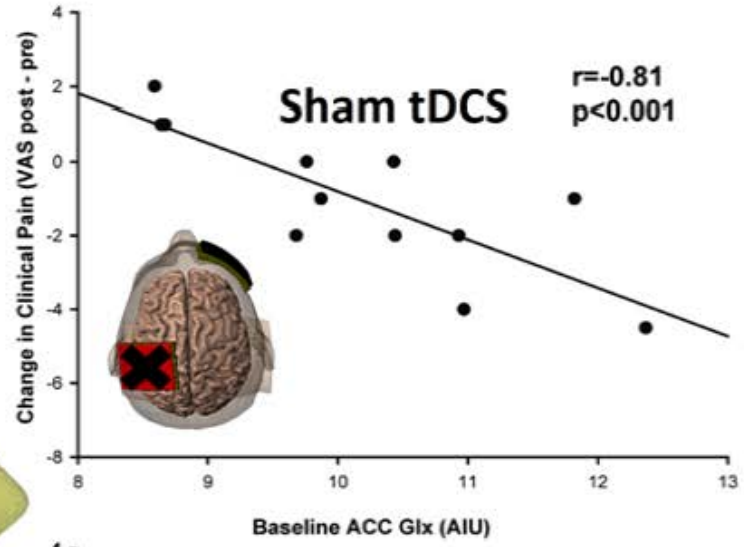


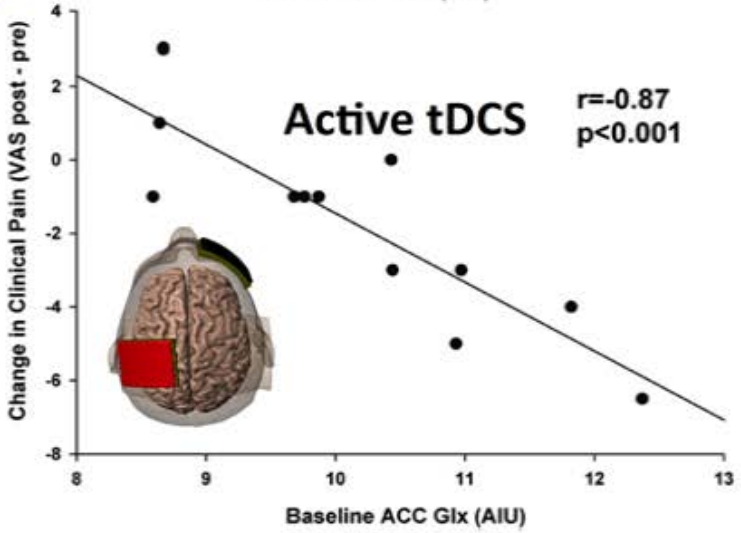
MICHR Clinical Trial Planning
CTSA High-Tech funding: UL1RR024986

Foerster et al, 2015
H.O.P.E. Lab, University of Michigan

Pre-Treament Glx within the Anterior Cingulate Predicts Subsequent Clinical Response to Sham and Active tDCS



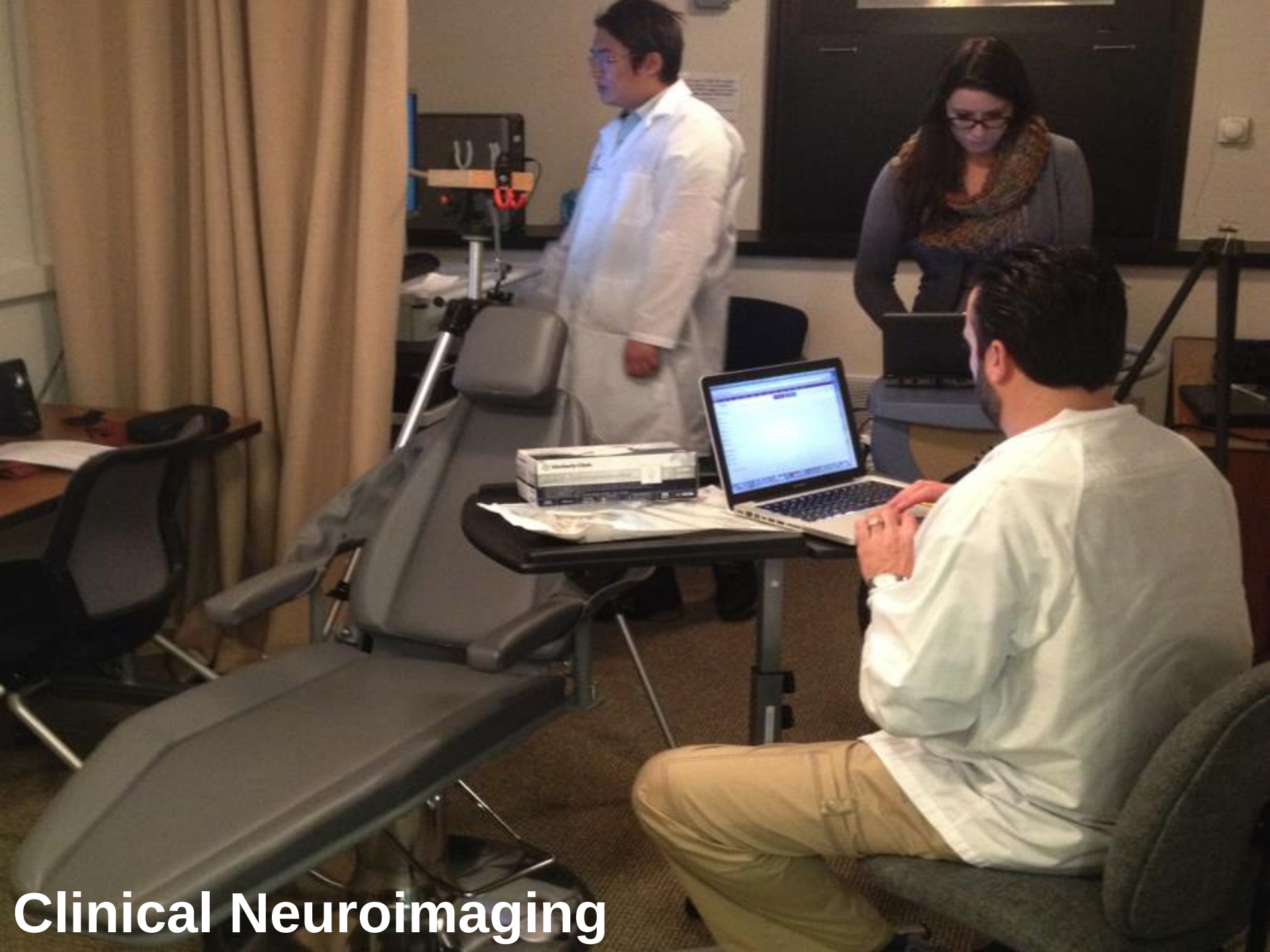




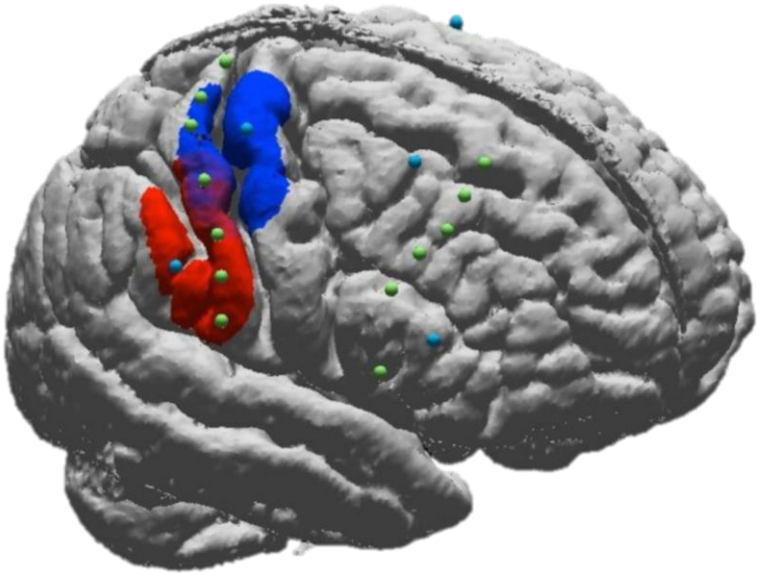
Foerster et al, 2015
H.O.P.E. Lab, University of Michigan

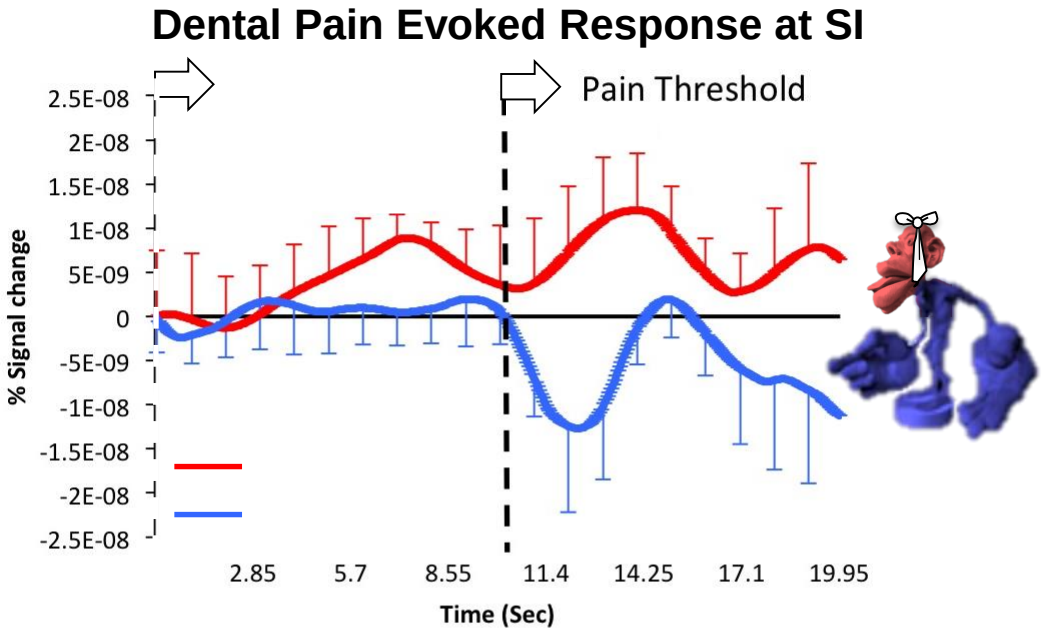
So what?

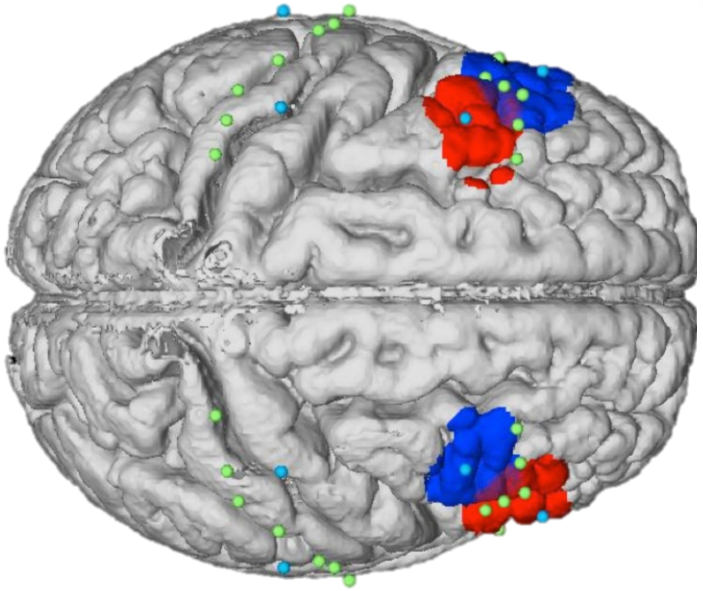
I can not read my patient's brain in the office!

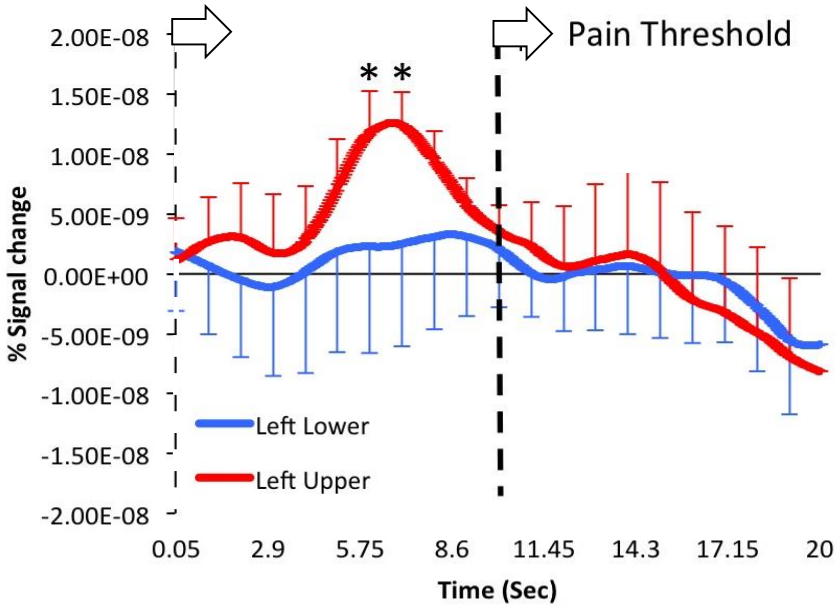


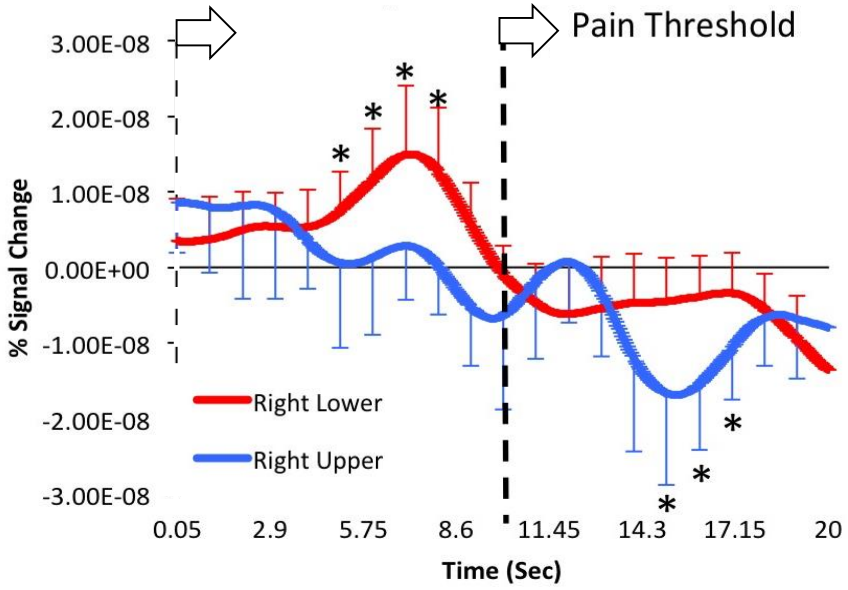
Clinical Neuroimaging




Dental Pain Evoked Response at SI
Pain Threshold
2.5E-08
2E-08
1.5E-08
1E-08
5E-09
0
-5E-09
-1E-08
-1.5E-08
-2E-08
-2.5E-08
% Signal change
2.85
5.7
8.55
11.4
14.25
17.1
19.95
Time (Sec)







Racek et al, 2015
H.O.P.E. Lab, University of Michigan

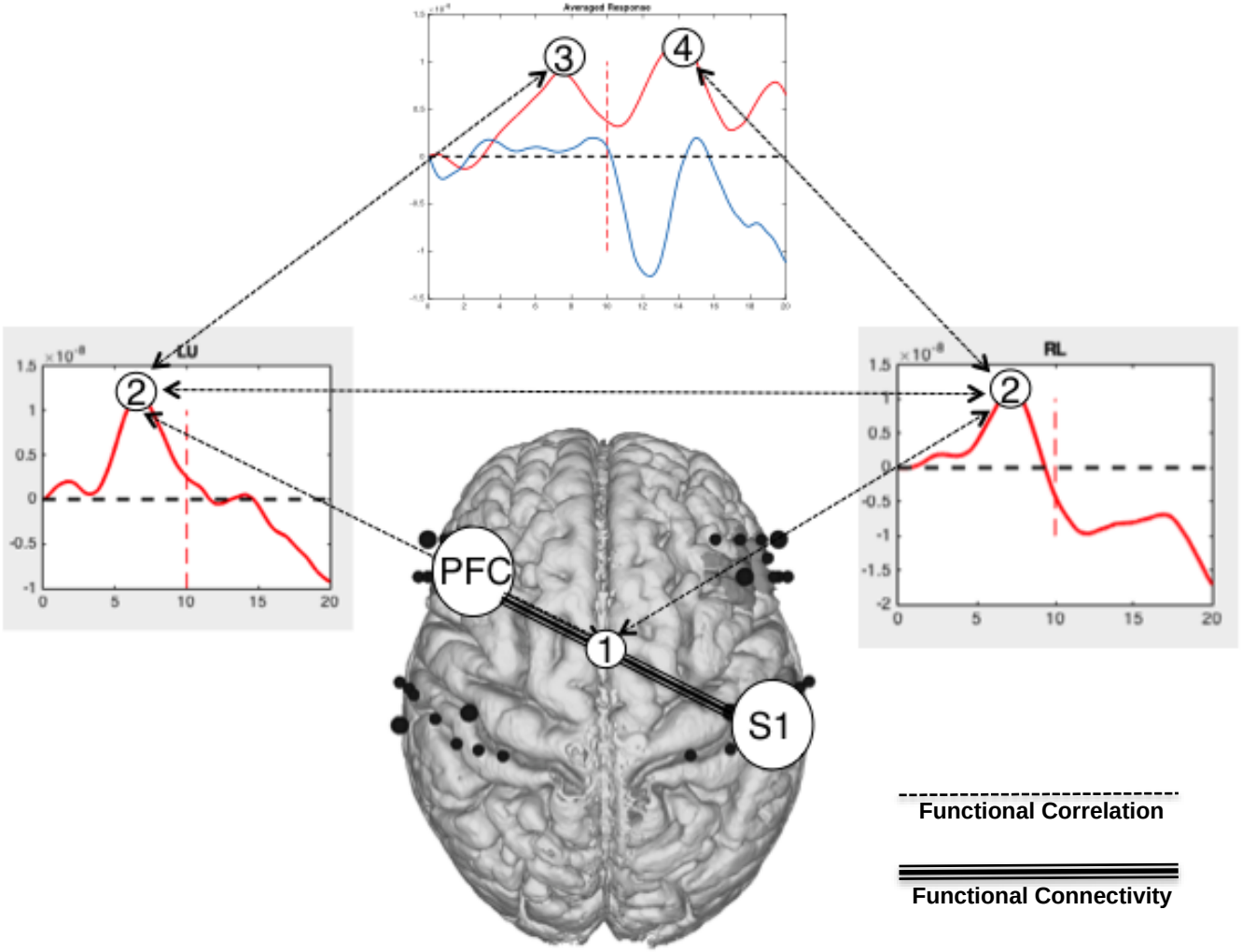
HIGHER CLINICAL PAIN

④ **Stronger Pain-Related Activity in S1**

③ **Faster and Stronger Cold-Related Activity in S1**

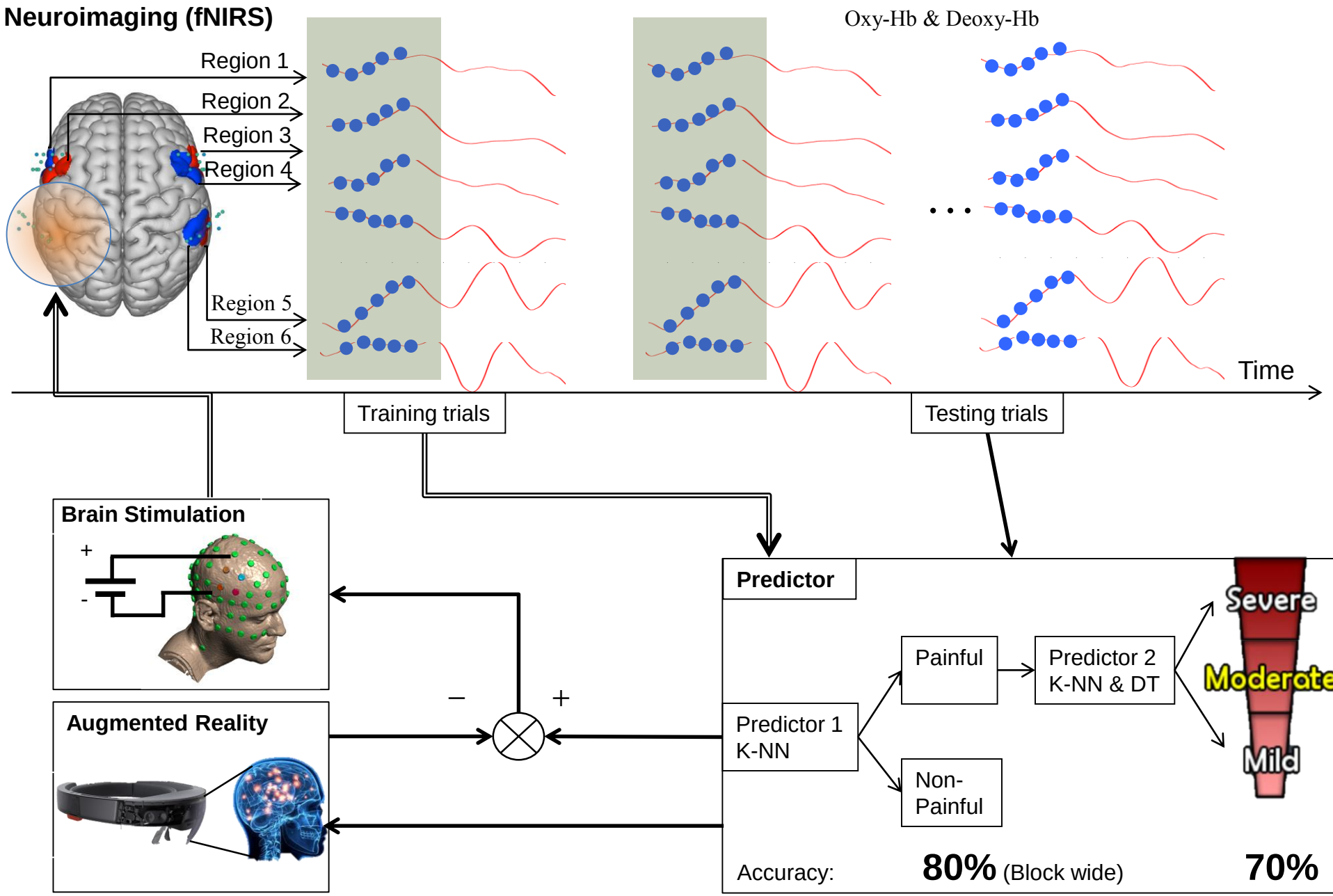
② **Stronger Activity in PFC During Pain Expectation**

① **Stronger PFC-S1 Functional Connectivity**



Hu et al
Under Review
H.O.P.E. Lab, University of Michigan

Pattern Recognition + Clinical Augmented Reality



K-NN: K Nearest Neighborhood DT: Decision Tree

MICHIGAN CLINICAL AUGMENTED REALITY FOR PAIN UNIT