

**ACCELERATED ELECTROENCEPHALOGRAPH
(EEG) GUIDED TRANSCRANIAL MAGNETIC
STIMULATION (ETMS) FOR POST-TRAUMATIC
STRESS DISORDER (PTSD) IN VETERANS AND
FIRST RESPONDERS**

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Neurostimulation for Neuropsychiatric Disorders II

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Disclosures

- No conflicts of Interest

Any off-label uses of devices or products will be disclosed and discussed in a balanced manner.

No commercial company or product names or logos will be used in this presentation.

This study was funded by:



eTMS-PTSD-001
Electroencephalogram (EEG) Personalized Transcranial Magnetic
Stimulation (eTMS) for Post-Traumatic Stress Disorder (eTMS for PTSD)

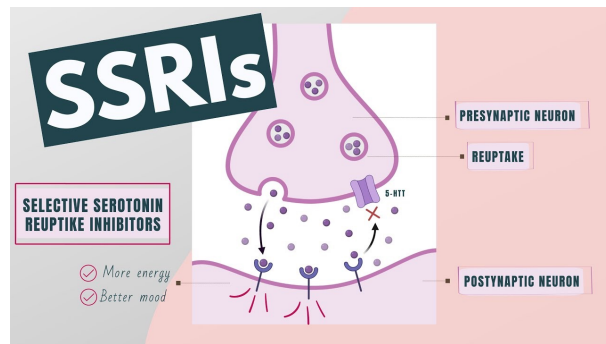
Clinical Trial Registry NCT06081309
FDA Protocol #G230168



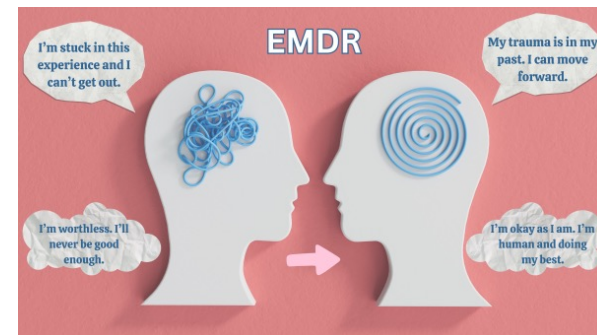
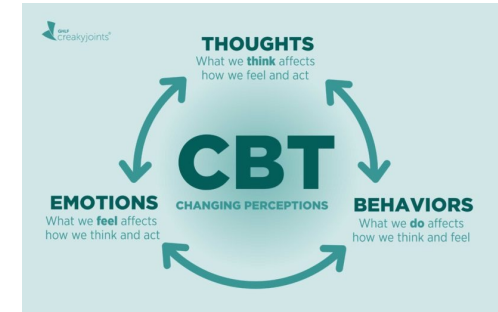
Current PTSD treatments:

Pharmaceuticals

- Anti-depressants (SSRIs)
- Anti-anxiety



Psychotherapy



Outcomes are not as high as we would prefer

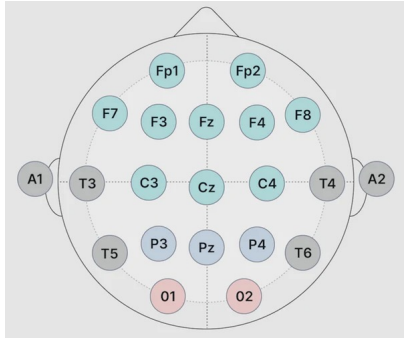
- Pharmacotherapy treats co-morbid symptoms not the root cause
- Reports of 30-50% of people do not optimally respond to to psychotherapy

<https://mindfulmovementscounseling.com/healing-trauma-how-emdr-therapy-is-the-real-deal/>
<https://creakyojoints.org/living-with-arthritis-mental-health/cognitive-behavioral-therapy-for-arthritis/>
https://www.google.com/url?sa=i&url=https%3A%2F%2Fwww.youtube.com%2Fwatch%3Fv%3D5wsWkTWJMTw&psig=AOvVawLov_tZhRWQSunK2bFb9XqD&ust=1761915618302000&source=images&cd=vfe&opi=89978449&ved=0CBYQIRxqFwoTCiCkuli-y5ADFOAAAAAdAAAAABAE



What is electroencephalogram TMS (eTMS)?

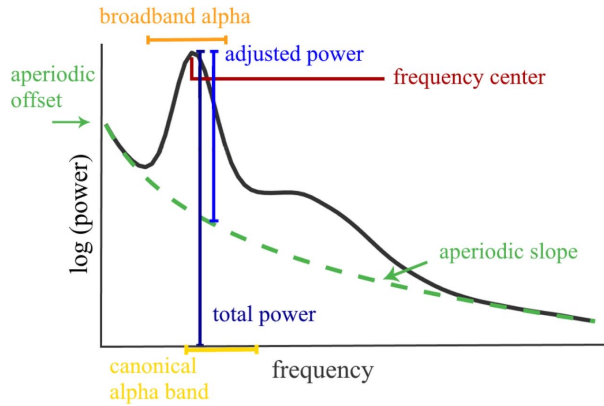
1. Collect EEG



Standard 10-20 system



2. Compute Individual Alpha



3. Conduct rTMS



rTMS machine and treatment chair



Butterfly figure-8 coil

Methods

Baseline: Determine eligibility

PCL-5 total score > 30

20 eTMS Treatments

16 participants completed 1 treatment per day
(must be completed within 35 total days)

14 participants completed 2 treatments per day
(must be completed within 21 total days)

1 Follow-Up Visit

No less than 2 hours after last treatment and within
the treatment window

Procedures	Enrollment		Randomized Study Treatment in Clinic		Follow-Up (F) Evaluations		
	SC	BL	Day 1	Days 2 through 35	(F1)	(F2)	(F3)
Acceptable windows	RD-28 to RD-2	RD-28 to RD-1	RD+1	RD+2 to RD+35	RD+20 to RD+35	RD+71 to RD+77	RD+176 to RD+196
Phone Screen	X						
Informed Consent	X						
MMSE, TMSs		X					
Demographics		X					
DHQ, BPI		X			X		
LEC-5, OSU-TBI-ID		X					
Medical History/Physical, CGI		X			X	X	X
Braincheck		X	X		X		
VR-36, PCL-5		X			X	X	X
PHQ-SADS, AUDIT, DAST-10, OCS, PSQI		X			X		
CSSRS		X			X	X	X
Concomitant Treatments, Medications, Illicit Drug and Alcohol Use		X	X	X	X	X	X
SEQ/AEs		X	X	X	X	X	X
EEG		X			X		
MT			X				
eTMS: (Active/Sham)			X	X			



Stage 1 Open Label Trial

Demographics (ITT group)

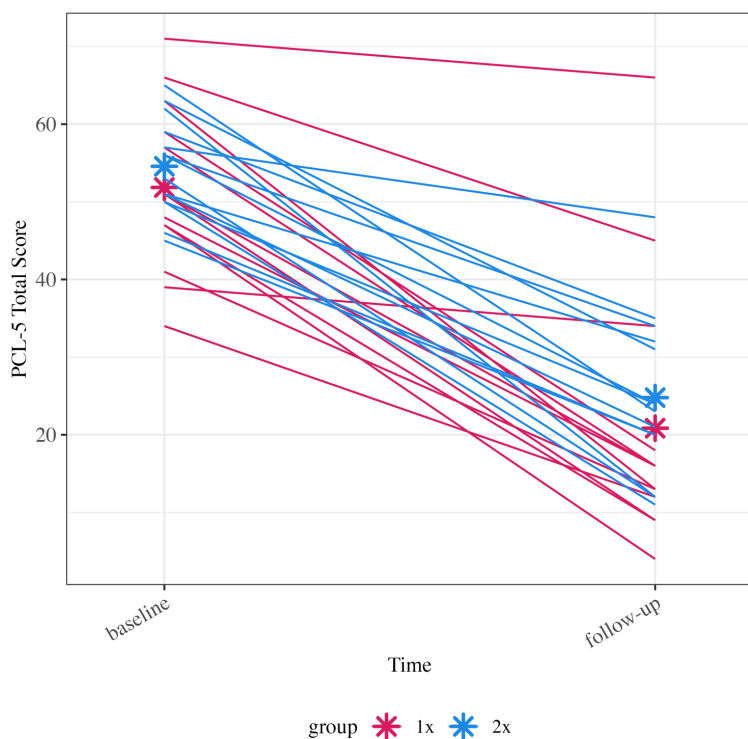
- Mean Age: 42.7 years
- 6 Female, 24 Male
- 2 Hispanic/Latino, 28 Not Hispanic/Latino
- 1 American Indian or Alaska Native, 25 White, 3 more than one race, 1 unknown/not reported
- 22 Military (retiree or Veteran), 4 Firefighters, 6 Police Officers*

Adverse Events (ITT group)

- 31 Total AEs reported
- 14/30 participants reported at least 1 AE
- 26 Mild, 3 Moderate, 2 Severe
- 17/31 AEs Not related to treatment, 5/31 suspected relationship, 9/31 definitely related
- Some observed AEs were: headache (20), irritability (2), short-term sadness (1), local site pain (1)



Behavioral Results



Variable	Summary Statistics			Linear Mixed-Effects Model		
	Mean Pre-Treatment	Mean Post-Treatment	SE	F(df)	p	η^2
1x	51.8	20.8	3.28			
2x	54.6	24.8	3.16			
Main Effect: Time				159.4(1,25)	< 0.001	0.864
Main Effect: Group				0.746(1,25)	0.396	0.029
Interaction: Group x Time				0.064(1,25)	0.803	0.003

No significant difference between the 1x and 2x protocol.

PCL-5 Total Score	Summary Statistics			Pairwise Comparison	
	Mean Difference	SE	95% CI	t(df)	Sig (two-tailed)
	-30.393	2.407	[25.44, 35.35]	-12.625(25)	<.0001

Significant decrease in PCL-5 total score (PTSD symptomology).
Decrease on average of >30 points (>10 is clinically significant).

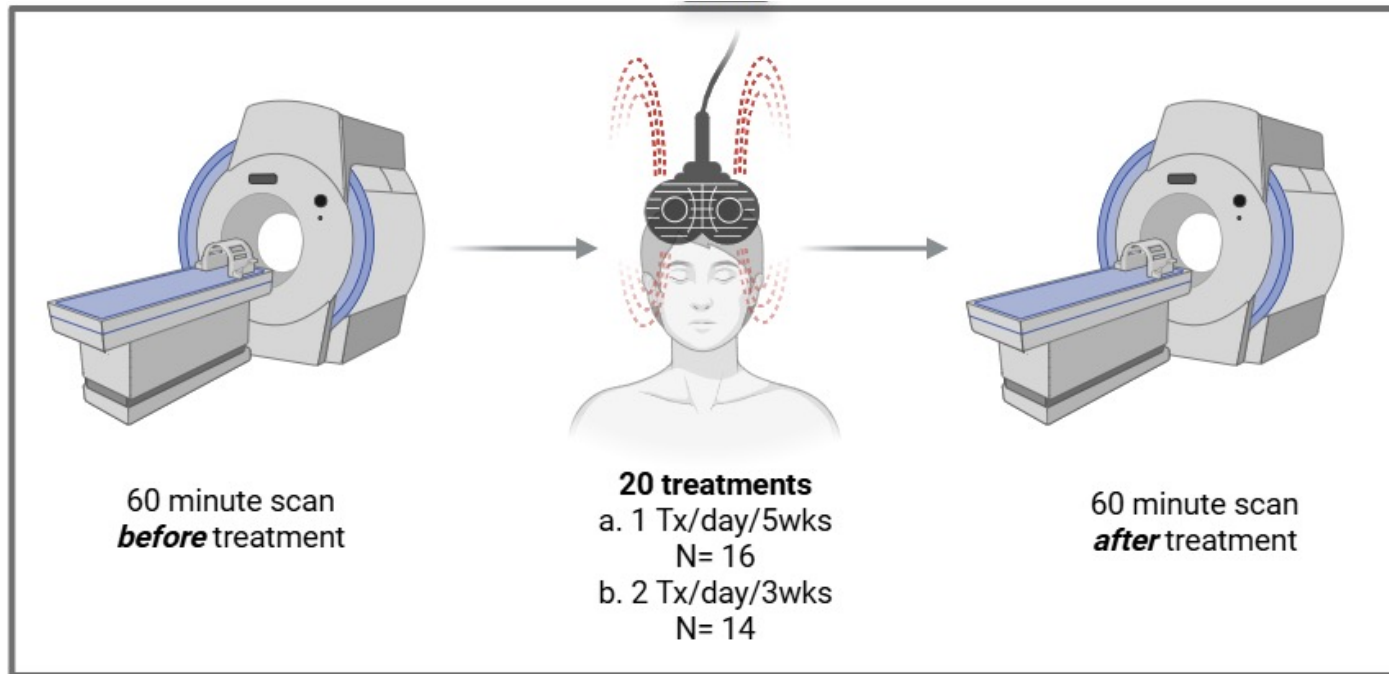
Participants (PP group):

One group (n=13) received 20 treatments once per day (1x)

One group (n=14) received 20 treatments twice per day (2x)



Stage 1 Concurrent MRI study



Participants: 16 of 26 completers first responders and/or veterans that consented for the eTMS pilot clinical trial also consented to the separate **MRI study**. All participants were aged 25-62 (mean age= 40.6, 5 females).

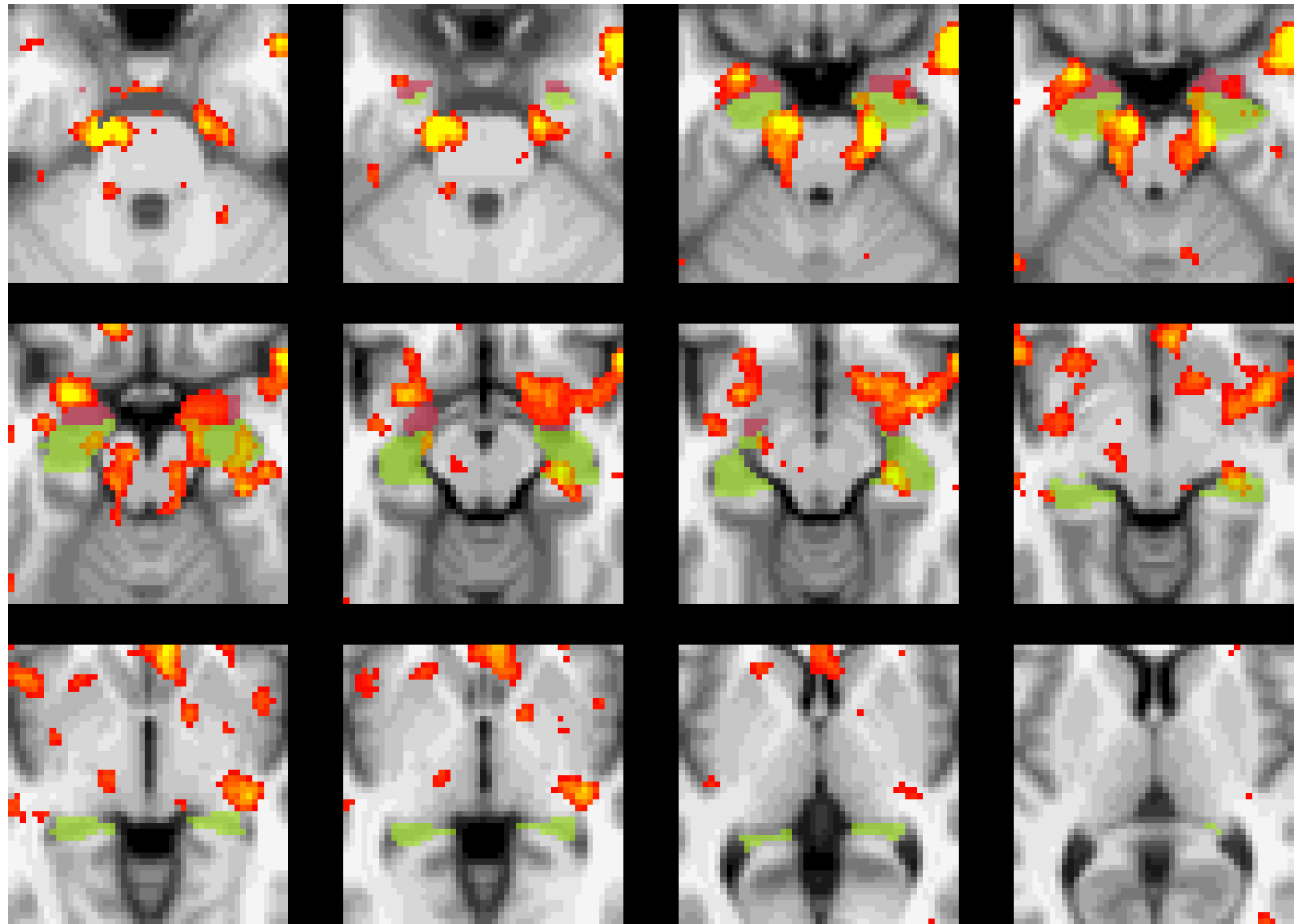
How does ASL work?

$$(SI_{\text{control}} - SI_{\text{label}})$$

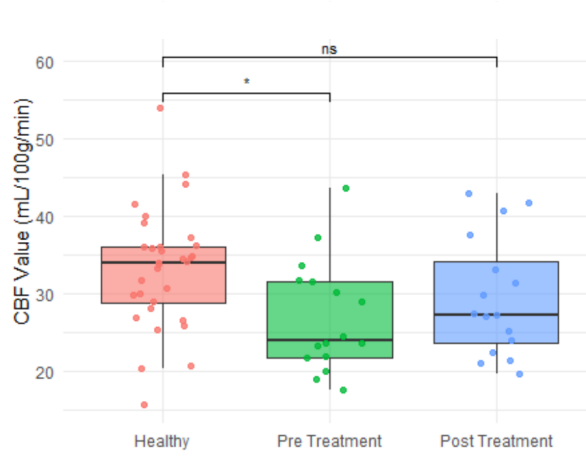


$$CBF = \frac{6000 \cdot \lambda \cdot (SI_{\text{control}} - SI_{\text{label}}) \cdot e^{-\frac{PLD}{T_{1,\text{blood}}}}}{2 \cdot \alpha \cdot T_{1,\text{blood}} \cdot SI_{PD} \cdot (1 - e^{-\frac{\tau}{T_{1,\text{blood}}}})} \text{ [ml/100g/min]}$$

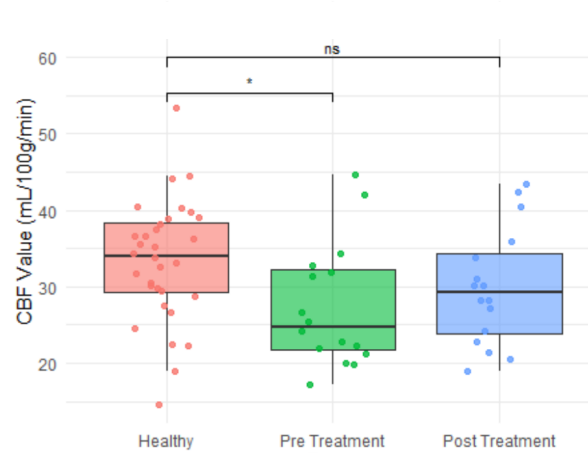
ASL perfusion
increases post-eTMS



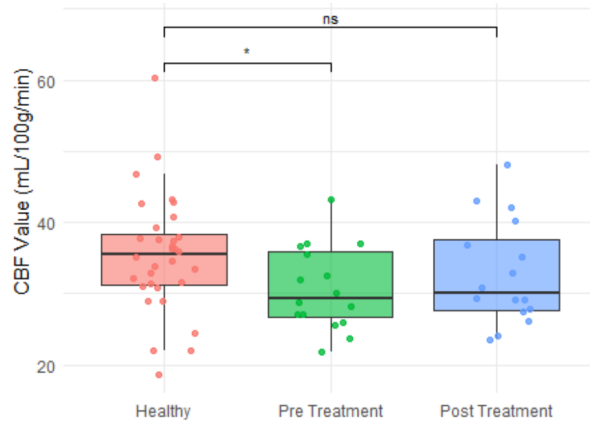
left Amygdala



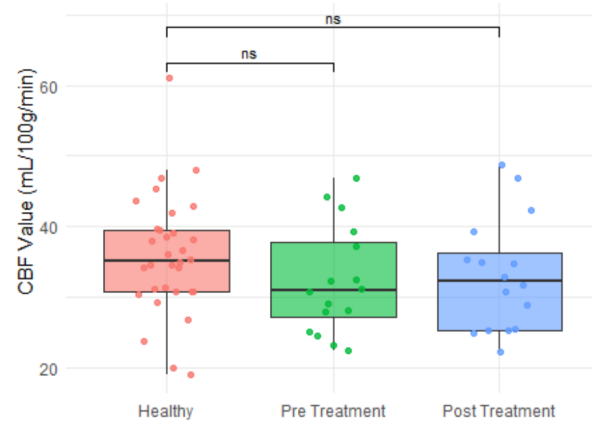
right Amygdala

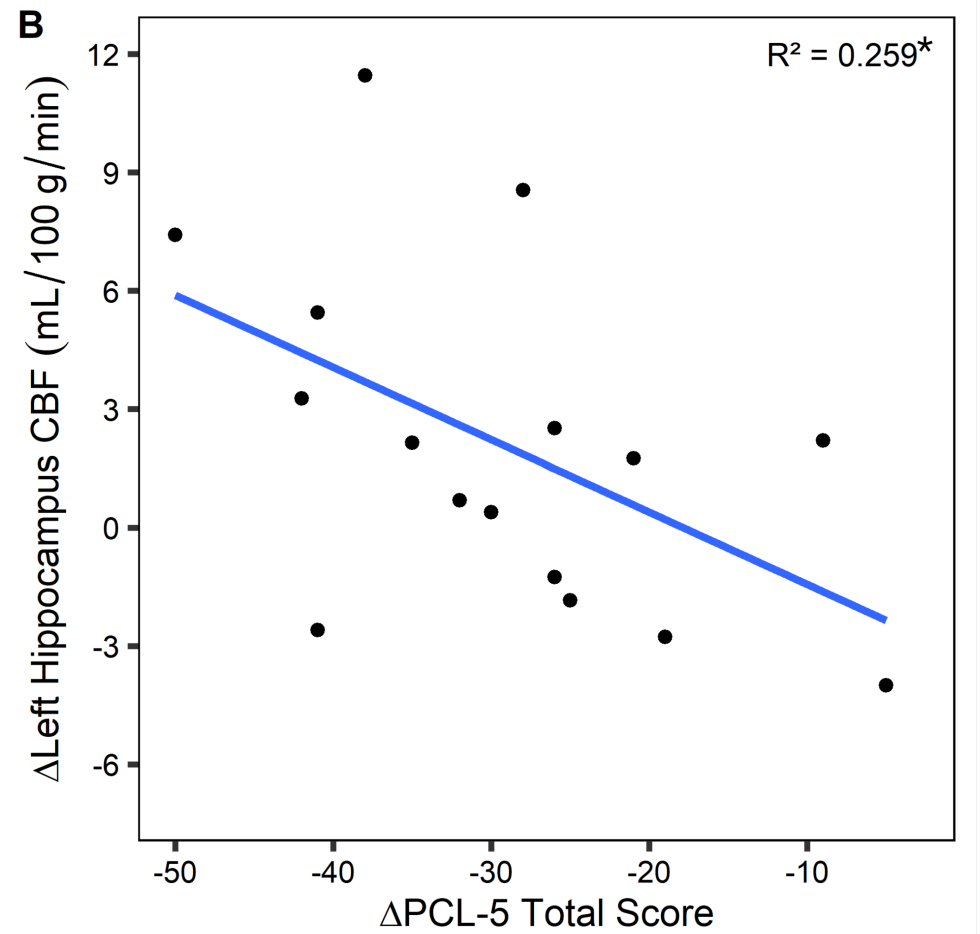
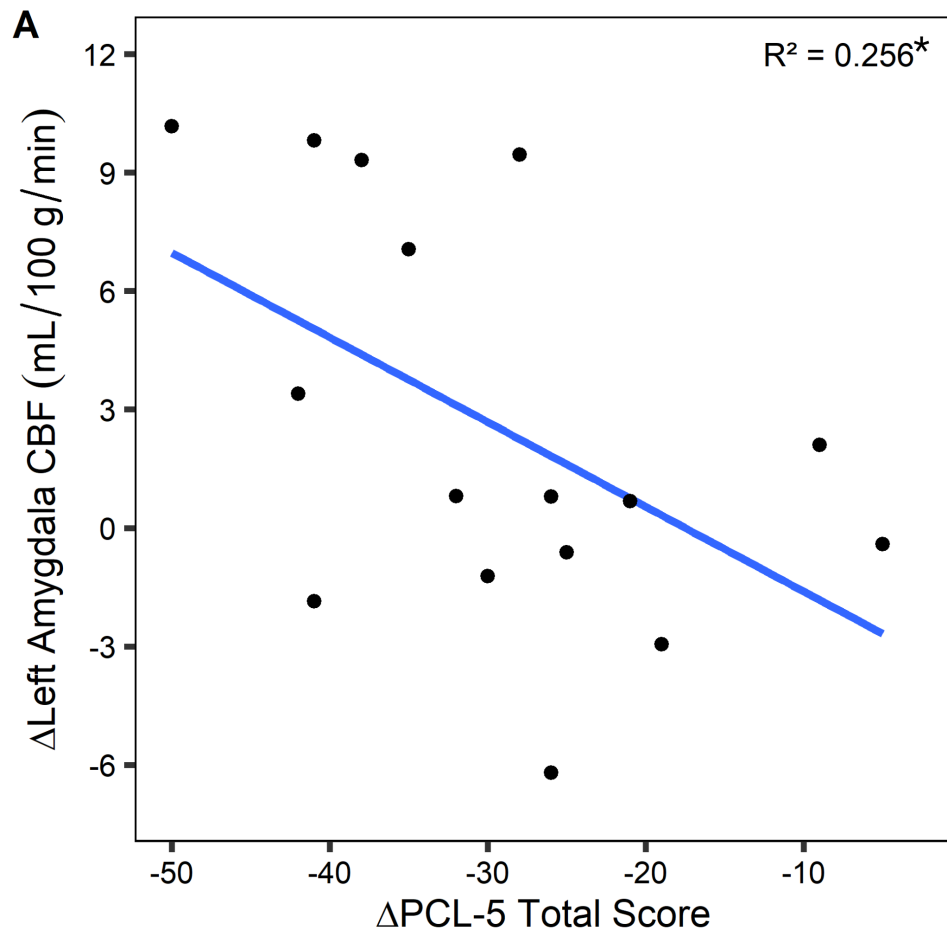


left Hippocampus



right Hippocampus





Discussion

- Personalized, non-pharmacologic and non-invasive treatments are needed to address the complex disruptions caused by PTSD⁷
- **eTMS** is a personalized non-invasive approach that has shown promise in combating PTSD
- Alterations in **cerebral perfusion** of the amygdala, frontal cortex, limbic systems, and hippocampal cortex contribute to the associated symptomology of PTSD³
- This study is the first of its kind to utilize **resting pcASL** to monitor the disruption of neurophysiology associated with PTSD
- This study revealed, for the first time, **resting CBF is diminished** below healthy levels in individuals suffering from PTSD **in regions involved in emotion and attention regulation**^{2,3}
- We identified **20 sessions of personalized eTMS** increases resting CBF in these regions, and such **changes were correlated with a decrease in PTSD symptomology** measured via the **PCL-5**



QUESTIONS?

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