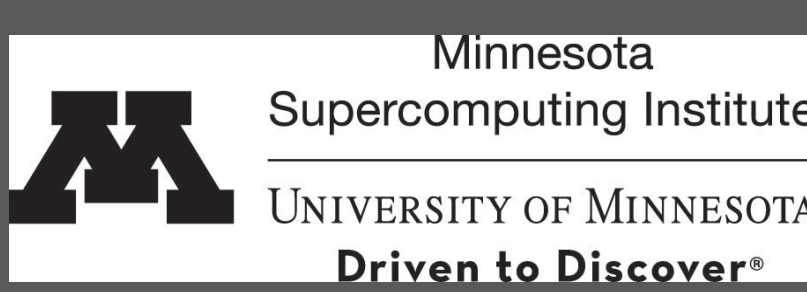


# Neurofeedback during Self-face Processing in Depressed versus Healthy Adolescents

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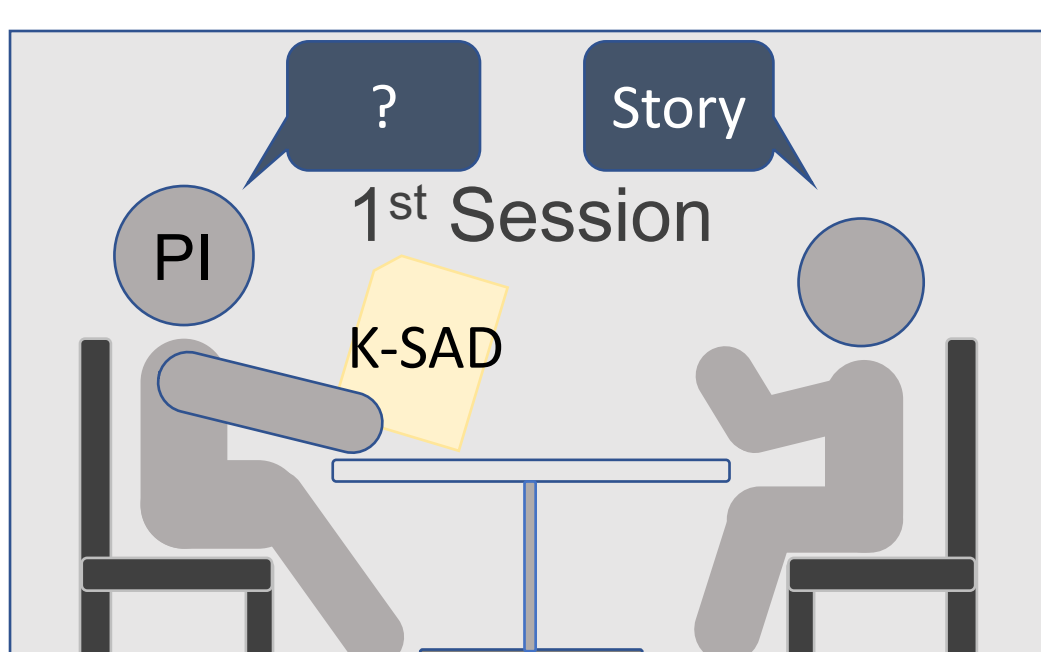
## Introduction/Background

- 12.8% of youths (age 12-17) in the U.S. have depression (NIMH, 2017). Patients mood disorders have 25 times higher suicidal attempts rate (U.S. HHS Office, 2012). Major depressive disorder (MDD) symptoms and suicidal attempts continue in adulthood. A key factor affecting depressed youths which increases suicide risks is negative self-processing.

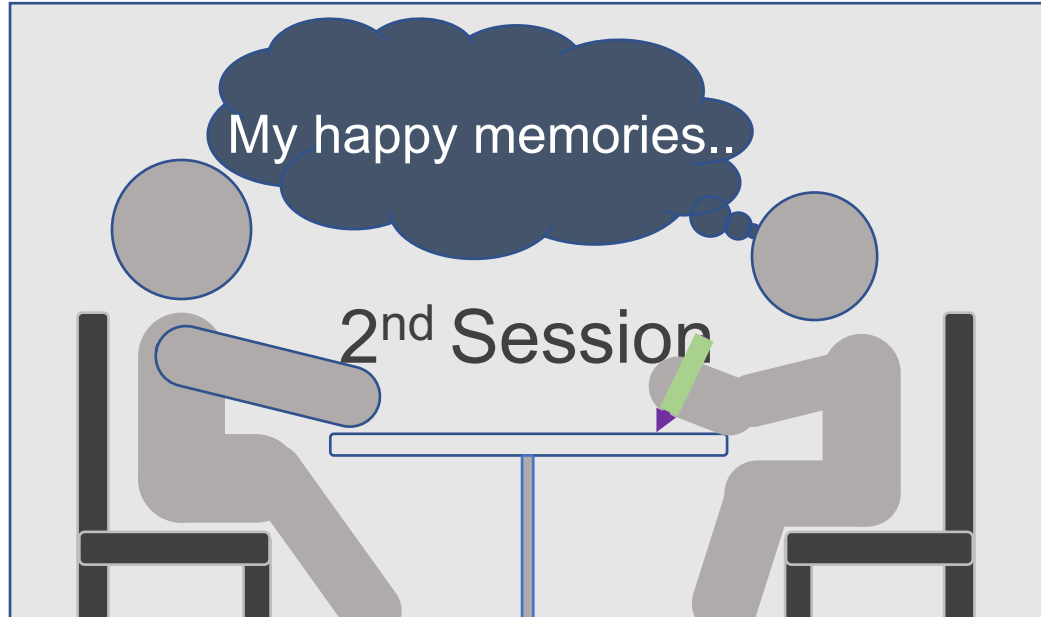
## Main objectives

- To modulate the neural functions supporting self-processing (how they think and view themselves) using a neurofeedback (NF) task in adolescents.
- To explore the short term changes depressed mood, rumination, and event attributional style in adolescents with and without significant depression.
- **Research Question:** What common or different brain areas of activity will be present among adolescents with and without depression during a neurofeedback task that uses the self vs. another face.

## Method



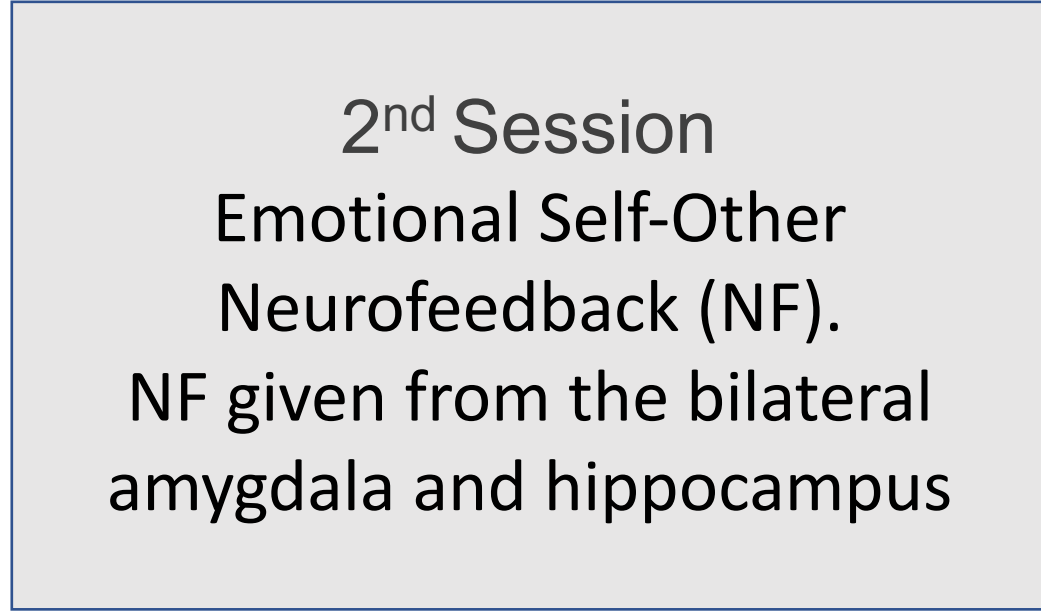
+Demographic information collected  
Interview based symptoms group decided



+CMRR safety screening & questionnaire  
+Everyone chose top 5 happy memories



+Individuals done NF and CB task in the 3Tesar-B fMRI machine at CMRR



NF given from the bilateral amygdala and hippocampus

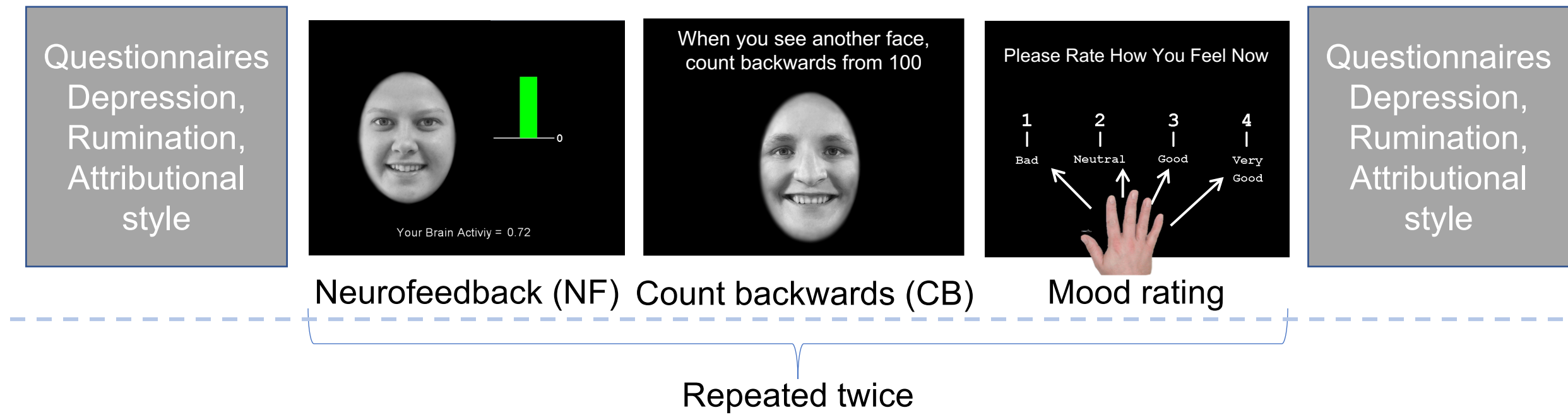
	Healthy Control	Depressed
	n=19	n=34
Suicide attempters	n=0	n=15
AgeS1:M (SD)	16.26(1.19)	16.08(1.27)
AgeS2:M (SD)	16.35(1.23)	16.11(1.25)
IQ:M (SD)	115.32(9.12) <sub>a</sub>	108.35(10.84) <sub>b</sub>
Sex		
Male	7(36.84%)	10(29.41%)
Female	12(63.16%)	24(70.59%)
Puberty: M(SD)	4.53(0.65)	4.53(0.68)
Family Structure		
Married	15(78.95%)	22(64.71%)
Living with partner	1(5.26%)	3(8.82%)
Separated-Divorced	3(15.79%)	5(14.71%)
Single	0	4(11.76%)
Antidepressants	0	26
Antipsychotics	0	2
Mood stabilizers	0	0
Anxiolytic	0	10
Depression Severity: M(SD)	19.21(3.56) <sub>a</sub>	49.85(16.14) <sub>b</sub>
Self_Esteem: M(SD)	134.9(27.87) <sub>a</sub>	106.2(20.9) <sub>b</sub>
Attributional Style: M (SD)	-6.32(3.67) <sub>a</sub>	-0.47(7.67) <sub>b</sub>
Depression before neurofeedback; M(SE)	3.76(3.95) <sub>a</sub>	30.5(13.32) <sub>b</sub>
Depression after neurofeedback; M(SE)	2.26(2.46) <sub>a</sub>	21.47(16.32) <sub>b</sub>
Rumination before neurofeedback; M(SE)	29.31(6.97) <sub>a</sub>	50.41(11.76) <sub>b</sub>
Rumination after neurofeedback; M(SE)	27.89(7.25) <sub>a</sub>	44.35(14.34) <sub>b</sub>

Note. Different subscripts denote s significant statistical differences.

+NF: Brain activities shown as a bar graph paired with self smiling face. Participants recalled happy memories to raise bar.

+CB: Unfamiliar teen's face appeared on the screen and participants counted numbers backwards from 100 by 1.

+Participants finished 3 questionnaires before and after the task.



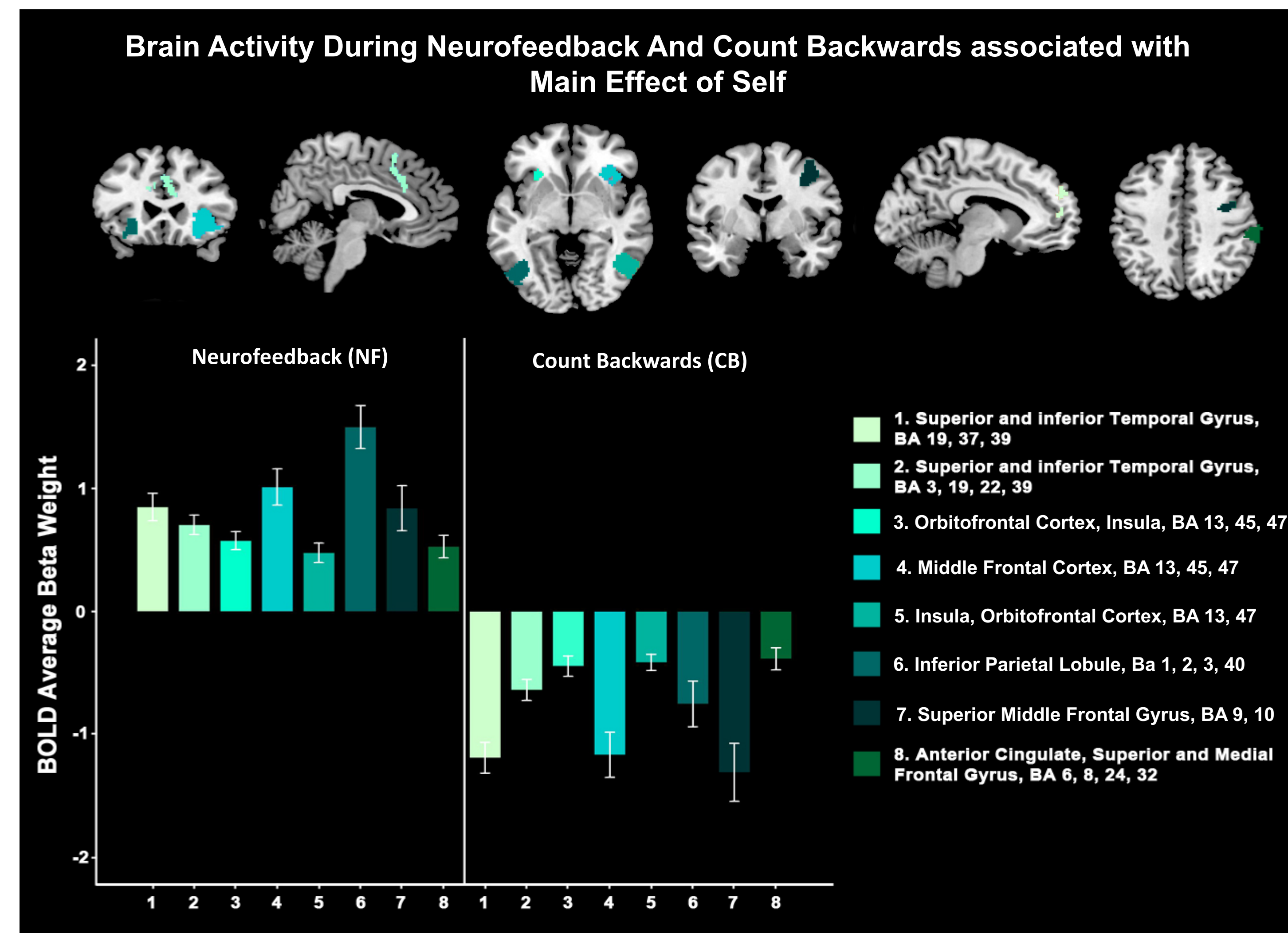
Repeated twice

## Analysis

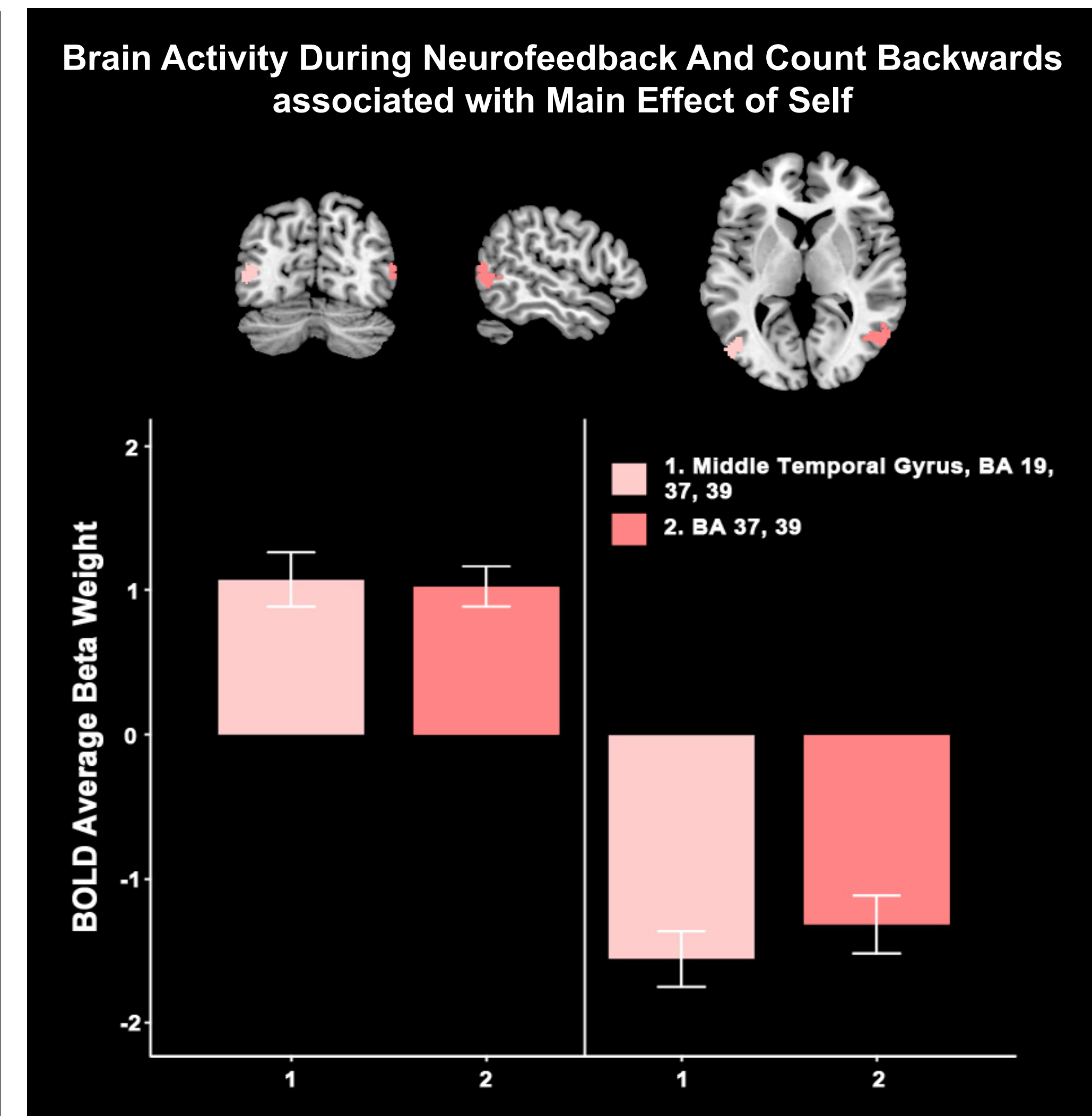
The task was built using E-Prime® and the data were stored in MSI.

1. A full factorial GLM was conducted using SPM 12 in MSI included group and feedback conditions as factors.
  2. Two separate GLMs explored feedback conditions : depressed, controls separately.
- +Xjview in MSI yielded voxel based active brain areas and labels.  
+A strict control for multiple comparisons (P-FWE 0.05).

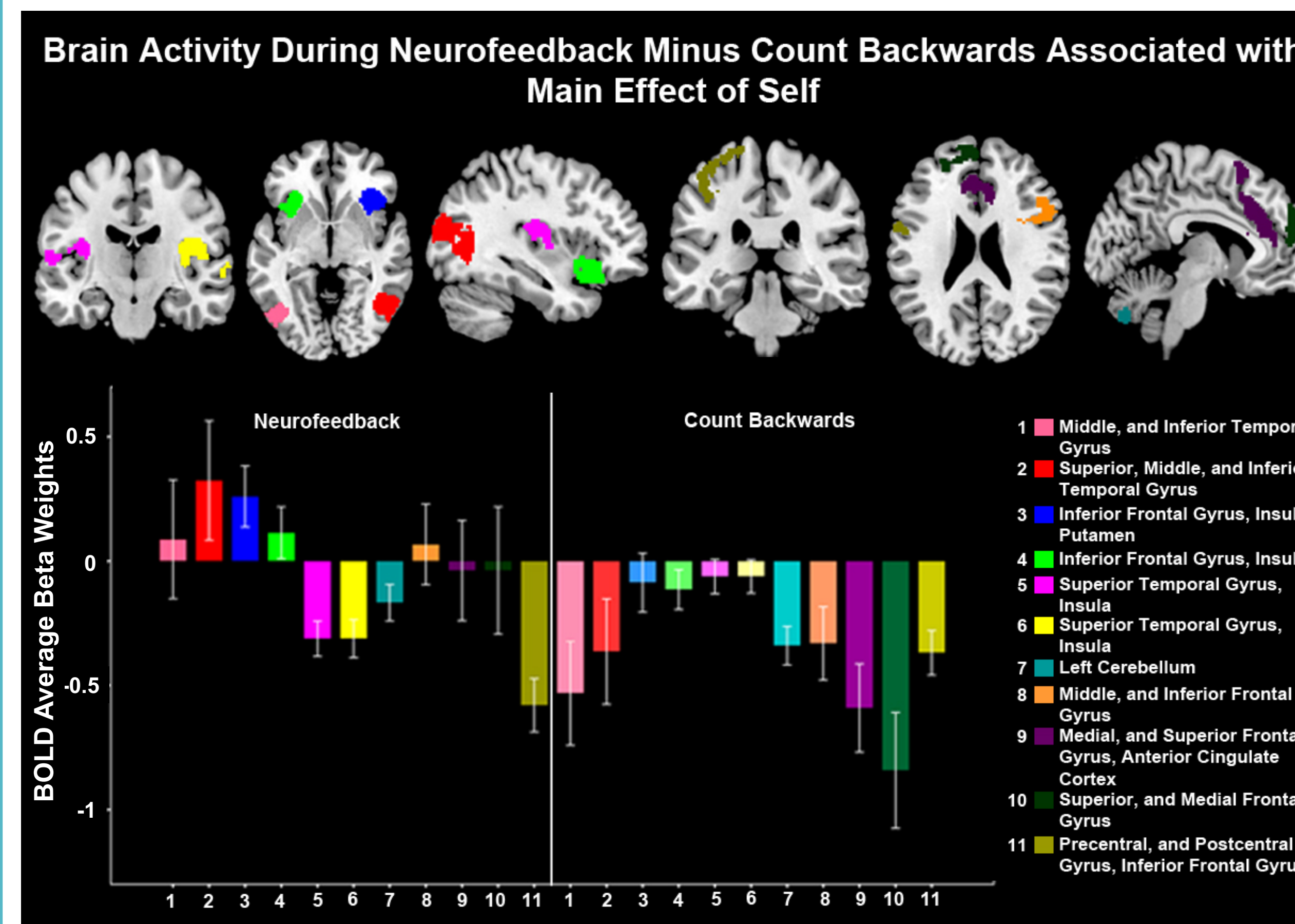
## Results



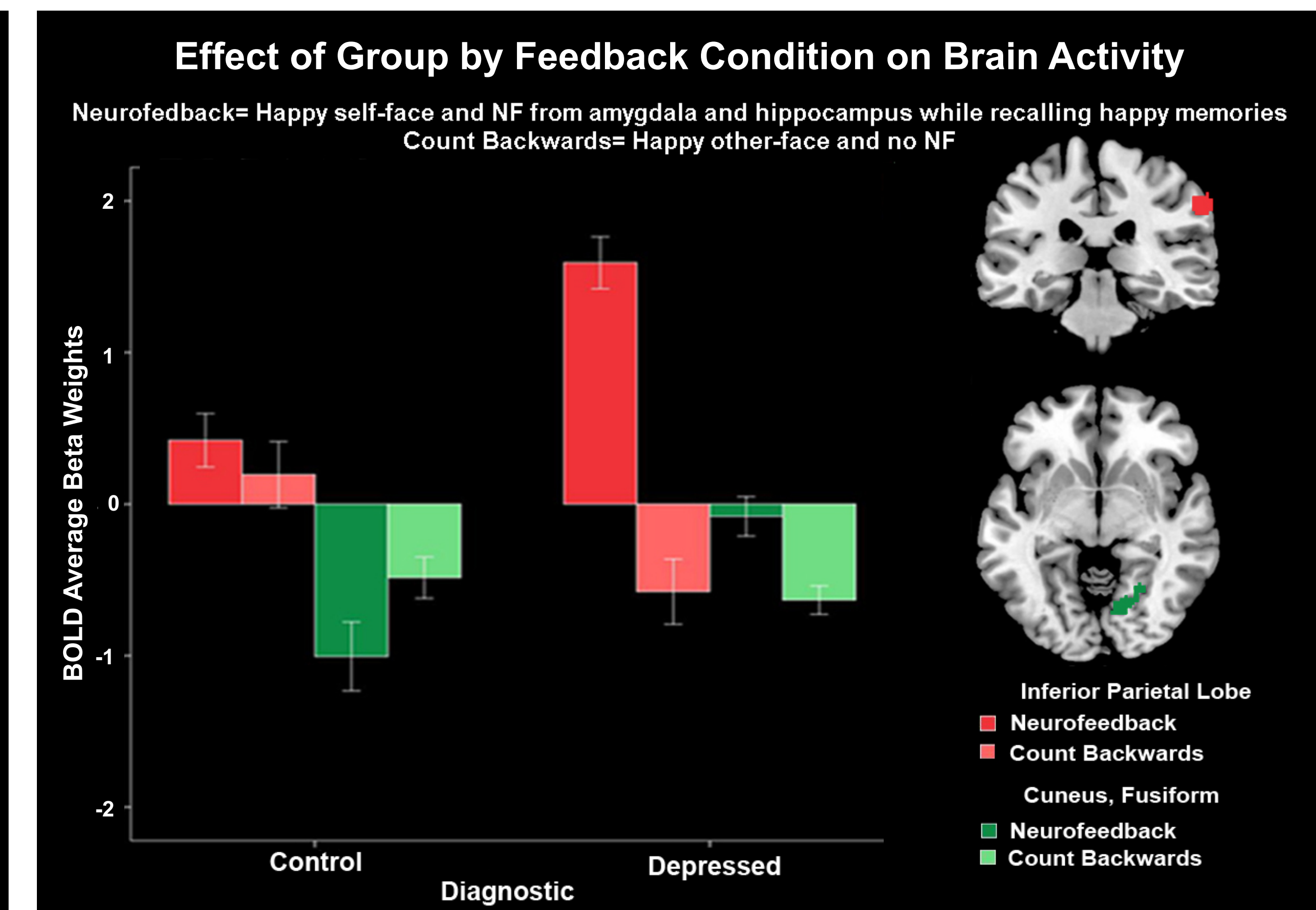
**Figure 1. Main Effect of Feedback conditions (NF and CB) in Depressed youth.** Brain activity for both conditions within adolescents with depression. Anterior Cingulate (self-processing), Insula (processing of proprioceptive stress, feelings, empathy, uncertainty in decision making), Inferior Parietal Lobe (high level features of faces, emotion-body image), and Orbitofrontal Cortex (feelings).



**Figure 2. Main Effect of Feedback conditions (NF and CB) Control Group.** Areas related to self-processing (fusiform) and memory retrieval and attention (angular gyrus) were involved.



**Figure 3. Main Effect of Feedback conditions (NF & CB) in all participants.**



**Figure 4. Group by Feedback interaction.** Inferior Parietal Lobe, Cuneus (related to apathy, integration of cognitive processes), and Fusiform Gyrus. However, the depressed youths showed less activity in the same brain areas during CB vs. NF compared controls.

## Conclusion

1. Neurofeedback during self-face processing and positive memory recall elicit more activity in midline cortical structures that enable emotion regulation, proprioception, and motor function. Depressed youths showed more activity during NF vs. CB, compared to healthy controls, in areas that support self-processing (fusiform) and perception of facial emotions and language.
2. Only depressed participants showed significant reduction in rumination and depressed mood, but no change showed in controls as expected. This could be a regression toward the mean in depressed youth.
3. Possibility of fMRI-NF as a new in vivo tool for the adolescents with treatment resistant depression.

## References

1. Major Depression. Retrieved Mar. 25 from <https://www.nimh.nih.gov/health/statistics/major-depression.s.html>
2. U.S. Department of Health and Human Services (HHS) Office of the Surgeon General and National Action Alliance for Suicide Prevention. (2012). 2012 National strategy for suicide prevention: Goals and objectives for action. Washington, DC: HHS, 1-184

## Limitation and future study

- No placebo group: the change in depressed mood and rumination might be due to the NF training or due to the regression toward the mean.
- Changes in mood and rumination are short term but we plan to follow up those who provided permission to contact in the future in 3-4 years.