Music and Depression

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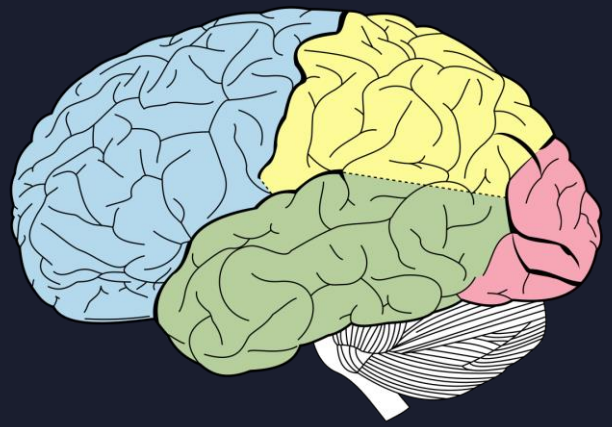
Introduction

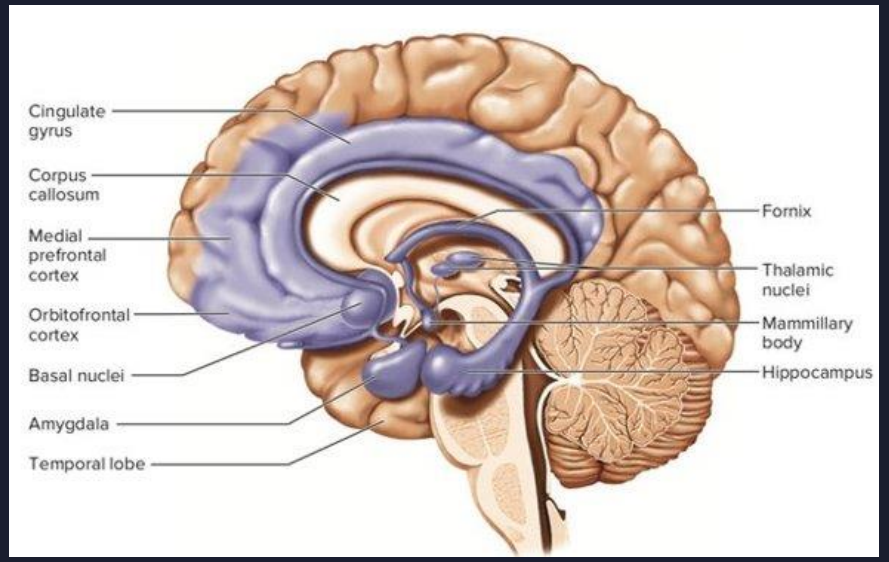
- Depression or major depressive disorder (MDD) causes persistent negative feelings
- Literature indicates that individuals with MDD prefer to listen to sad music as compared to others.
- How emotional music impacts the individuals' brain signals when compared to the nonmusical auditory paradigm

Introduction

- The part of the brain related to processing auditory information is the temporal lobe.
- The parts of the brain related to happiness or emotion are the amygdala and hippocampus
- These areas are also hypothesized to be related to depression in multiple studies.



https://en.wikipedia.org/wiki/Temporal_lobe



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Introduction- Our Aim

- Identify the regions of the brain that are activated given musical and non-musical stimuli in subjects with MDD and a never depressed control group
- Estimate the connection between the identified regions of the brain

Introduction- Data Explanation

- Nineteen individuals with (MDD) and 20 never-depressed (ND) control participants listened to positive and negative emotional musical and nonmusical stimuli during fMRI scanning.
- Participants in the MDD group were all experiencing a current depressive episode at the time of scanning

Introduction- Data Explanation

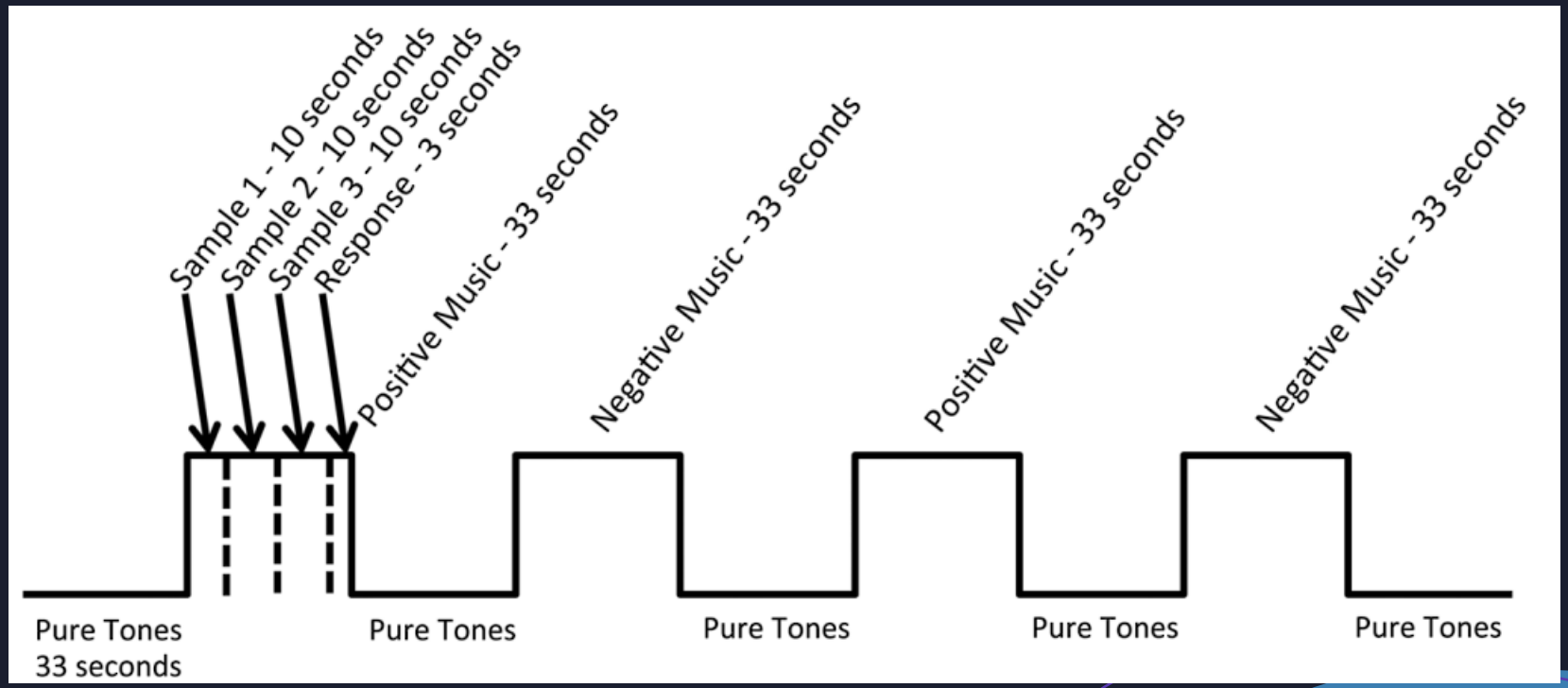
For participants in ND group

- No current or past manic episodes
- No comorbid anxiety disorders
- No current alcohol abuse or dependence
- No depression medication during the study.

Introduction- Data Explanation

The auditory stimulus were presented in a block manner.

Example run:



Lepping RJ, Atchley RA, Chrysikou E, Martin LE, Clair AA, Ingram RE, et al. (2016) Neural Processing of Emotional Musical and Nonmusical Stimuli in Depression. PLoS ONE 11(6): e0156859. doi:10.1371/journal.pone.0156859

Introduction- Data Explanation

Scanning was conducted on a 3 Tesla Siemens Skyra scanner. With:

- Repetition Time: 3 seconds
- Echo Time: 0.025 seconds

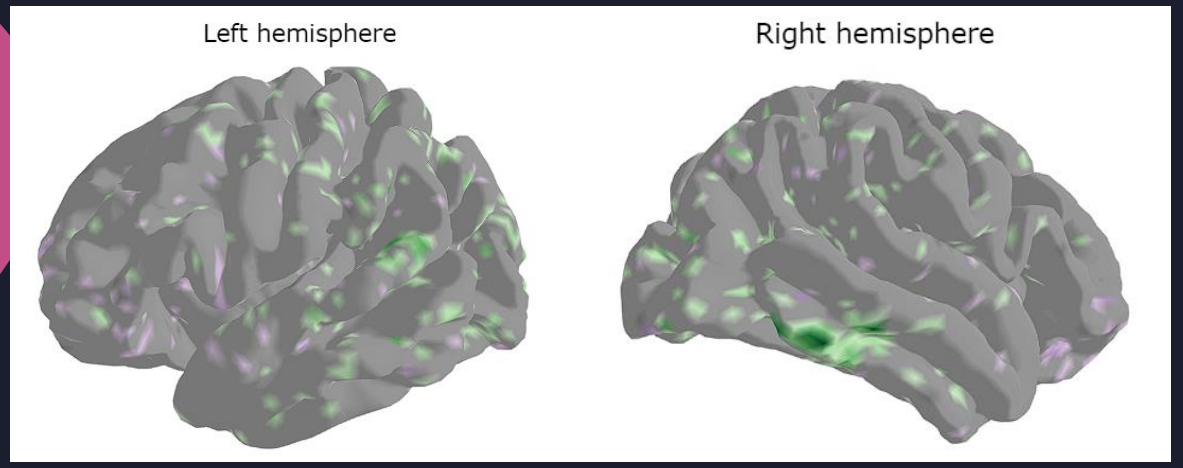
Methods- T-contrast Analysis

- Threshold T-map produced by General Linear Model (GLM) gives an effective summary of activation patterns in functional brain images
  - 90% threshold is used to identify most activated regions
- T-values of each voxel is computed using GLM
- Then a T-map brain is plotted to visualize brain activation regions.

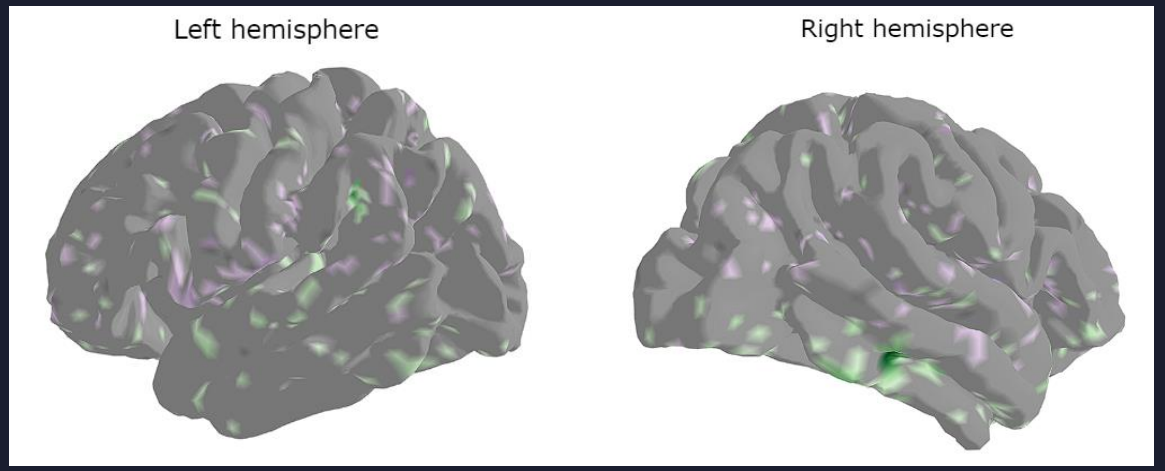
Results and Interpretation

T-contrast Analysis

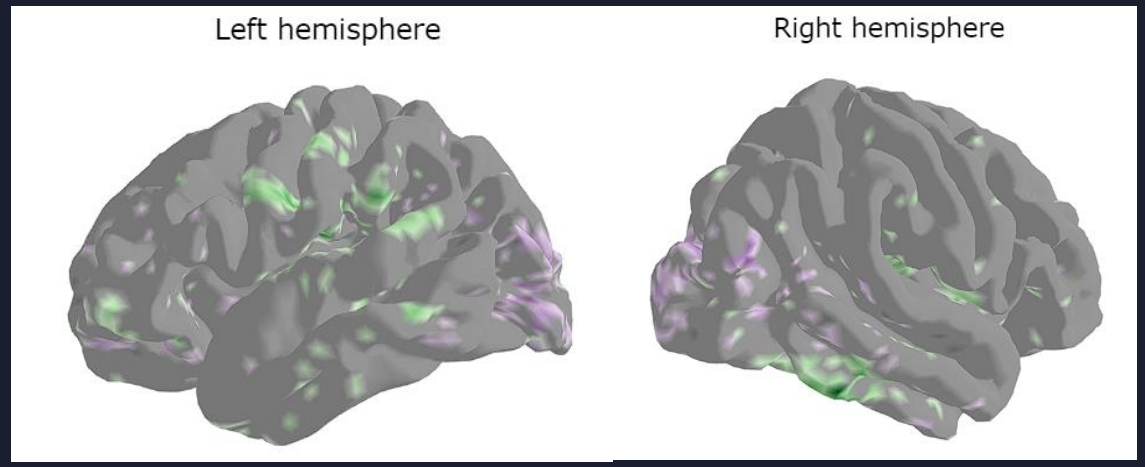
Control ND – Musical



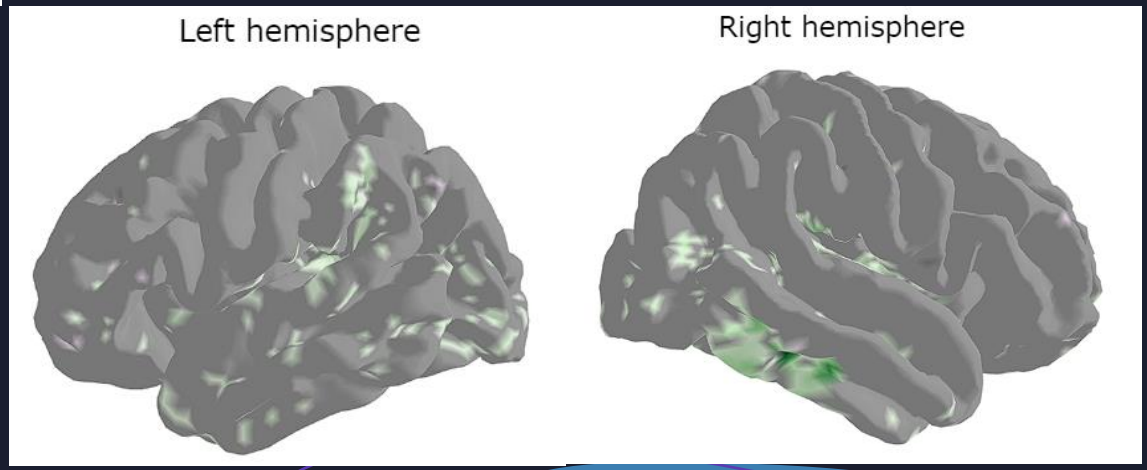
MDD – Musical



Control ND – Non-Musical



MDD – Non-Music



Methods- Functional Connectivity Analysis

- The MSDL atlas is used to extract a time series
- As the MSDL atlas comes with (x, y, z) MNI coordinates for the different regions, we can visualize the matrix as a graph of interaction in a brain.
- A connectome matrix is created using sparse covariance
- The corresponding connectome graph is plotted using the connectome matrix

Methods

Functional Connectivity Analysis

Subject groups:

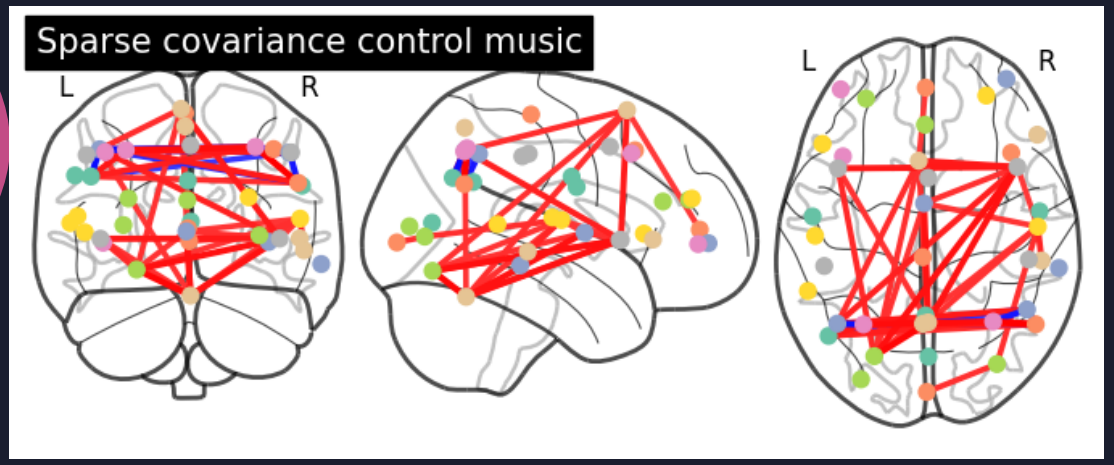
- Control group with musical stimuli
- Control group with nonmusical stimuli
- MDD group with musical stimuli
- MDD group with nonmusical stimuli

- Functional connectivity analysis performed on each subject group
- The outputs of the analysis are:
  - ✓ Sparse covariance matrix
  - ✓ Connectivity brain map of covariance values in the 95th percentile
  - ✓ Interactive 3D brain map of covariance values in the 95th percentile
- The regions of the sparse covariance matrix containing the top 5% of values, both positive and negative, are extracted for each subject group
- The connectivity brain plot is examined for each subject group and regions with highest connections are identified
- The 3D brain plot is examined for more detailed information about node connectivity

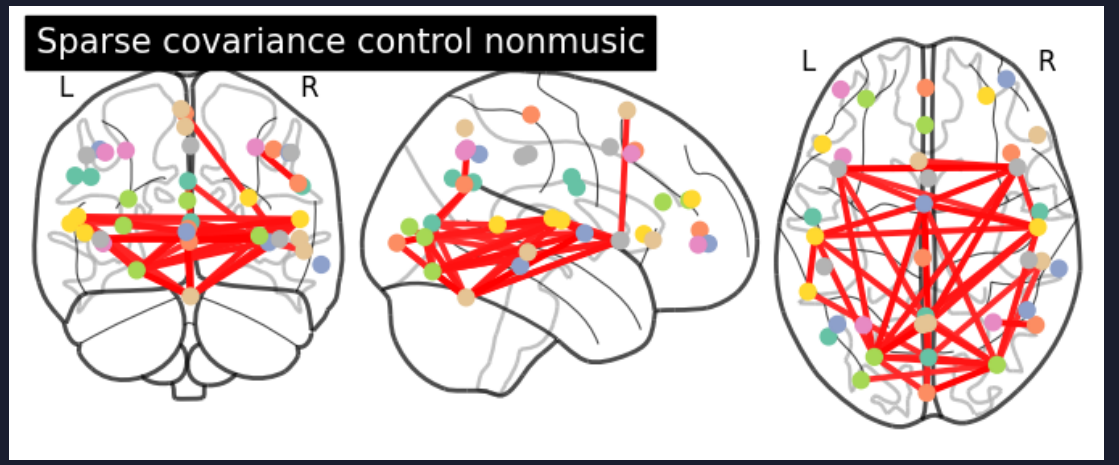
Results and Interpretation

Functional Connectivity Analysis

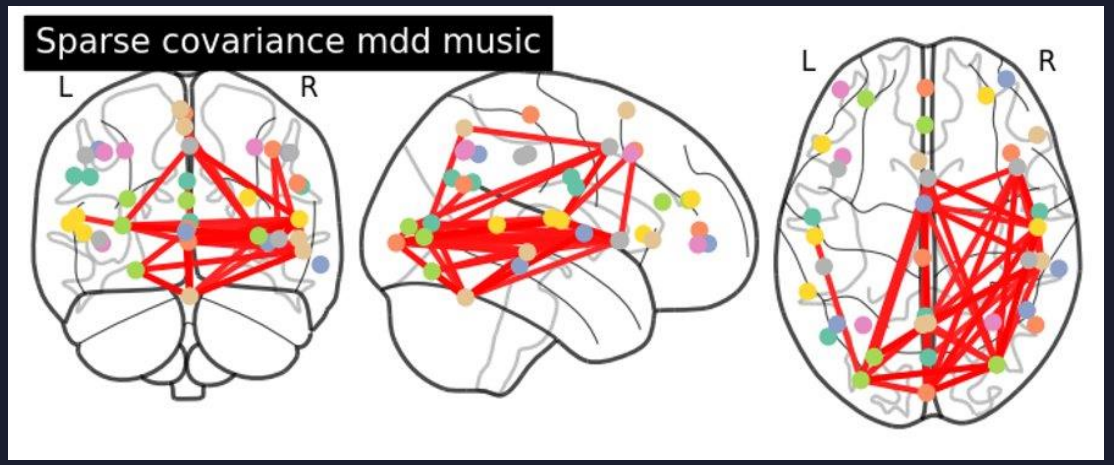
Control group: musical stimuli



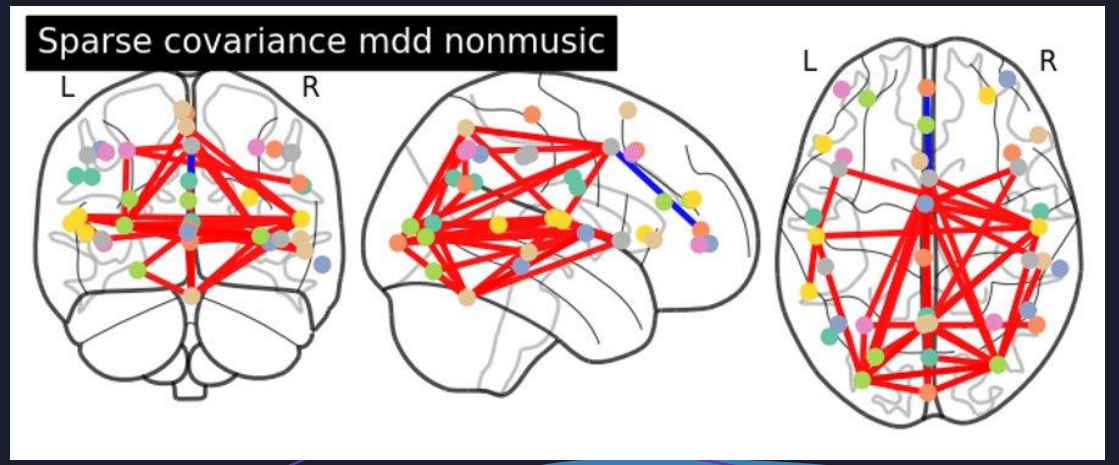
Control group: nonmusical stimuli



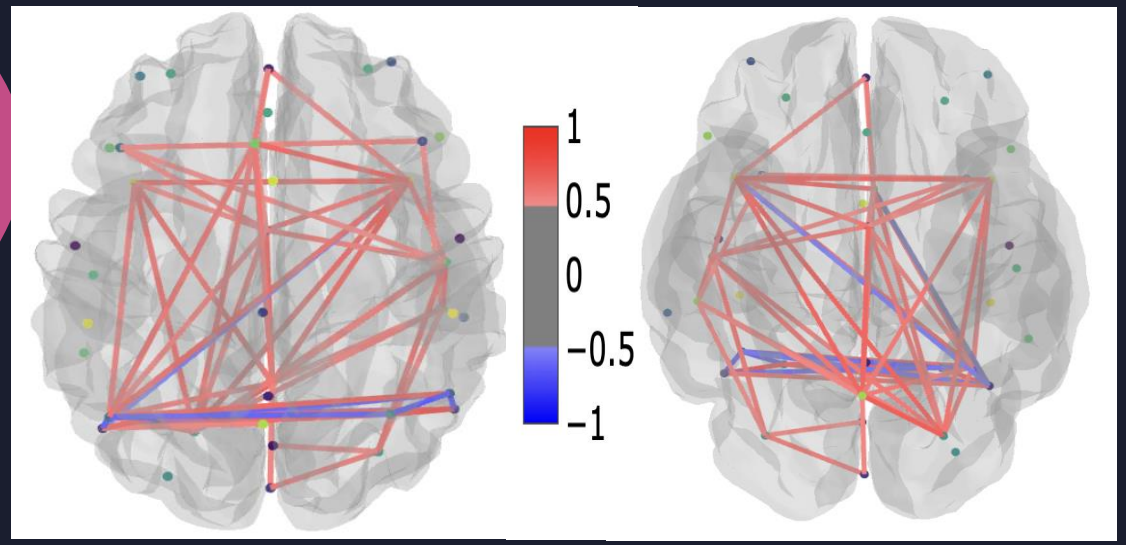
MDD group: musical stimuli

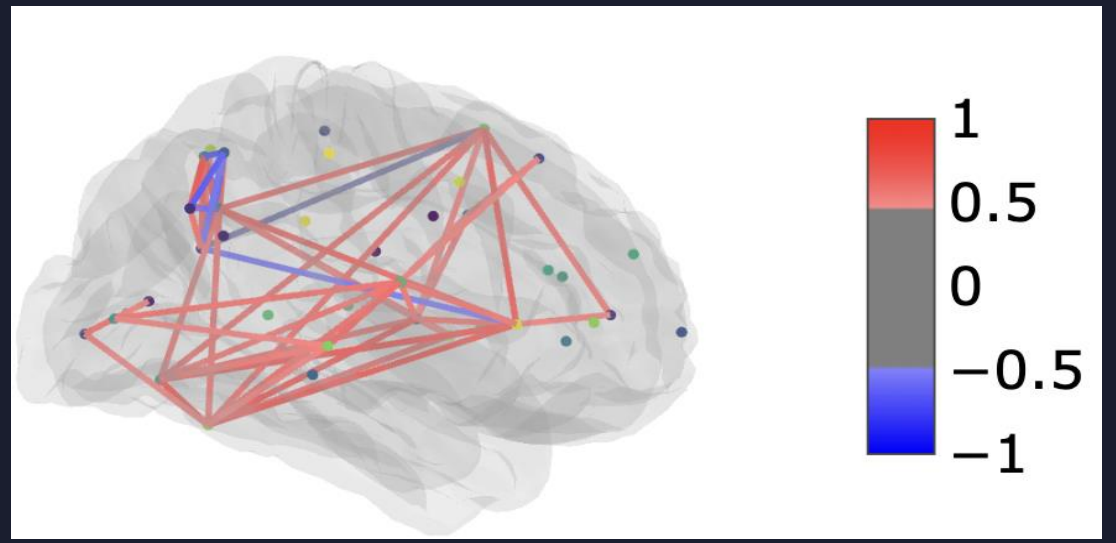


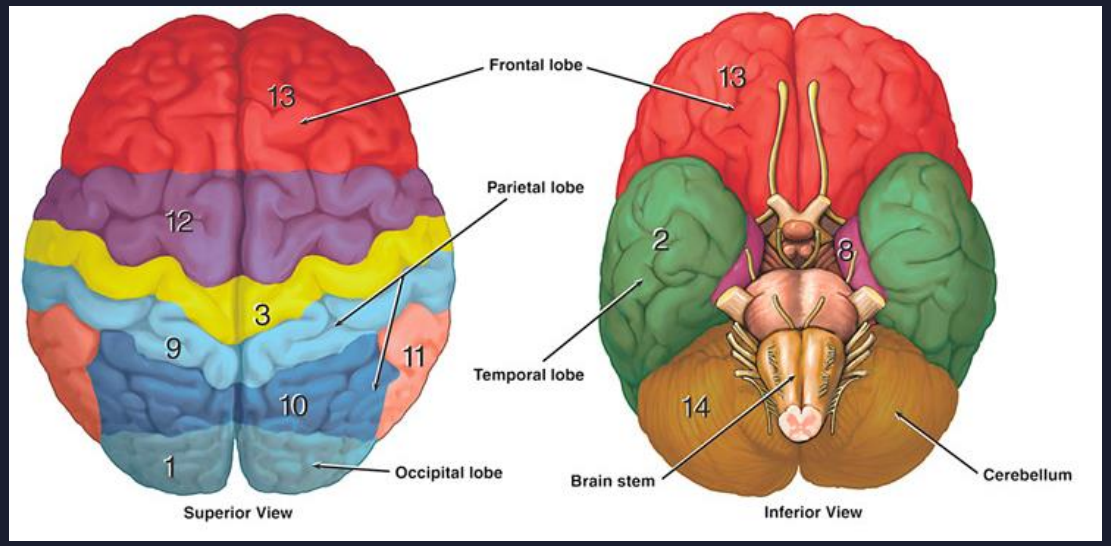
MDD group: nonmusical stimuli

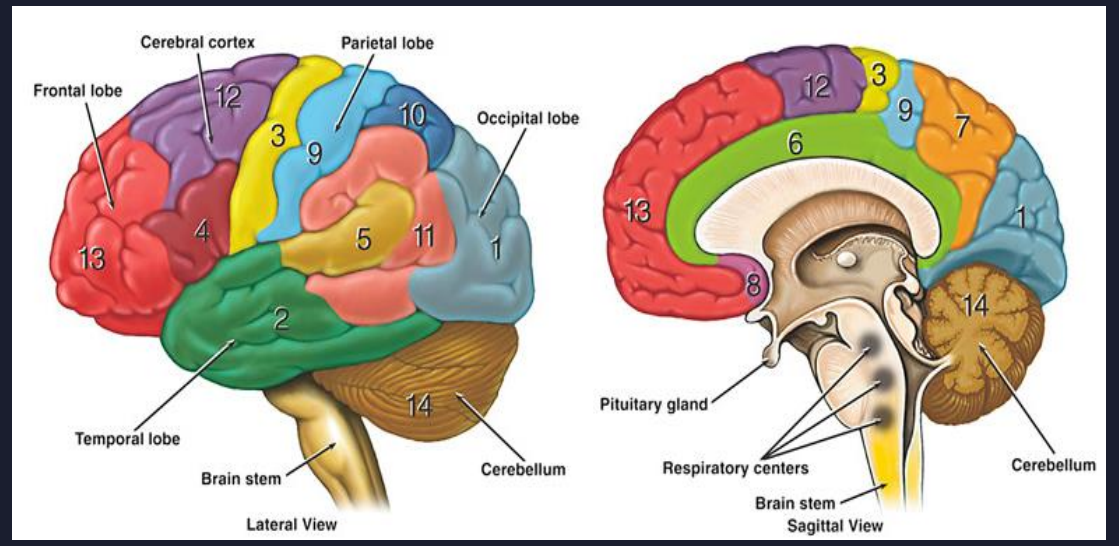


Control group: musical stimuli

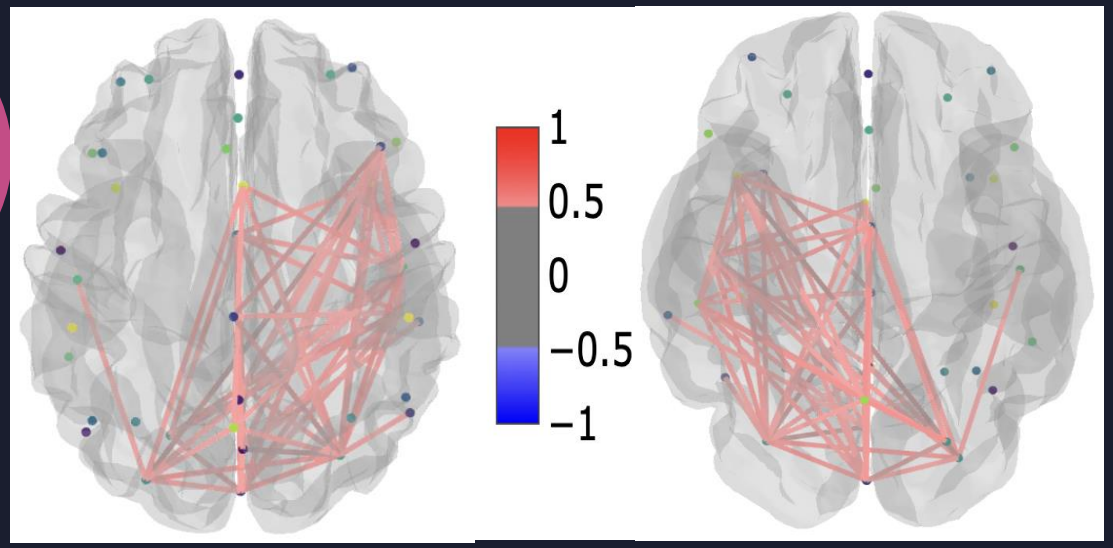


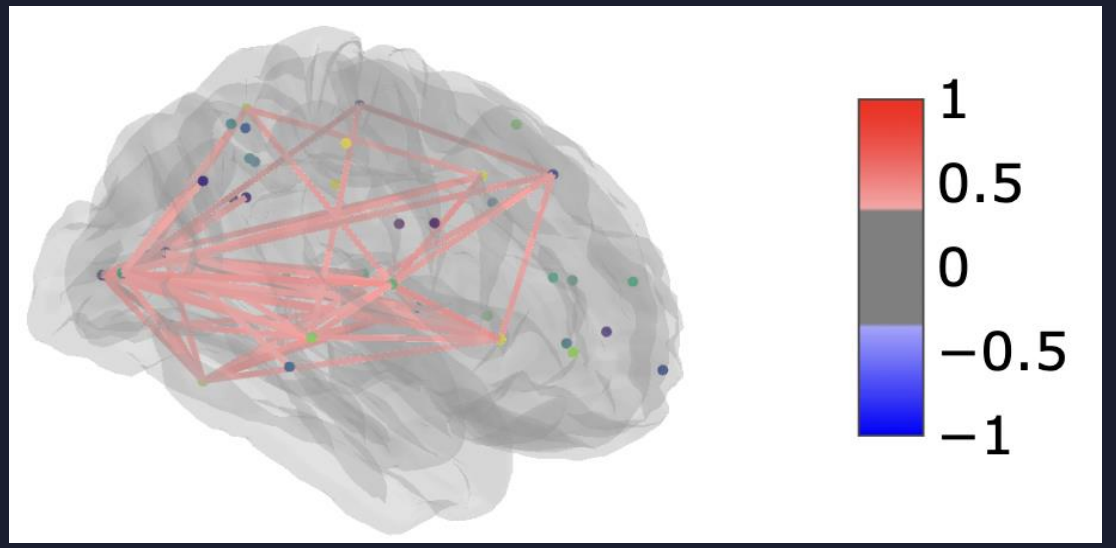


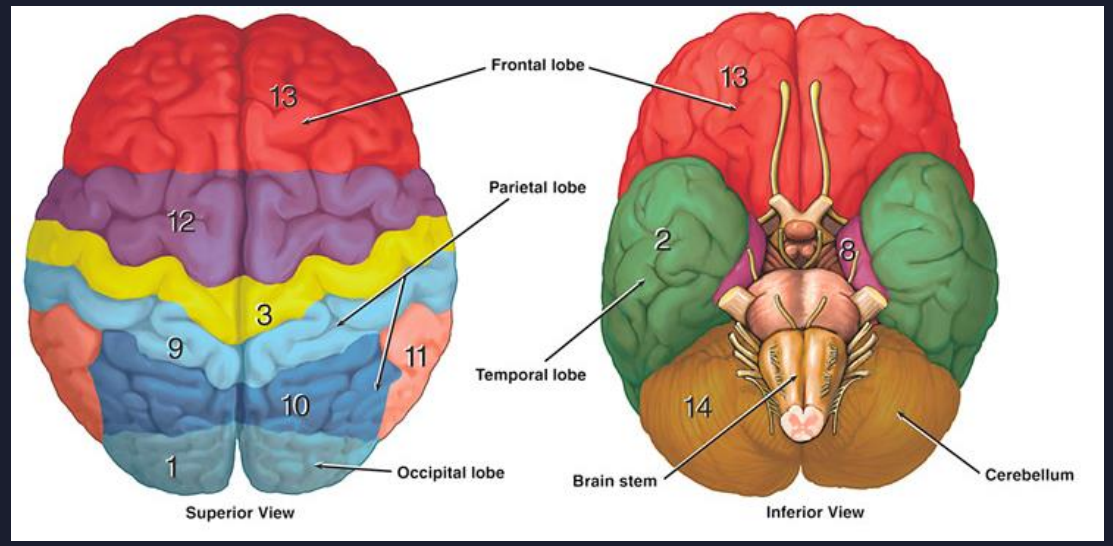


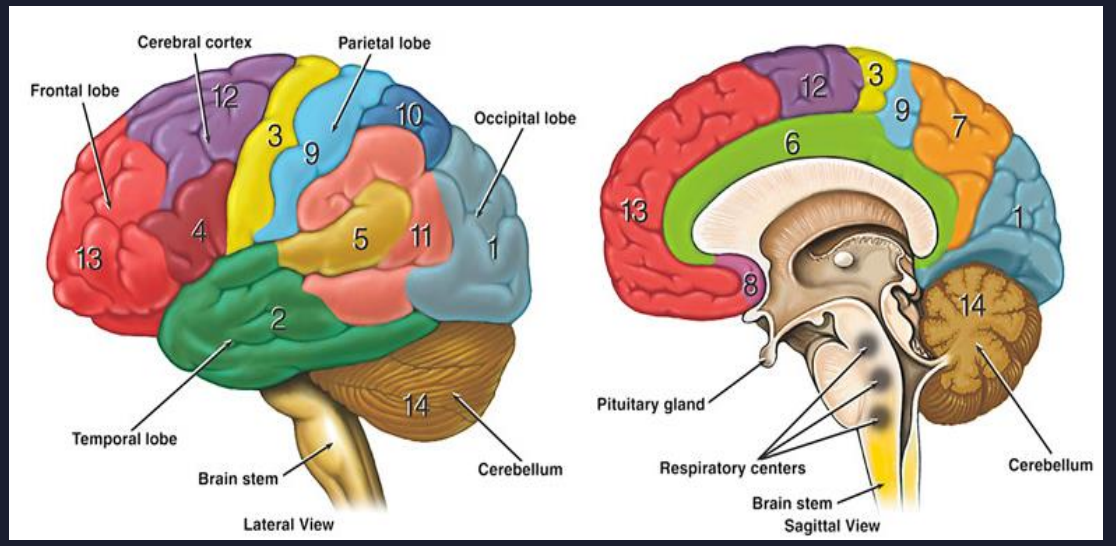


MDD group: musical stimuli

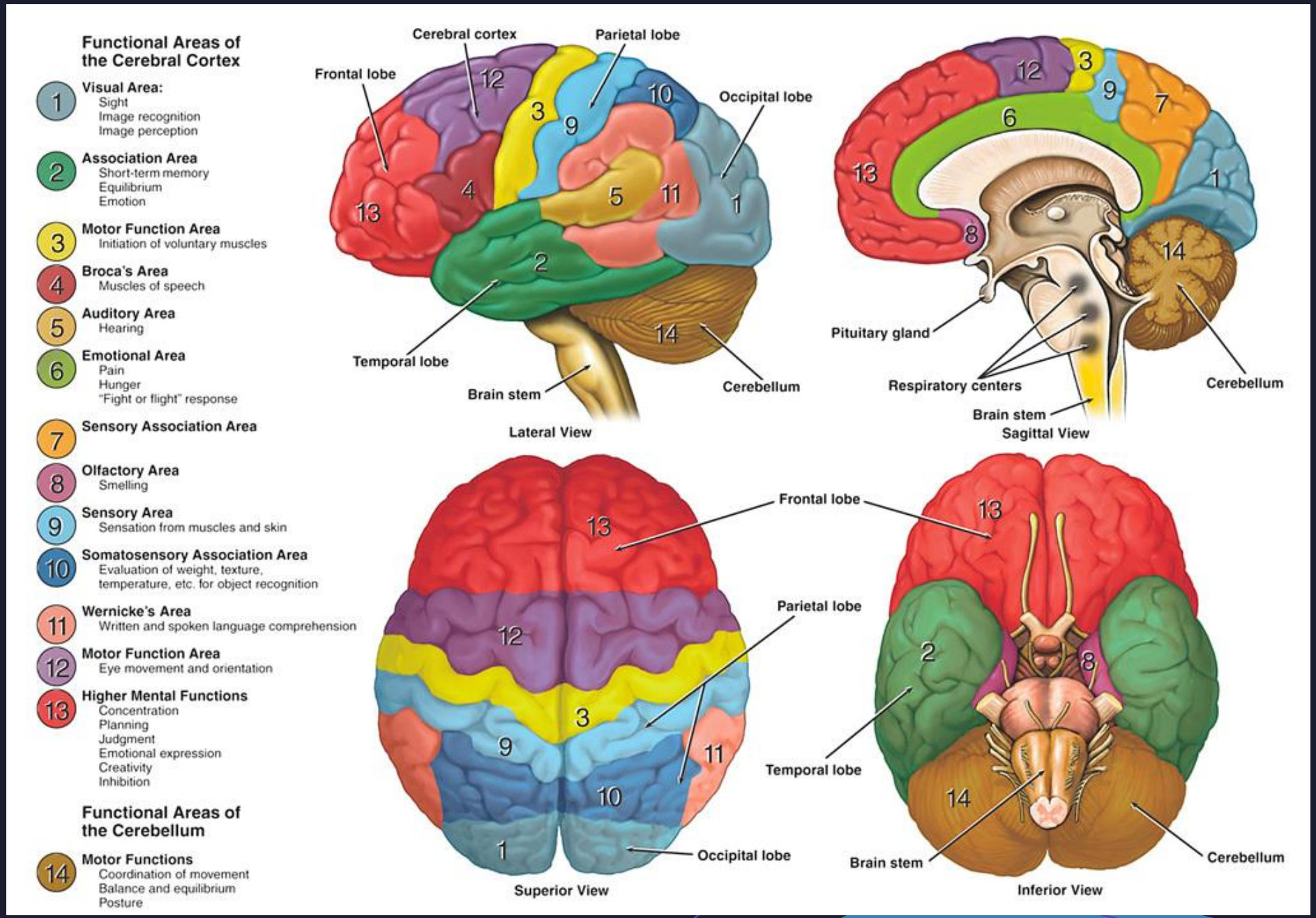








Interpretation



https://www.dana.org/wp-content/uploads/2019/08/anatomy-function-brain-areas-basics-aug-2019-2024.jpg

Limitations

- Pre-processing using fmriPrep
- Lack of baseline brain region map

Future works

- GLM model to compute t-map can be improved
- Investigate how positive and negative stimuli impact the activation areas and connection between brain regions

References

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- https://dana.org/article/neuroanatomy-the-basics/ (brain region map in interpretation)