

Schizophrenia morphometry and functional connectivity study

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Background

~ 1% of population affected

polygenic disease

no known mechanism, many hypotheses

evidence for structural and functional changes in the brain

**multimodal brain imaging can be used for both psychological scales' values
prediction and diagnosis validation**

Goal of the project

- to identify structural and functional features valuable for schizophrenia classification
- interpret finding and compare them to previously shown changes in schizophrenia patients' brain
- build a model to predict transdiagnostic symptom severity based on psychological scales + sMRI + fMRI

Data used

UCLA Consortium for Neuropsychiatric Phenomics LA5c Study downloaded from openneuro.org

171 individuals (121 CONTROL + 50 SCHZ)

sMRI data based on FreeSurfer features

fMRI connectome based on AAL atlas 116 parcellation

self-reported scales

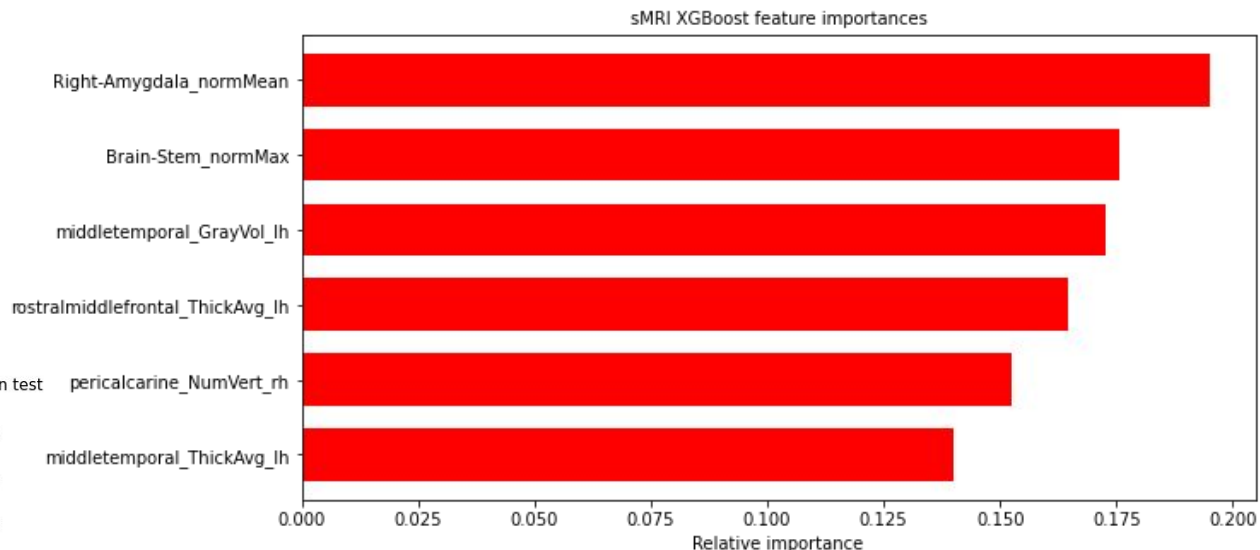
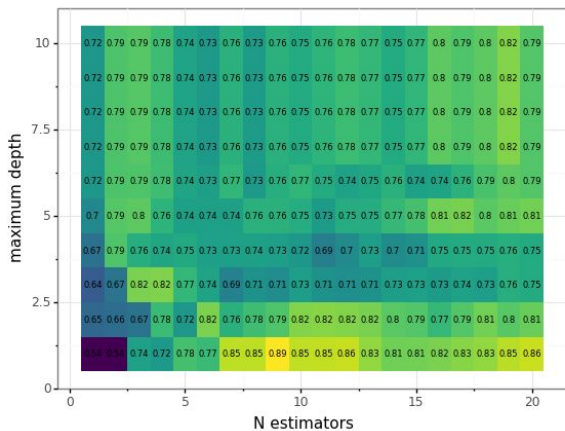
Transdiagnostic Symptom Severity for Mood, Anhedonia, and Anxiety

Analysis pipeline

1. Creation XGBoost model for FreeSurfer features to classify Schizophrenic vs Control brains
2. Analysis of features important for the classification
3. Creation Elastic Net model predicting symptoms severity on psychological scales by FreeSurfer features
4. Analysis of FreeSurfer features connected with the development of particular symptoms

Results: sMRI and diagnosis

	KNN	Logistic	Random Forest
mean cross val	0.556217	0.684367	0.717167
st dev	0.046399	0.065017	0.071784
score on train	0.807692	1.000000	0.976923
score on test	0.568182	0.727273	0.704545



Revealed features

1. Amygdala
2. Brain stem
? reticular formation changes
3. Middle temporal cortex (Grey Matter Volume and Thickness)

Cui, Y., Liu, B., Song, M., Lipnicki, D. M., Li, J., Xie, S., ... Jiang, T. (2017). Auditory verbal hallucinations are related to cortical thinning in the left middle temporal gyrus of patients with schizophrenia.

Psychological Medicine, 48(01), 115–122.

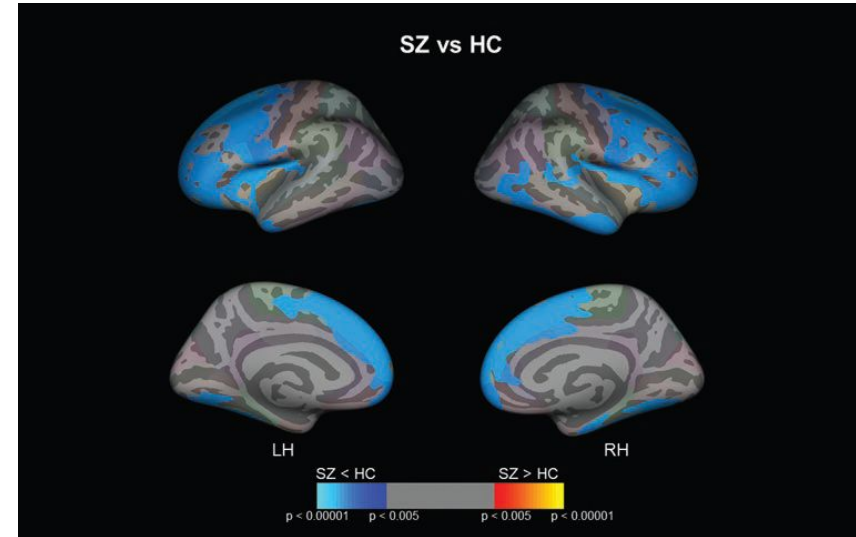
doi:10.1017/S0033291717001520

(<https://doi.org/10.1017/S0033291717001520>)

4. Rostral middle frontal cortex (Thickness)

Asmal, L., du Plessis, S., Vink, M., Chiliza, B., Kilian, S., & Emsley, R. (2016). Symptom attribution and frontal cortical thickness in first-episode schizophrenia. *Early Intervention in Psychiatry*, 12(4), 652–659. doi:10.1111/eip.12358 (<https://doi.org/10.1111/eip.12358>)

5. Pericalcarine cortex (Number of Vertices in the Cortex)

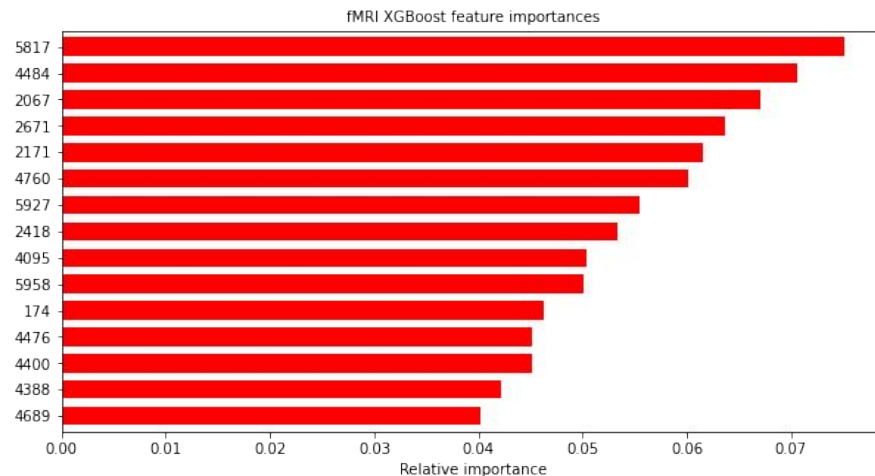
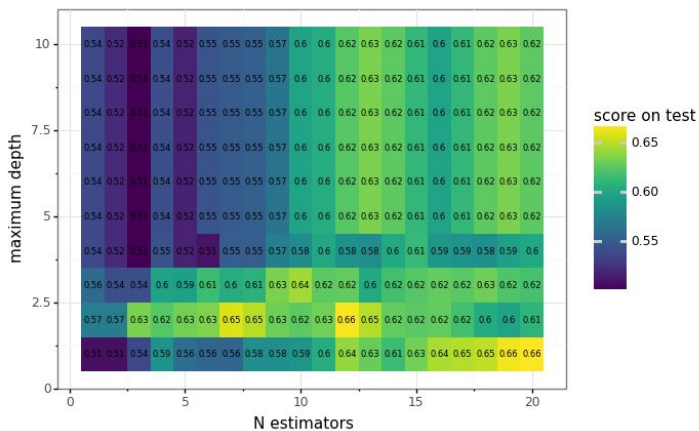


Cortical statistical maps comparing the cortical thickness between schizophrenia (SZ) patients and healthy controls (HC)

Takayanagi, Y., Sasabayashi, D., Takahashi, T., Furuichi, A., Kido, M., Nishikawa, Y., ... Suzuki, M. (2019). Reduced Cortical Thickness in Schizophrenia and Schizotypal Disorder. *Schizophrenia Bulletin*. doi:10.1093/schbul/sbz051 (<https://doi.org/10.1093/schbul/sbz051>)

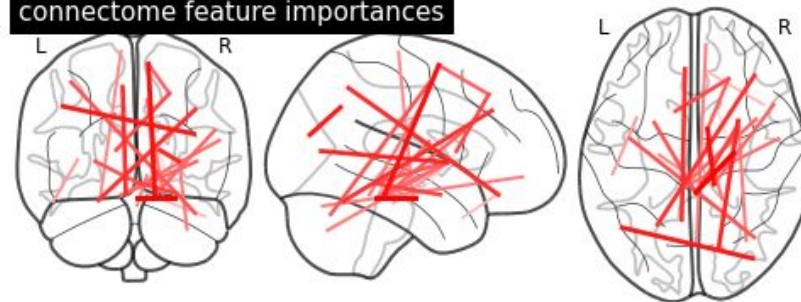
Results: fMRI and diagnosis

	KNN	Logistic	Random Forest
mean cross val	0.572767	0.800267	0.664267
st dev	0.141852	0.102782	0.118147
score on train	0.767442	1.000000	0.961240
score on test	0.697674	0.720930	0.720930



Cerebellum
Amygdala
Hippocampus

connectome feature importances



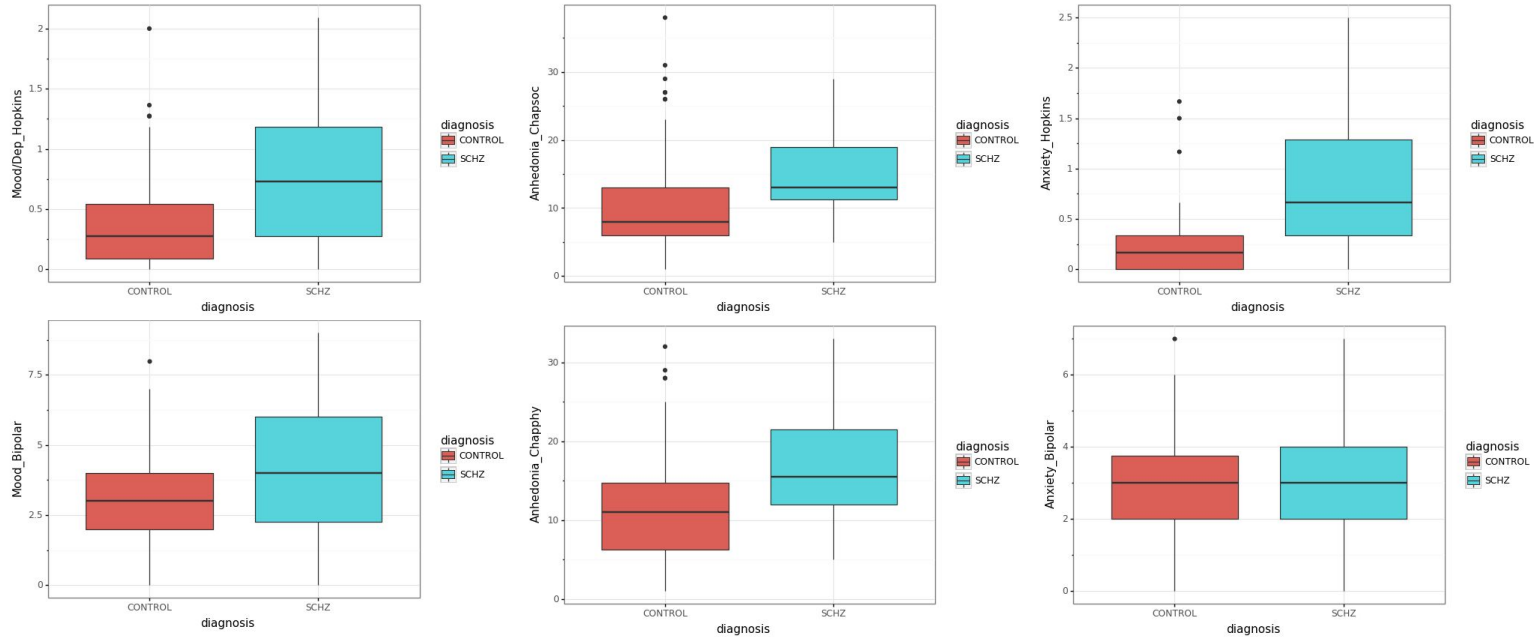
Psychological scales

Machine Learning Models Identify Multimodal Measurements Highly Predictive of Transdiagnostic Symptom Severity for Mood, Anhedonia, and Anxiety

Monika S. Mellem, Yuelu Liu, Humberto Gonzalez, Matthew Kollada, William J. Martin, and Parvez Ahammad

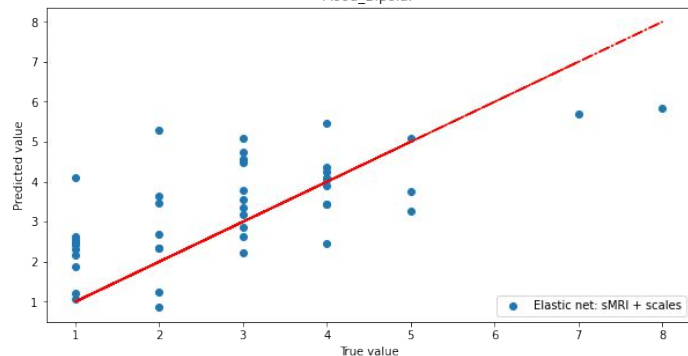
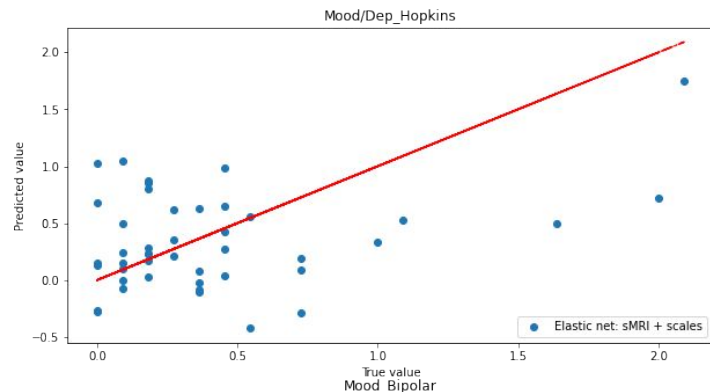
- **Mood/Dep_Hopkins**
Hopkins Symptom Checklist (depression symptom questions)
- **Mood_Bipolar**
Mood questions from the Scale for Traits that Increase Risk for Bipolar II Disorder
- **Anhedonia_Chapsoc**
Chapman Social Anhedonia Scale
- **Anhedonia_Chapphy**
Chapman Physical Anhedonia Scale
- **Anxiety_Bipolar**
Anxiety questions from the Scale for Traits that Increase Risk for Bipolar II Disorder
- **Anxiety_Hopkins**
Hopkins Symptom Checklist anxiety symptom questions

Results: psychological scales and diagnosis



Almost all transdiagnostic symptom severity scales look promising for separating schizophrenia patients from healthy individuals (except for 'Anxiety_Bipolar' scale, which shows no visible differences)

Elastic net: scales + sMRI for Mood symptoms



dick33

dick42

tci156t

Right-Accumbens-area_normMin

barratt24

eysenck40

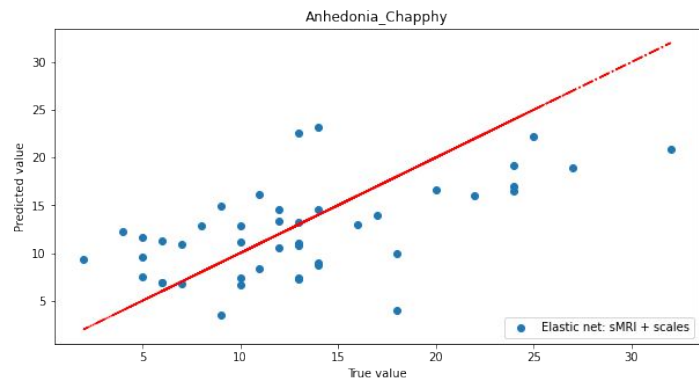
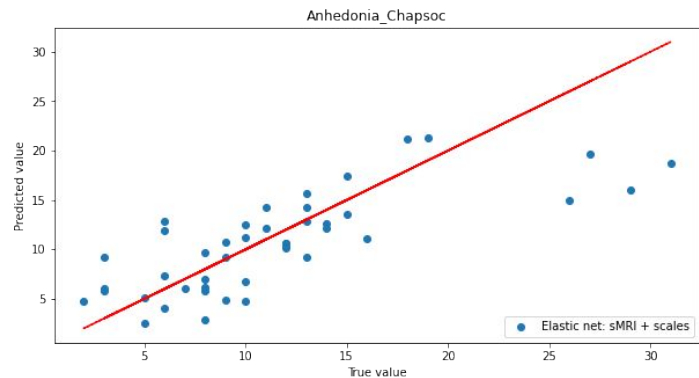
tci65t

tci81t

eysenck49

tci53t

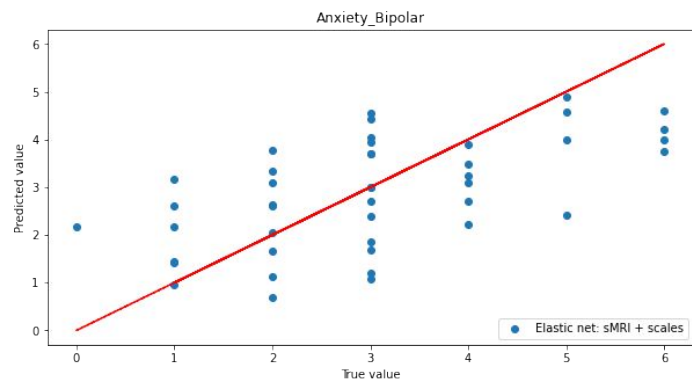
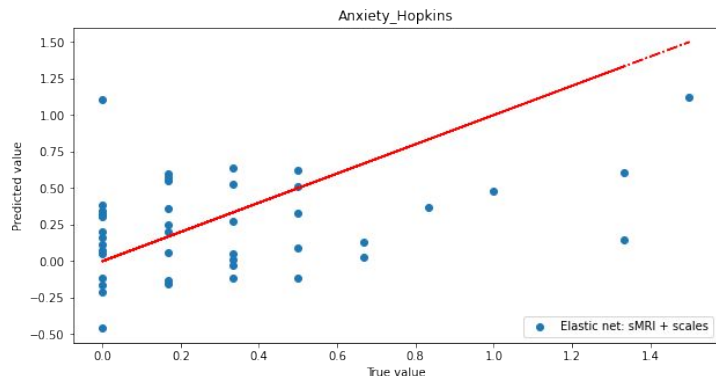
Elastic net: scales + sMRI for Anhedonia symptoms



tci231t
eysenck5
tci117t
eysenck35
rd3

chaphypo39
dick25
cuneus_ThickAvg_rh
tci53t
eysenck46

Elastic net: scales + sMRI for Anxiety symptoms



dick19

entorhinal_MeanCurv_lh

chapper20

chapper33

chapper28

inferiortemporal_ThickStd_lh

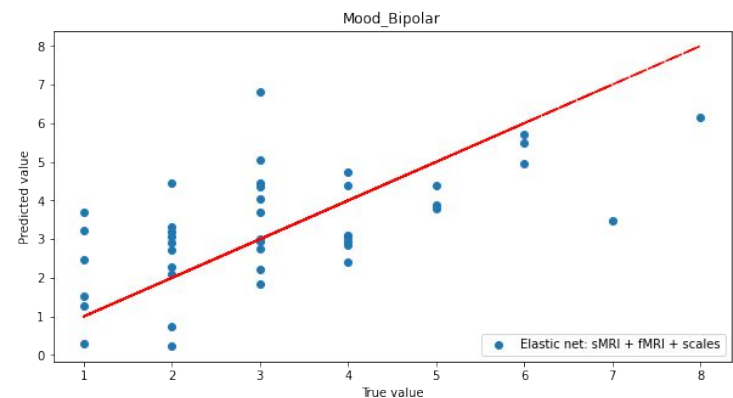
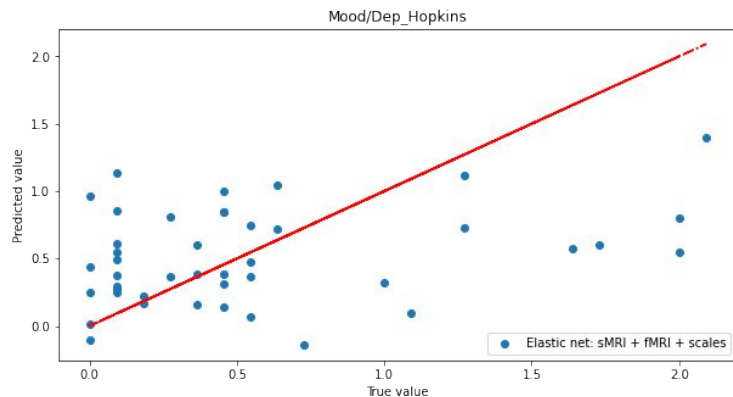
mpq79

dick37

tci46t

dick7

Elastic net: scales + sMRI + fMRI for Mood symptoms



CC_Mid_Anterior_normStdDev

temporalpole_ThickStd_rh

6270

chapper28

chapper20

chaphypo22

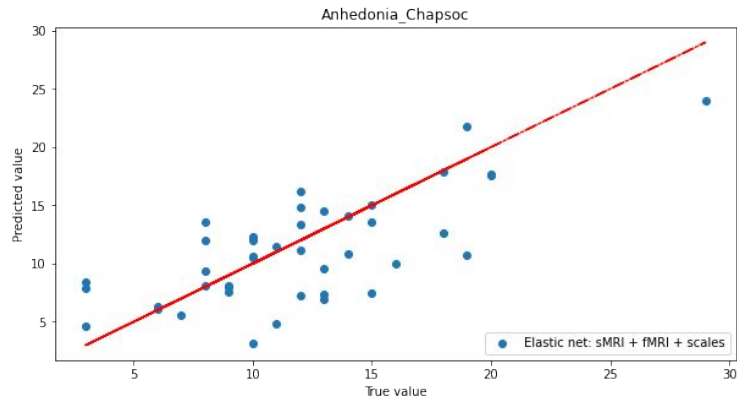
eysenck49

golden_sumscore

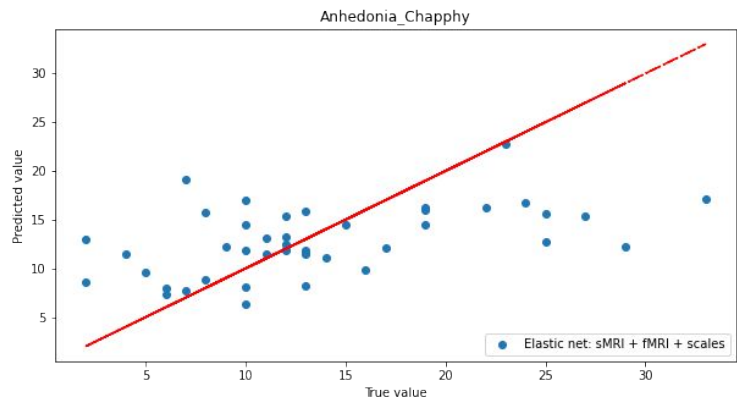
tci65t

tci53t

Elastic net: scales + sMRI + fMRI for Anhedonia symptoms

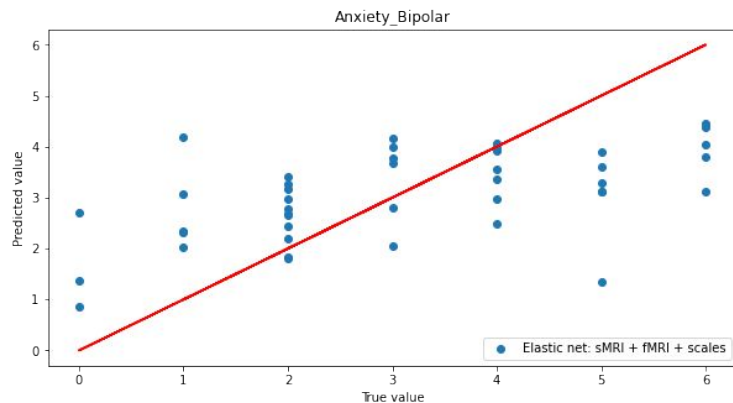
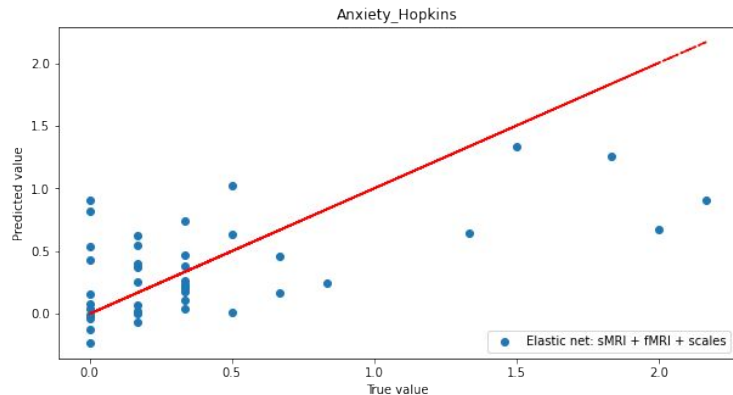


golden1
tci117t
reward_dependence
tci231t
rd3



tci83t
tci53t
tci141t
reward_dependence
eysenck46

Elastic net: scales + sMRI + fMRI for Anxiety symptoms



tc1230t

parstriangularis_MeanCurv_rh

chapper2

barratt5

chapper20

eysenck8

inferiortemporal_ThickStd_lh

tc146t

Left-choroid-plexus_normMax

tc155t

Conclusions and perspectives

1. Structural features are better predictors for Schizophrenia than functional
2. Most structural changes in Schizophrenia are associated with Cortex
3. Most functional changes in Schizophrenia are associated with Cerebellum, Amygdala and Hippocampus

Diffusion-weighted imaging MRI data is still waiting for its hero...

