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NeuroSpin, CEA, Université Paris-Saclay, France

Neuroimaging

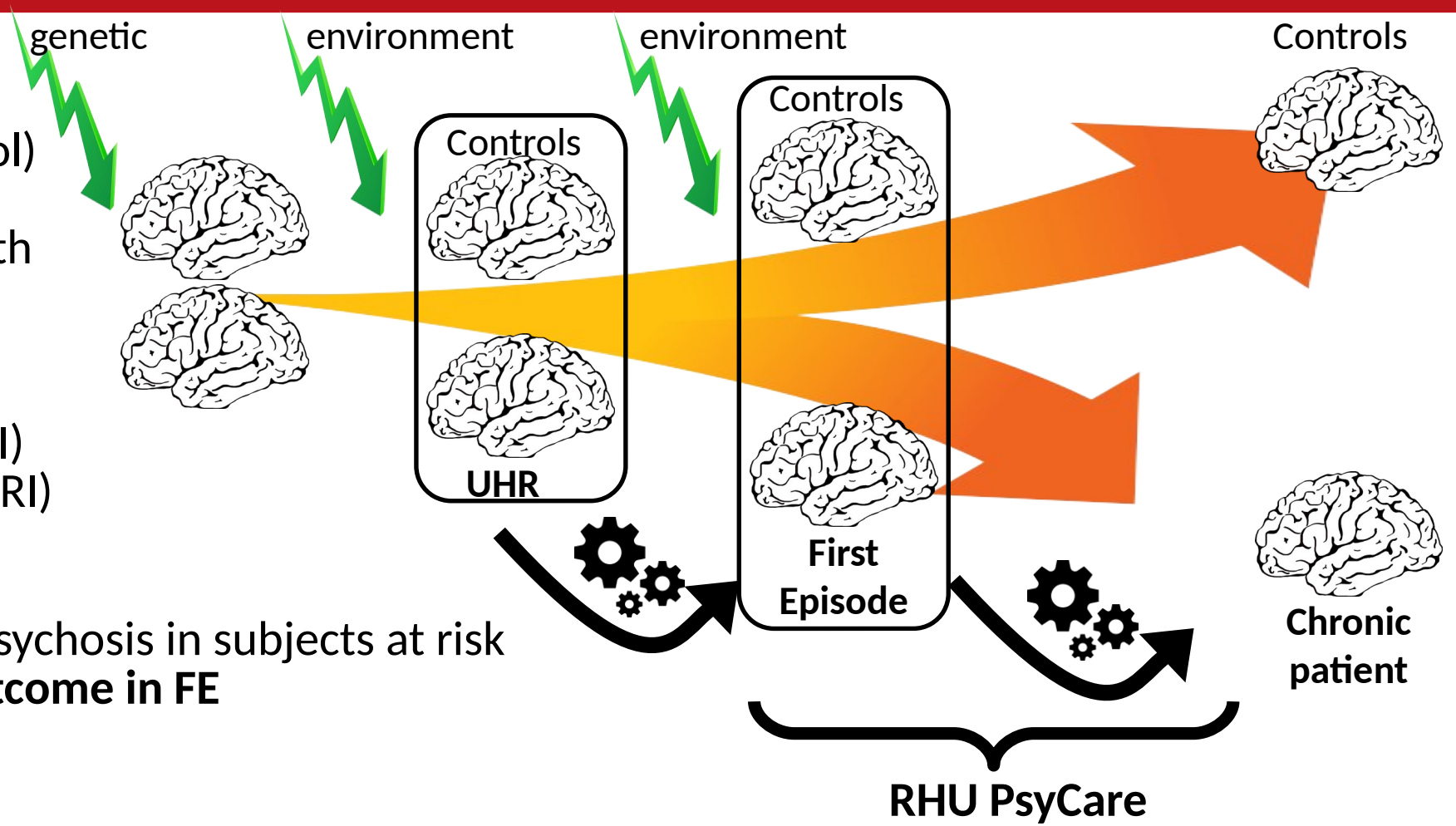
PsyCARE
Vers une psychiatrie préventive et personnalisée

Data Analysis

Toward personalized medicine: early identification of subject at risk

Rational

- Genetic and environment (trauma, stress, toxic, alcohol) modify the trajectory of the brain development from birth to young adults.
- Subtle differences in brain functioning (fMRI) anatomy (sMRI) or connectivity (dMRI) and metabolism (PET and MRI)



Goal

- Prognostic of transition to psychosis in subjects at risk
- **Prognostic of functional outcome in FE**

Methods

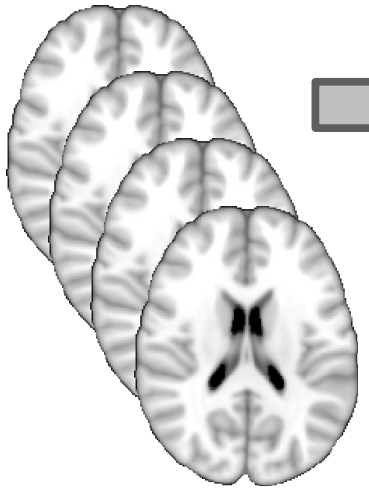
- Supervised machine learning algorithms can **capture those brain patterns**
- Learn to predict the outcome from past brain scans at early stage of the disorder progression
- Provide prognostic information about the patient evolution toward psychiatric disorders (depression, schizophrenia, bipolar-disorder).

Methods: Machine learning to predict the clinical outcome

First episode patients

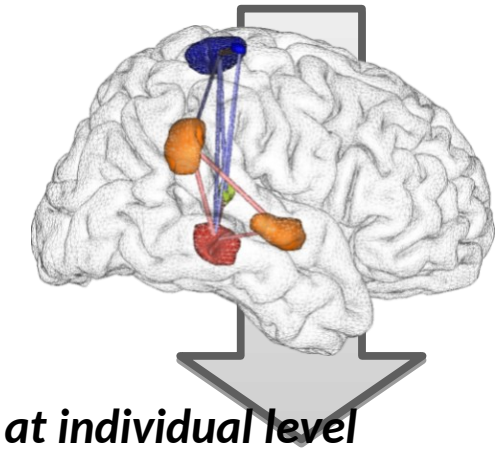
Personalized therapeutic strategies

Follow-up functional outcome



Machine Learning at a cohort level

Find a global mapping from the brain to the outcome



Signature (biomarker)

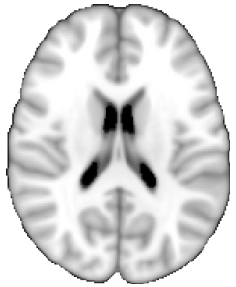
Predict at individual level

(1) Individual prognosis of response to different therapeutic strategies

(2) Select the therapeutic strategy with the best outcome

(3) Imaging profile “signature” that covariate with phenotype (clinical severity)

New patient



Good candidate for treatment or prognosis

Methods: Multi-modal machine learning to predict the clinical outcome

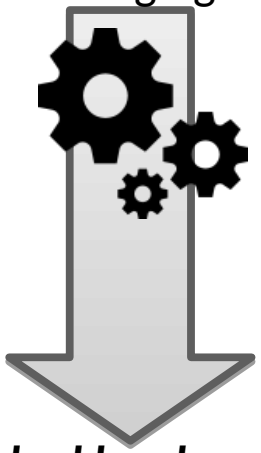
First episode patients

Personalized therapeutic strategies

Follow-up functional outcome

Multi-modal Machine Learning

Combine Neuroimaging + Omics + clinic



Predict at individual level

(1) Individual prognosis of response to different therapeutic strategies

(2) Select the therapeutic strategy with the best outcome

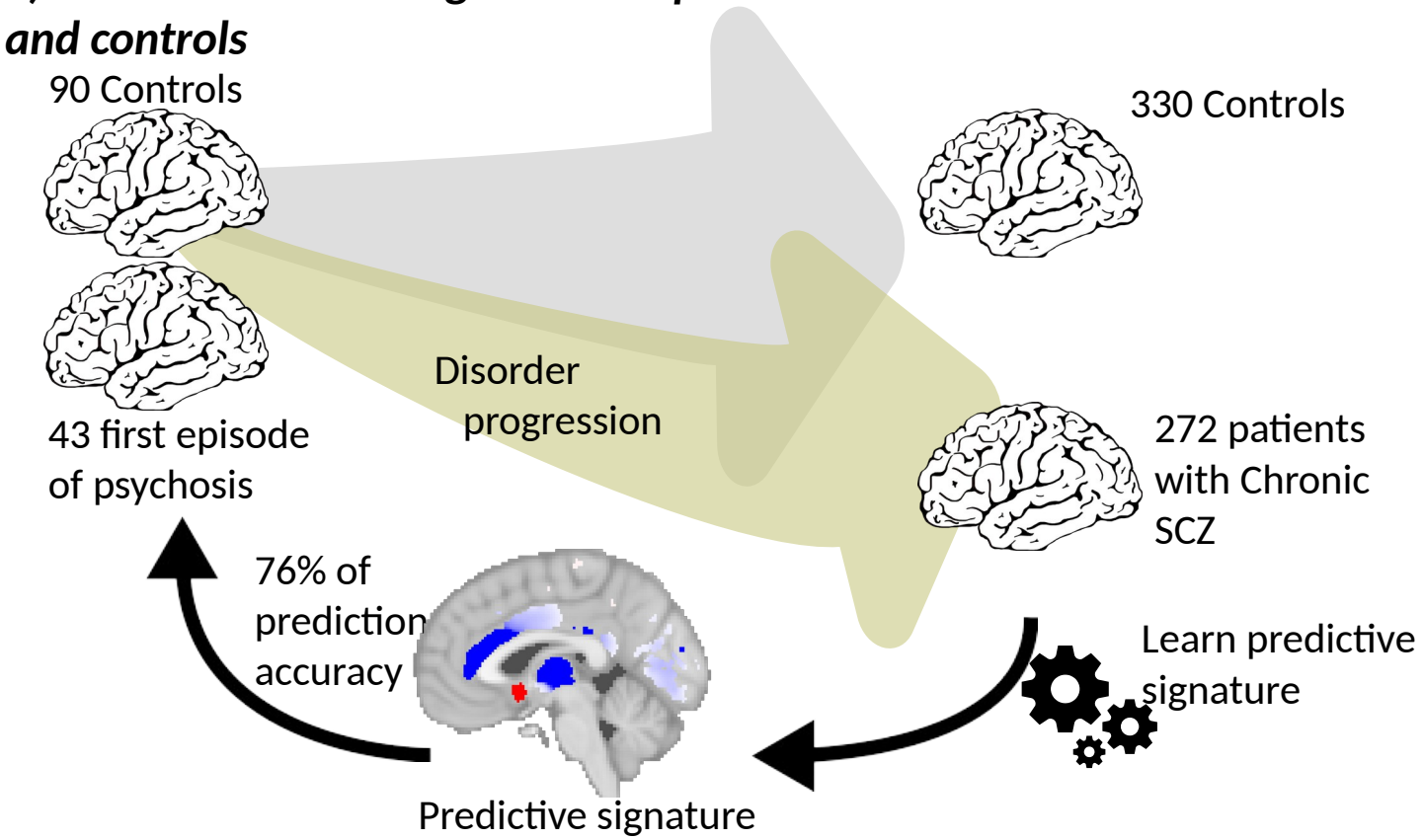
(3) Imaging profile “signature” that covariate with phenotype (clinical severity)

New patient

Good candidate for treatment or prognosis

Neuroanatomical Signature of Schizophrenia that generalizes to first episode

1) Learn a Predictive signature on patients with chronic SZ and controls



2) Discriminate first episode from controls

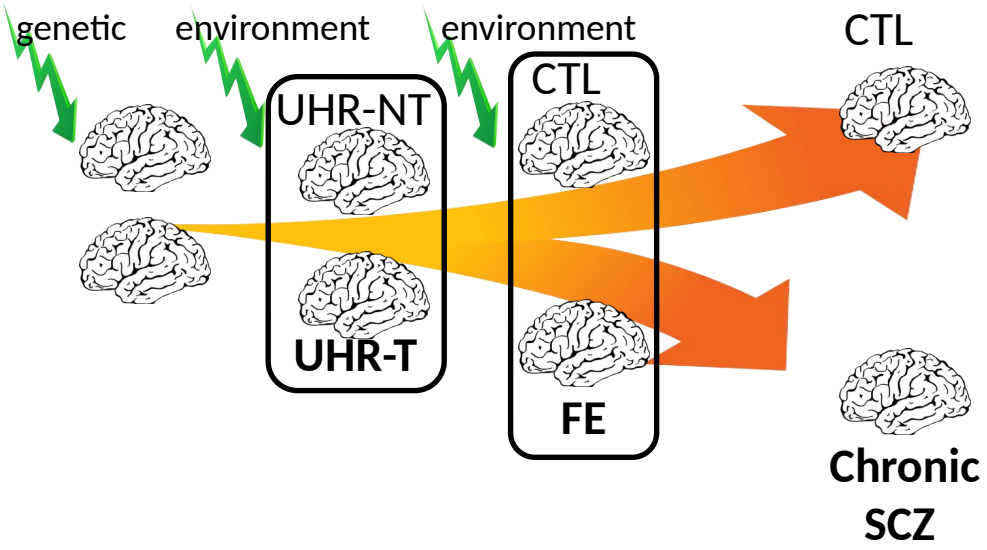
3) Perspectives: brain score of disorder progression

[De Pierrefeu Acta Psychiatrica Scandinavica, 2018]

Collab with

- CHU Lille (R. Jardri)

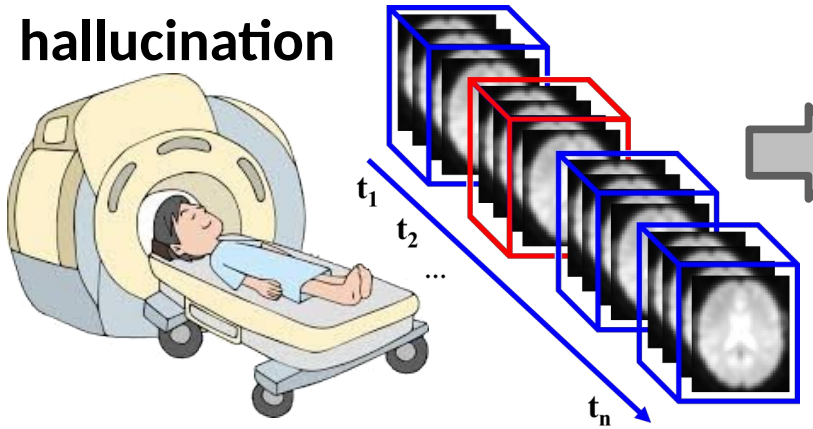
- SHU Ste-Anne Paris (M.O. Krebs)
- CHU Créteil (J. Houenou)



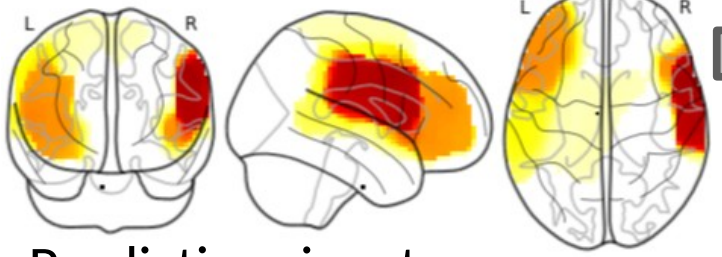
Classification rate:	**?**	**76%**	**80%**

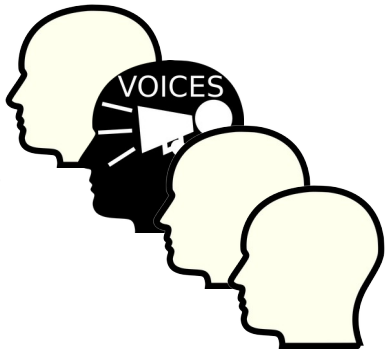
Functional MRI Activation Patterns to Predict hallucinations in Schizophrenia for neurofeedback

1) rest functional MRI during hallucination



2) Learn functional signature of hallucination





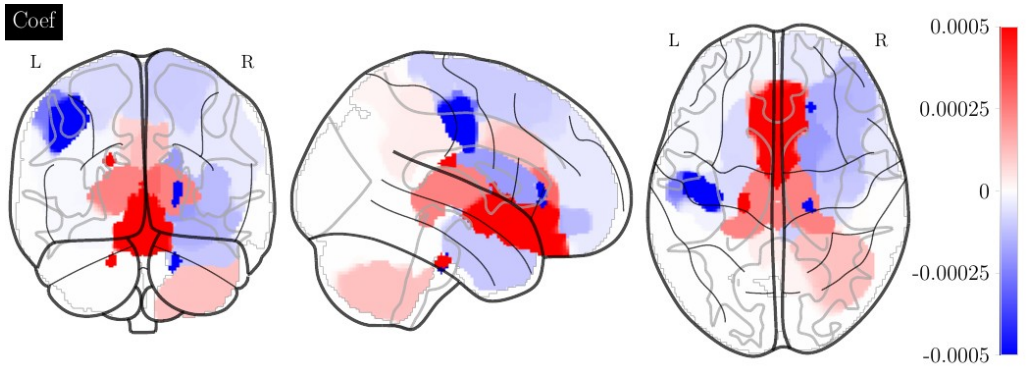
Predictive signature:
Broca's area and its right homologue

3) Decoding
4) Neuro-feedback

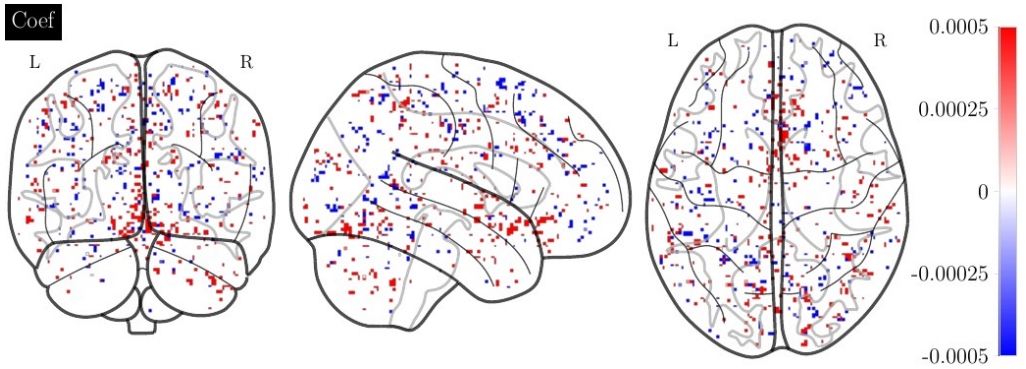
[De Pierrefeu Hum. Brain Map., 2018]
Collab with
- CHU Lille (R. Jardri)

Predict psychotic transition using structural imaging in UHR subjects

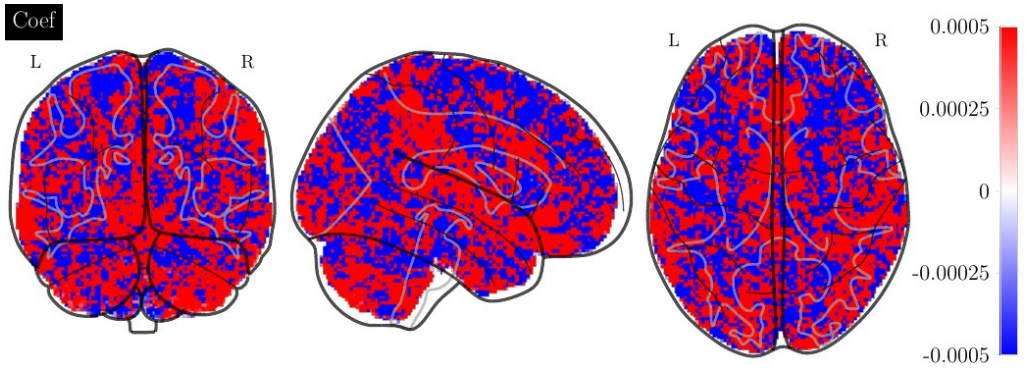
TVEnet
AUC: 0.79



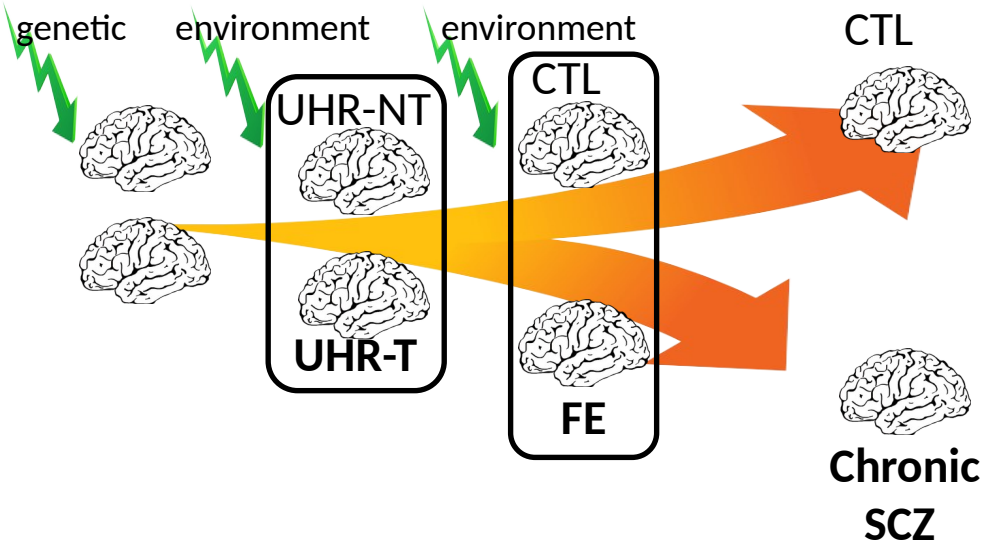
Lasso
AUC: 0.7



Ridge
AUC: 0.66

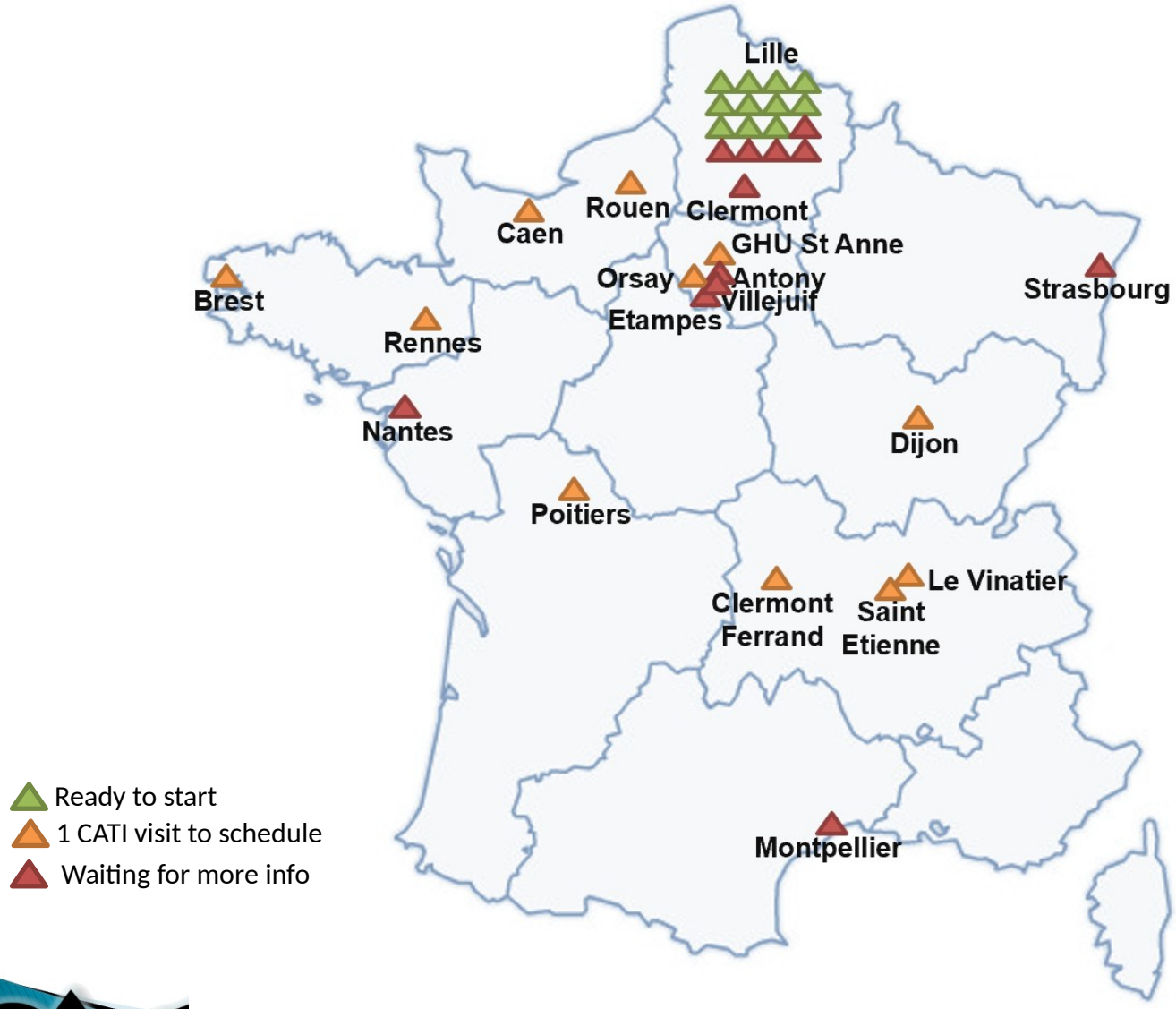


Anton Iftimovici

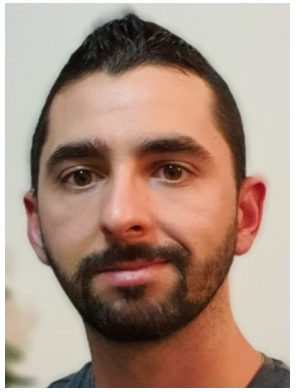


Classification rate:	**79%**	**76%**	**80%**

Large scale collection of neuroimaging



Lille:
David Roman



CATI Team