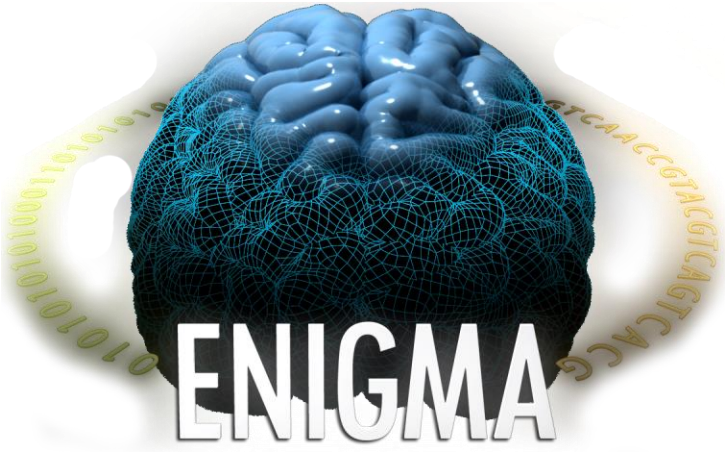
The ENIGMA project



Martine Hoogman, PhD
jPI, Human Genetics, Radboudumc

Enhancing Neuro Imaging Genetics through Meta-Analysis

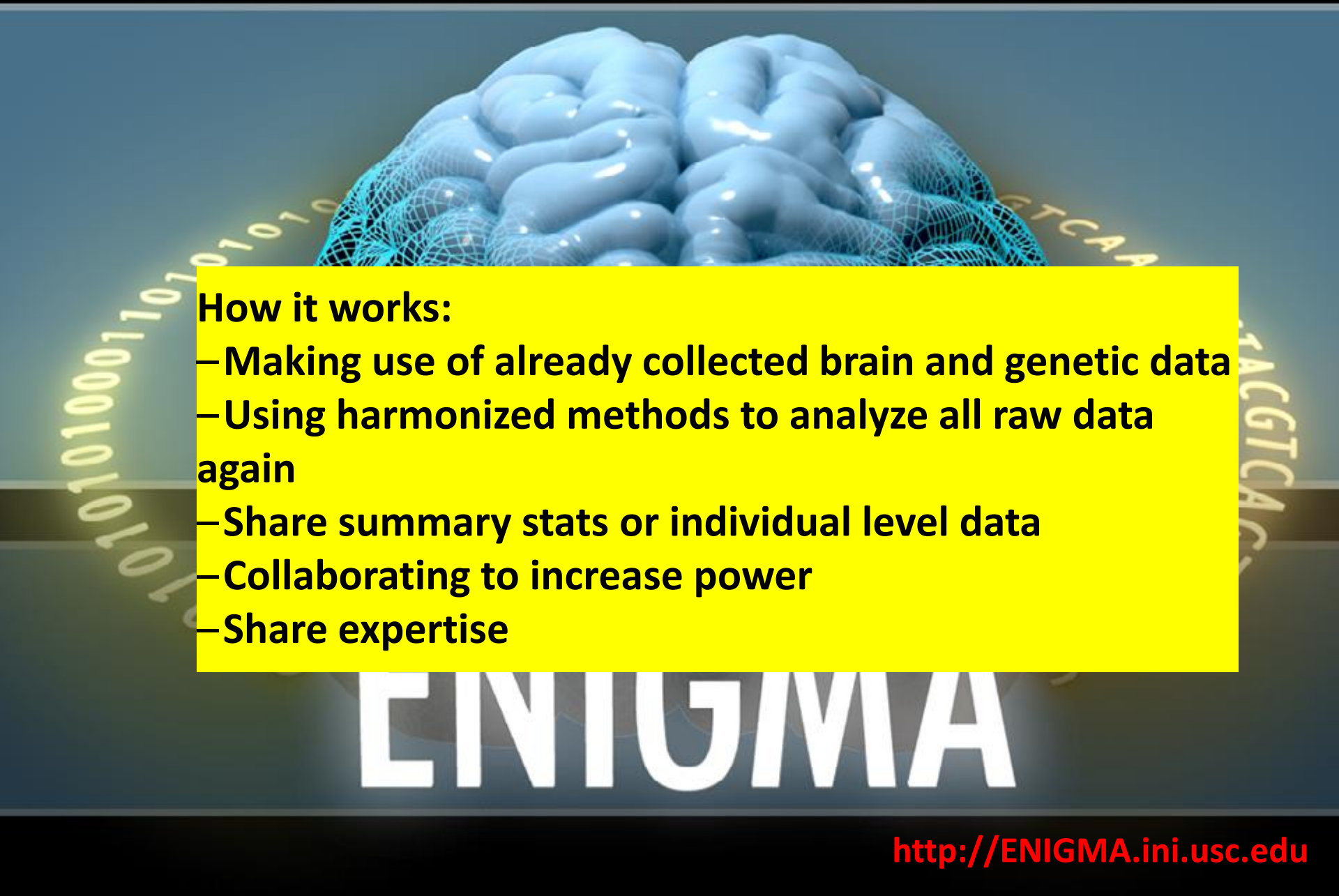
PI: Paul Thompson (USC)

The ENIGMA Network brings together researchers in imaging genomics to understand brain structure, function, and disease, based on brain imaging and genetic data.

ENIGMA

http://ENIGMA.ini.usc.edu

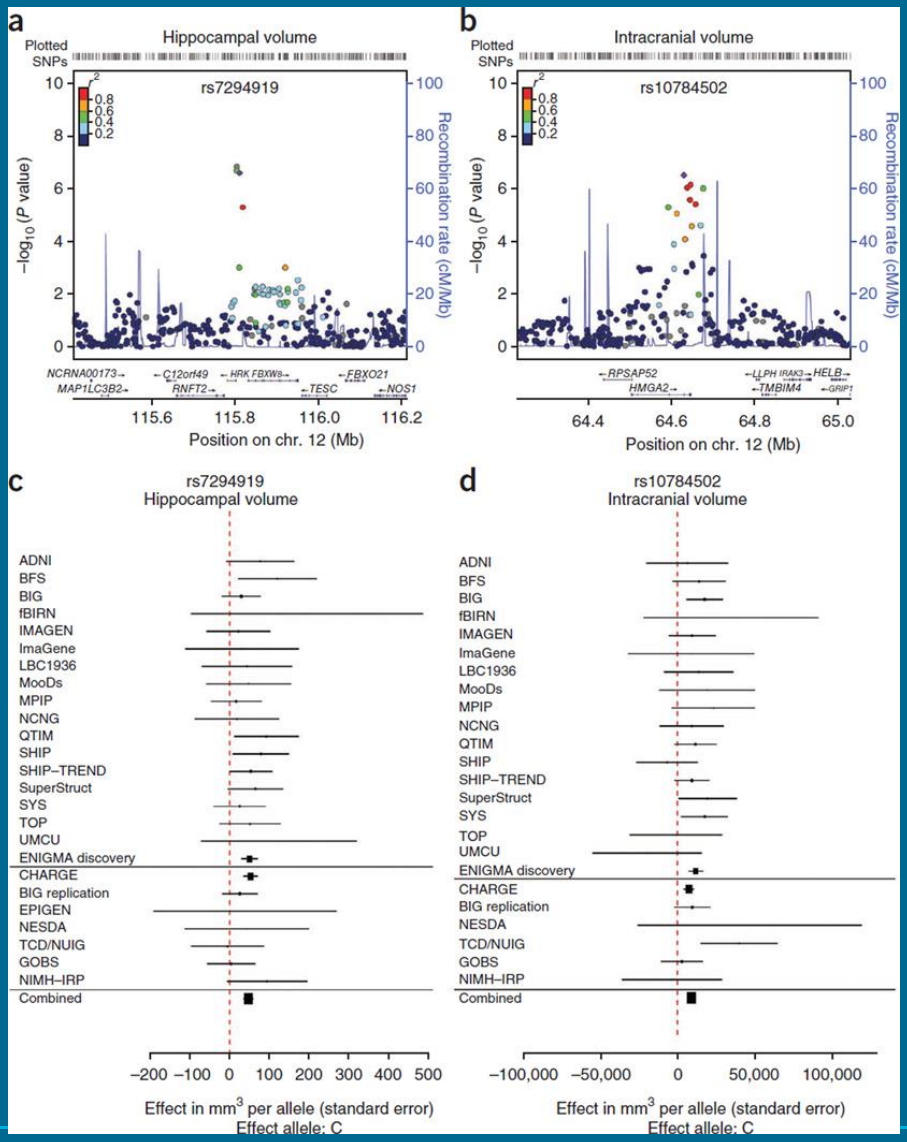
Enhancing Neuro Imaging Genetics through Meta-Analysis



How it works:

- **Making use of already collected brain and genetic data**
- **Using harmonized methods to analyze all raw data again**
- **Share summary stats or individual level data**
- **Collaborating to increase power**
- **Share expertise**

First success: Stein et al, 2012, Nature Genetics



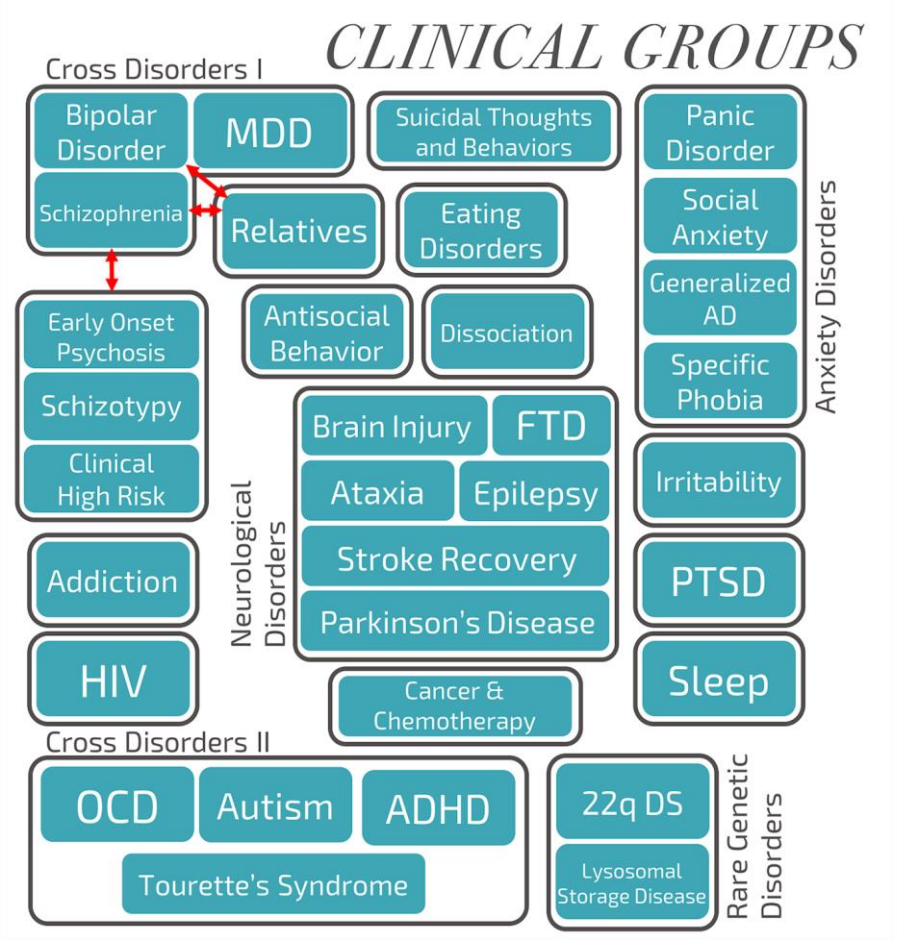
N = 21,151

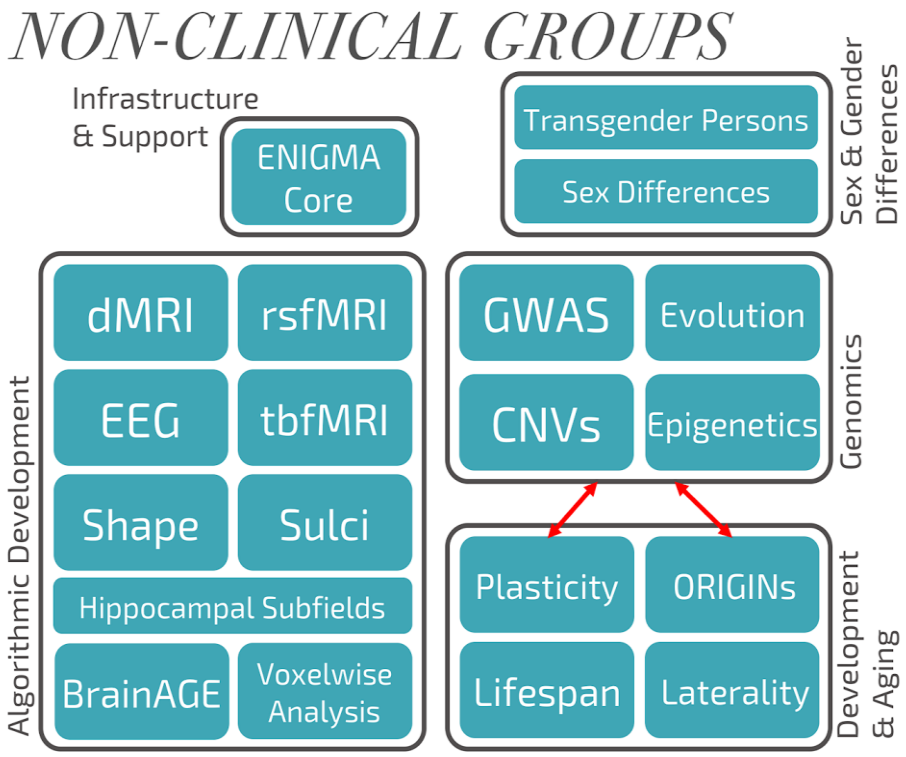
GWAS meta-analysis of Hippocampal volume and ICV

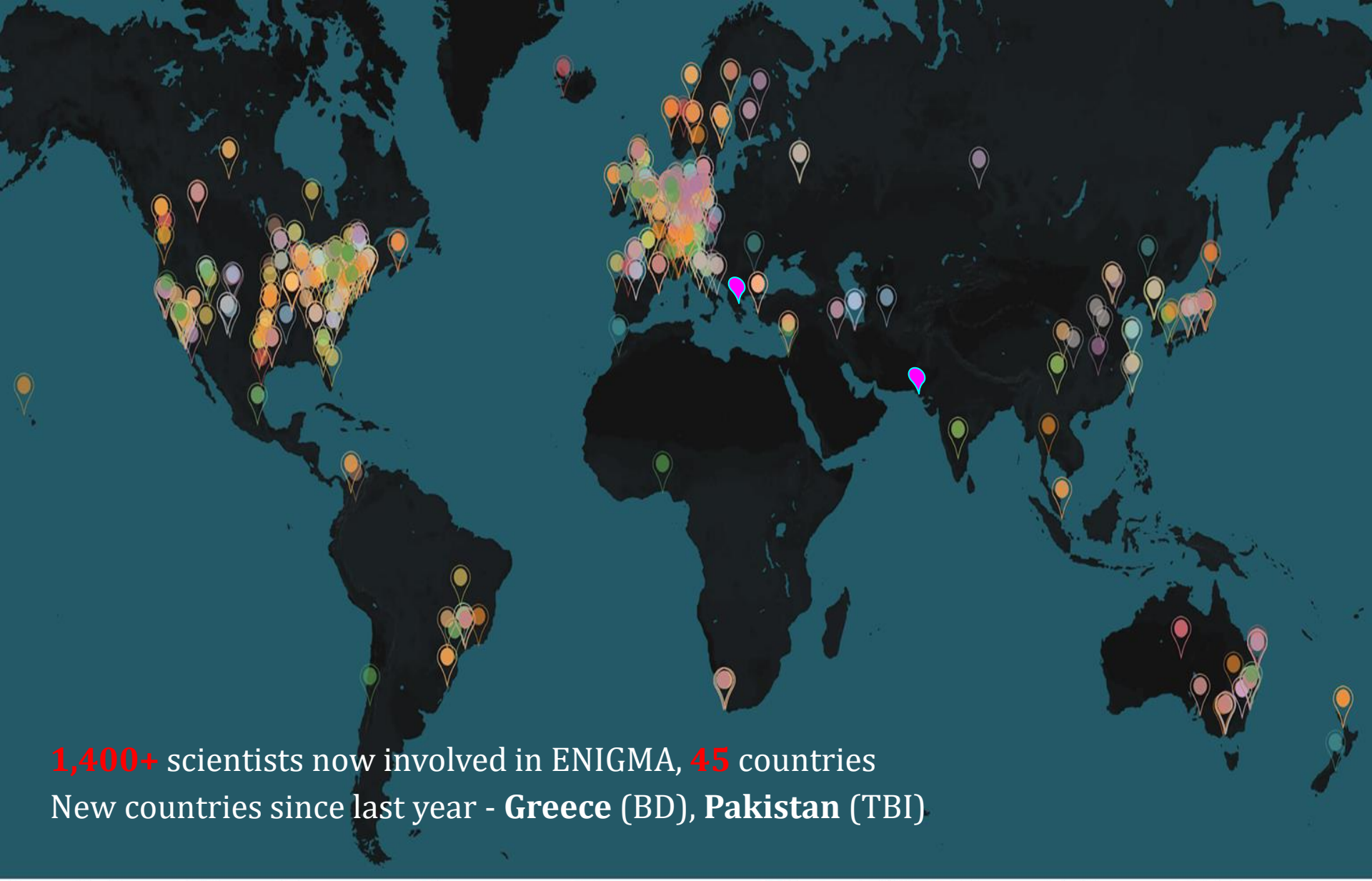
umc

Working Groups: Chart Overview

50 total working groups →
30 clinical, **20** non-clinical





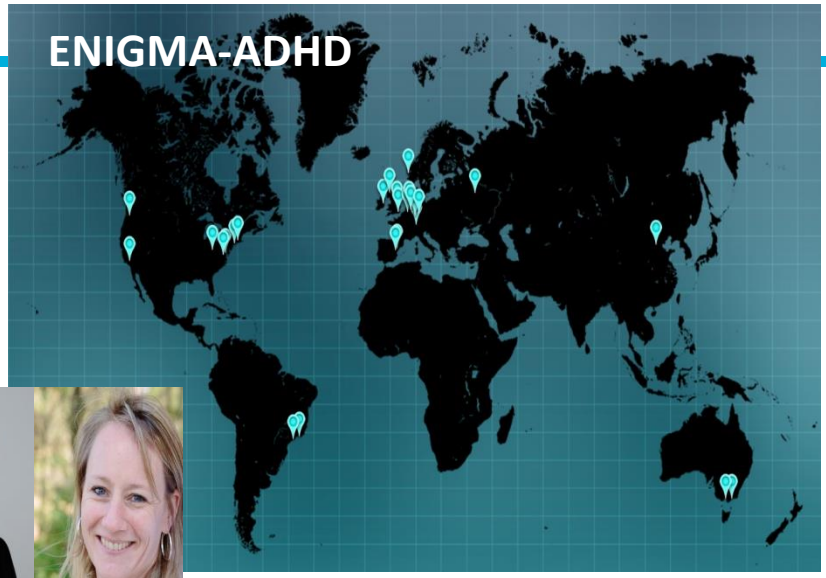

1,400+ scientists now involved in ENIGMA, 45 countries
New countries since last year - **Greece** (BD), **Pakistan** (TBI)
Primary Working Group
22q Deletion Syndrome
MDD
BD
SCZ
Addiction
ADHD
Anxiety
ASD
Ataxia
Brain Injury
BrainAGE
Clinical High Risk
CNVs
Core
DTI
Early Onset Psychosis
Eating Disorders
EEG
Epigenetics
Epilepsy
Evolution
Frontotemporal Dementia
GWAS
Hippocampal subfields
HIV
Irritability
Laterality
Lifespan
OCD
ORIGINs
Parkinson's
Plasticity
PTSD
Relatives
rsfMRI
Schizotypy
Sleep Disorders
Storage Disease
Stroke Recovery
Suicidal Thoughts & Behaviors
Sulci
Tourette's Syndrome
Transgender Persons

ENIGMA'S
CLINICAL
WORKING GROUPS

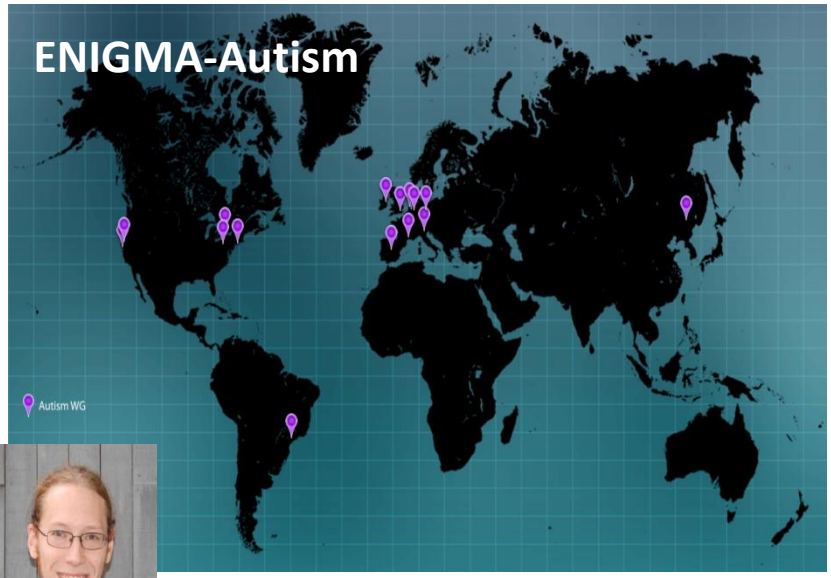
9 LARGEST
NEUROIMAGING STUDIES
IN THE FOLLOWING CLINICAL POPULATIONS

- **10,105** Major Depression Schmaal et al 2016
- **9,572** Schizophrenia van Erp et al 2018
- **6,503** Bipolar Disorder Hibar et al 2016
- **3,876** Epilepsy Whelan et al 2018
- **3,665** OCD Boedhoe et al 2018
- **3,242** ADHD Hoogman et al 2017
- **1,868** PTSD Logue et al 2018
- **3,222** Autism Spectrum Disorder van Rooij et al 2018
- **789** 22q DS Sun et al 2018

Nijmegen researchers



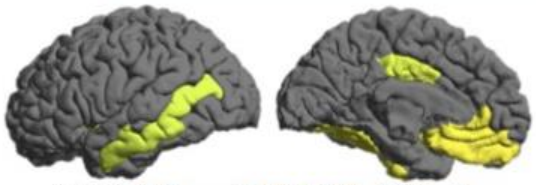
Barbara Franke & Martine Hoogman



Jan Buitelaar
& Daan van Rooij

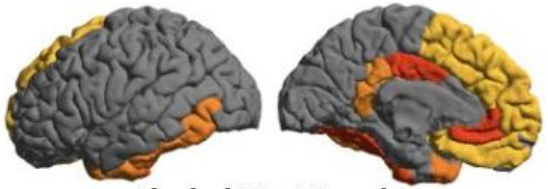
Radboudumc

Comparing results becomes easy!

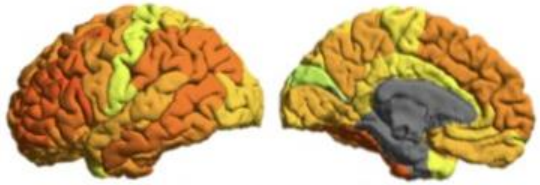


MDD: Schmaal 2017 Mol Psych

OCD
Boedhoe 2017 Am J Psych

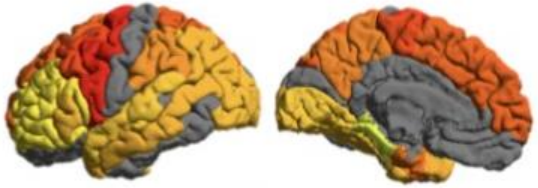


Alcohol Use Disorder:
Mackey 2018 Am J Psych

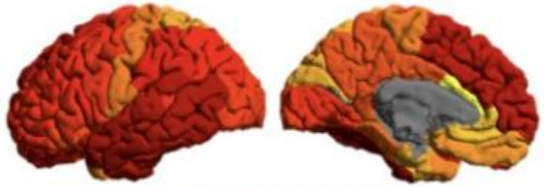


BD: Hibar 2018 Mol Psych

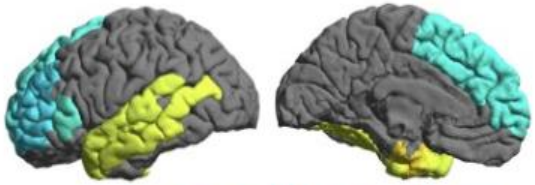
ADHD: Hoogman 2019 Am J Psych



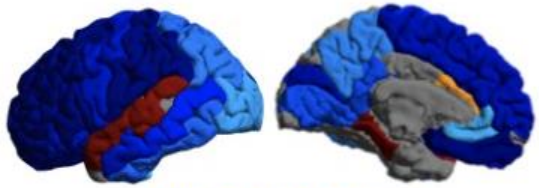
Epilepsy: Whelan 2018 Brain



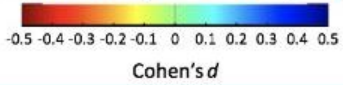
SCZ: van Erp 2018 Biol Psych



ASD: van Rooij 2017 Am J Psych



22q: Sun 2019 Mol Psych



ENIGMA

Advantages

- Sample size and power
- Collaborating is fun and easy
- Life-span perspective (broad age range)
- Harmonized segmentation procedures and protocols for QC and analysis

Disadvantages

- Old data
- Collected with various aims (inclusion criteria etc)
- Heterogeneity of other phenotypes of interest (example: ADHD severity measures collected with different instruments)
- Cross-sectional data
- (Submission systems/journals still don't understand consortia papers…)

Access to the data via proposal form to PI's of WG, more information: http://enigma.ini.usc.edu/

10-years ENIGMA: special issue HBM 2020