# OHBM-DGKN symposium on machine-learning and precision medicine: from basics to clinical applications

**Christian Grefkes** Organizer
Department of Neurology, University Cologne
Cologne, Germany, NRW

## Overview
Gesa Hartwigsen (Univ. Leipzig, Germany, DGKN) will discuss how domain-general networks contribute to language reorganization after (virtual) lesions. Here, multivariate techniques help to identify inter-individual differences in response to inhibitory neurostimulation to key language areas. In the second part, she will discuss stimulation-induced improvements in language when targeting domain-general areas of the multiple-demand network with facilitatory neurostimulation. In the second talk, Thomas Yeo (Univ. Singapore, OHBM) will talk about developing machine learning algorithms to provide insights into neuropsychiatric disorders. He will discuss how unsupervised machine learning can be used to provide insights into the heterogeneity of autism spectrum disorders based on MRI data. He will then discuss how supervised machine learning may predict Alzheimer's disease dementia progression up to 5 years into the future. In the third talk, Gaël Varoquaux (McGill Montreal & Univ. Paris Saclay, OHBM) will discuss how machine learning on large brain-imaging cohorts can open new alleys for markers of mental health. He will especially highlight issues on the external and construct validity of brain-imaging based markers. Finally, Susanne Weis (Univ. Düsseldorf and Jülich Research Center, Germany) will address artificial intelligence (AI) approaches to analyze data from neuroimaging, wearables and features that can be extracted from social media. She will elaborate on current developments and differences to classical statistics. Afterwards, she will discuss the possibilities and limitations of AI-based methods and the ethical, legal and social aspects that arise from their use.

## Lecture 1: *The role of domain-general networks for language reorganization*
**Gesa Hartwigsen** Presenter

In this talk, I will discuss how domain-general networks contribute to language reorganization after (virtual) lesions. Evidence from combined neurostimulation and neuroimaging points towards rapid short-term reorganization in response to network perturbation, with a contribution beyond specialized language areas. Here, multivariate techniques help to identify inter-individual differences in response to inhibitory neurostimulation to key language areas. In the second part, I will discuss stimulation-induced improvements in language when targeting domain-general areas of the multiple-demand network with facilitatory neurostimulation. Such network approaches may help to advance current therapeutic approaches.

## Lecture 2: *Using Machine Learning to Understand & Predict Neuropsychiatric Disorders*
**Thomas Yeo** Presenter

I will highlight our group's work on developing machine learning algorithms to provide insights into neuropsychiatric disorders from MRI data. I will first discuss how we have used unsupervised machine learning to derive insights into heterogeneity in autism spectrum disorder. I will then discuss how we have used supervised machine learning to predict Alzheimer's disease dementia progression up to 5 years into the future.

**Lecture 3:** *Measuring mental health with brain imaging and machine learning*
**Gael Varoquaux** Presenter

The study of mental health relies vastly on behavior testing and questionnaires. I will discuss how machine learning on large brain-imaging cohorts can open new alleys for markers of mental health. My claims are that challenges are the amount of diagnosed conditions rather than heterogeneity of the conditions and that we should turn to proxy labels. I will discuss another fundamental challenge to this agenda: the external and construct validity of brain-imaging based markers.

**Lecture 4:** *Predictions of mental traits: Road to Utopia or Orwell?*
**Susanne Weis** Presenter

New approaches to using artificial intelligence to analyze data from neuroimaging, wearables and features that can be extracted from social media, already make it possible to predict cognitive abilities, personality traits and mental illnesses, as well as to reveal mental states. So are we now facing the transparent human being? Here, I will first briefly describe the technical and conceptual background of the current development and its differences to classical statistics. Afterwards, I will discuss the possibilities and limitations of AI-based methods and the ethical, legal and social aspects that arise from their use.