

# Course Title: Assessing the understandability of AI solutions in psychiatry

## Teacher

Dr. Cristina Berchio

## Course description

This course aims at assessing the understandability of AI solutions in Psychiatry by investigating whether embedding clinical, behavioral, pathophysiological, and genetic information into AI models reduces uncertainty and generates more clinically relevant decisions. Psychiatric disorders show highly variable characteristics and risk factors. Therefore, AI prognostic and diagnostic solutions are fed with a wide variety of patient related information (e.g., symptoms, behaviors, brain-related data). Because different diagnostic categories are often associated with drastically different clinical manifestations and neurobiological substrates, explaining clinical phenomena with AI is challenging. We will address this challenge by presenting algorithms that discriminate between psychiatric diagnoses based on multimodal data informed by biological and clinical priors. We show AI solutions that are interpretable in clinical settings, besides generating a more comprehensive view of the pathophysiology of psychiatric conditions. Specific topics are: i) Multi-modal learning algorithms informed by pathophysiological information; ii) Comparison of categorical models obtained based on human knowledge and categories derived from AI models in neuroimaging; iii) Validation of deep-phenotyping based algorithms in less characterized individuals.

## Course period

December 2023-February 2023

## SSD

PSI/02

## Credits and Hours

3 CFU, 2 of lecture (8 Hours) and 1 of practice (15 hours), for a total of 31 hours.

## Exam Modality

Two alternatives are available to the student to pass this exam:

- 1) Paper presentation. Students present the content of 2 papers suggested by the teacher. No groups are allowed.
- 2) Project. Students implement and experimentally validate an algorithm or its variation from a paper suggested by the teacher. Projects can be done in groups of 1-3 students, depending on the algorithm.

## Teacher(s) CV

The teacher's CV is attached.

## Teacher(s) Main Publications

1. **Berchio, C.**, Rihs, T. A., Piguet, C., Dayer, A. G., Aubry, J. M., & Michel, C. M. (2016). Early averted gaze processing in the right Fusiform Gyrus: An EEG source imaging study. *Biological psychology*, 119, 156-170.  
<https://pubmed.ncbi.nlm.nih.gov/27381931/>
2. **Berchio, C.**, Piguet, C., Michel, C. M., Cordera, P., Rihs, T. A., Dayer, A. G., & Aubry, J. M. (2017). Dysfunctional gaze processing in bipolar disorder. *Neuroimage: clinical*, 2017, 16, 545-556.  
<https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5608173/>
3. **Berchio, C.**, Piguet, C., Gentsch, K., Küng, A. L., Rihs, T. A., Hasler, R., ... & Perroud, N. (2017). Face and gaze perception in borderline personality disorder: An electrical neuroimaging study. *Psychiatry Research: Neuroimaging*, 269, 62-72.  
<https://www.ncbi.nlm.nih.gov/pubmed/28941875>
4. **Berchio, C.**, Küng, A. L., Kumar, S., Cordera, P., Dayer, A. G., Aubry, J. M., ... & Piguet, C. (2019). Eye-gaze processing in the broader bipolar phenotype revealed by electrical neuroimaging. *Psychiatry Research: Neuroimaging*, 291, 42-51.  
<https://www.ncbi.nlm.nih.gov/pubmed/31398614>
5. **Berchio, C.**, Rodrigues, J., Strasser, A., Michel, C. M., & Sandi, C. (2019). Trait anxiety on effort allocation to monetary incentives: a behavioral and high-density EEG study. *Translational psychiatry*, 9(1), 1-13.  
<https://www.ncbi.nlm.nih.gov/pubmed/31300637>
6. Damborská, A., Piguet, C., Aubry, J. M., Dayer, A. G., Michel, C. M., & **Berchio, C.** (2019). Altered electroencephalographic resting-state large-scale brain network dynamics in euthymic bipolar disorder patients. *Frontiers in psychiatry*, 10: 826.  
<https://pubmed.ncbi.nlm.nih.gov/31803082/>
7. **Berchio, C.**, & Micali, N. (2022). Cognitive assessment using ERP in child and adolescent psychiatry: difficulties and opportunities. *Psychiatry Research: Neuroimaging*, 319, 111424. IF: 2.88  
<https://pubmed.ncbi.nlm.nih.gov/34883368/>
8. Mauriello, C., Pham, E., Kumar, S., Piguet, C., Aubry, J. M., Dayer, A., ... & **Berchio, C.** (2022). Dysfunctional temporal stages of eye-gaze perception in adults with ADHD: a high-density EEG study. *Biological Psychology* (2022): 108351.  
<https://pubmed.ncbi.nlm.nih.gov/35568095/>
9. **Berchio, C.**, Annen, L. C., Bouamoud, Y., & Micali, N. (2023). Temporal dynamics of cognitive flexibility in adolescents with anorexia nervosa: A high-density EEG study. *European Journal of Neuroscience*, 57(6), 962-980.

<https://pubmed.ncbi.nlm.nih.gov/36683346/>

10. **Berchio, C.**, Kumar, S. S., & Micali, N. (2023). EEG Spatial-temporal Dynamics of Resting-state Activity in Young Women with Anorexia Nervosa: Preliminary Evidence. *Brain Topography*, 1-14.

<https://pubmed.ncbi.nlm.nih.gov/37615798/>

## Short curriculum vitae

### General information



#### ■ Personal data

- Cristina Berchio
- Date of birth: 3 March 1983
- Place of birth: Alba (CN), Italy
- ORCID: 0000-0002-4573-5997
- E-mail: [cristina.berchio@uniba.it](mailto:cristina.berchio@uniba.it)
- Professional address: Department of Translational Biomedicine and Neuroscience (DiBrain), University of Bari Aldo Moro, Piazza Giulio Cesare, 11, 70124 Bari, Italy

#### ■ Education

- **Phd in Neuroscience**, University of Parma, Italy. 01/2009-12/2012, defence: 22.04.2013, Supervisor Prof.: V. Gallese. Title of the thesis: 'High-density EEG and the Mirror Mechanism in children. Two empirical studies conducted on Typical Development children and children with Autism Spectrum Disorder.' Final mark: 'Ottimo'
- **Master Degree in Developmental Psychology**, University of Torino, Italy. 10/2005-02/2008  
Title of the thesis: "The treatment of Autism in Italy: a comparison between programs, methods and techniques". Final mark: 110 out of 110.
- **Bachelor in Developmental Psychology**, University of Torino, Italy. 09/2002-11/2005.  
Final mark: 110 out of 110 (with honors).
- **High school for science**, Acqui Terme (Piemonte), Italy. 09/1997-06/2002.  
Final mark: 100 out of 100.

#### Additional relevant training

- Mindfulness-based interventions for psychiatric disorders : Certificate of Advanced Studies (CAS), 'Certificat de formation continue Interventions basées sur la Pleine Conscience (Mindfulness)', Haute Ecole Spécialisée de Suisse occidentale, Switzerland. 09/2017-10/2018.

#### ■ Past and present positions

- RTDa, University of Bari Aldo Moro, DiBrain, Italy: present.
- Senior research scientist 'Maître Assistant-e': Dept. of Child and Adult Psychiatry, University of Geneva, Switzerland.
  - April 2019- February 2023. Prof. N. Micali (100%)
  - May 2018-March 2019. Prof. A. Dayer/ Prof. Jean-Michel Aubry (100%).
- Postdoctoral researcher: Dept. of Adult Psychiatry/Basic Neuroscience, University of Geneva, Switzerland.  
02/2013-04/2018. Prof. C.M. Michel, Prof. A. Dayer, Jean-Michel Aubry (100%).
- Doctoral student: University of Parma, Italy. 01/2009-12/2012. Supervisor: Prof V. Gallese (10

■ **Language skills** Italian: mother tongue; English: very good; French: very good.

## ■ **Major scientific achievements**

My research interests focus on understanding the neurobiology bases of psychiatric disorders, particularly to understand how the brain influences behaviour and emotional responses. Within this framework, I am specialized in applying electrophysiological techniques to assess brain and cognitive functions in psychiatric disorders.

I have a strong background in applying spatio-temporal methodologies using high-density electroencephalography 'EEG' magnetoencephalography and 'MEG' data (e.g., k-means microstate analyses, electrical neuro-imaging).

During my PhD, at the University of Parma, I investigated the mirror mechanism in autism and in typically developing children using EEG. During my post doc, at the University of Geneva, in the Functional Brain Mapping Lab headed by Prof. Christoph Michel (world expert in the field of electrical neuroimaging), I applied EEG to study patients with emotional dysregulation disorders. In these projects, I validated a 2-back gaze working memory task (Berchio et al., 2016), and I collected data in patients with bipolar disorder (Berchio et al., 2017a), borderline personality disorder (Berchio et al., 2019), attention-deficit/hyperactivity disorder (Mauriello et. al, 2022), as well as in offspring of bipolar patients (Berchio et al., 2019b). I was also involved in other EEG projects within the framework of the NCCR SYNAPSY 'The synaptic bases of mental diseases': a project on emotional face processing in children of mothers with post-traumatic stress disorder with Prof. D. Schechter (Perizzolo et al., 2019), and in a project with Prof. Carmen Sandi from the EPFL on anxiety (Berchio et al., 2019), where I co-supervised two doctoral students.

Immediately after the election of Nadia Micali (world expert in the field of feeding/eating disorders) as head of the « child and adolescent psychiatry division» at the University-Hospitals of Geneva, I got in contact with her and we discussed neurobiological projects in eating disorders. The projects have been funded and implemented (Berchio et al., 2023 a,b).

At the University of Bari (DiBrain), I am currently using MEG to investigate brain functions in patients with psychosis and at-risk individuals.

## ■ **Teaching activities at the Master in Neurosciences, Geneva University Neurocenter, Switzerland.**

**Tutoring:** In the Neuroscience programme at the University of Geneva (02/2018-02/2023).

## ■ **Teaching activities at the Lemanic Neuroscience Doctoral School, University of Geneva, Switzerland**

- Teaching: Advanced EEG course for Lemanic PhD students: high density EEG recordings/Hands-on: ERP analysis: 04/2017 (8 hours); 4/2019 (8 hours), Geneva. Switzerland.
- PhD students co-supervision at the University of Geneva, Department of Psychiatry/Basic Neuroscience: High density EEG acquisition, design and implementation of EEG paradigms, EEG-based neuro-imaging analysis.

### ■ **Other scientific activities**

Reviewer of the following Journals: Plos One, Brain Topography, Neuropsychologia, Social Cognitive and Affective Neuroscience, Psychiatry research, BMC Neurology, European Child and Adolescent Psychiatry; European Journal of Neuroscience; Neuroimage: clinical; Computers in Biology and Medicine.

Guest Editor: Frontiers in Human Neuroscience, 'New Insights Into the Cognitive Neuroscience of Eating Disorders' (2022).