A model of neurovisceral integration: the central-autonomic network in psychopathology and medical conditions

ABSTRACT: Autonomic nervous system (ANS) dysregulation, mostly a reduced cardiac vagal tone as measured by the high frequency (HF) power of heart rate variability (HRV), is a key factor in psychopathology, including depression, severe mental illness (SMI) [1], as well as several medical conditions (e.g., cardiovascular disease) [2]. A network of brain regions (the central autonomic network; CAN) – including the anterior cingulate (ACC), insular, orbitofrontal, and ventromedial prefrontal cortices, and the amygdala – has been shown to be affected in psychopathology, mostly when associated with somatic symptoms. Through projections to the hypothalamic and brainstem autonomic nuclei, this network has been also postulated to control HRV. Studies using neuroimaging techniques and EEG co-registration, proposed a key role of theta activity linking CAN, particularly rostral ACC activity, to HRV.

Project_2 **The central-autonomic network in the association between depression and Anorexia Nervosa (PIs: Palomba; co-PIs: Favaro, Bertoldo, Gentili, Messerotti Benvenuti, Solmi[1])**
Interestingly, autonomic dysregulation, and particularly an altered HRV modulation, has been also shown in eating disorders [3,4], not necessarily as a consequence of body dysfunctions. Both depression and anorexia nervosa lead to significant impairments in individual functioning and health. In light of this, early recognition, prevention and effective treatment of such diseases are highly recommended.

The project will recruit a sample of patients with depressive symptoms and a sample of patients with anorexia nervosa. The aims of the project can be summarized as follows:

(1) assess HRV and brain electrical activity of the CAN in young patients with depression, or anorexia nervosa compared with controls;

(2) examine if theta activity is a candidate EEG marker of HRV dysfunction in those populations;

(3) investigate whether the above central and autonomic measures are associated with clinical, cognitive and affective variables, treatment, and history of illness;

(4) assess whether the above central and autonomic measures have an impact on clinical outcome at 12 months follow-up.

Participants. Patients with depressive symptoms and anorexia nervosa will be included, with a diagnosis as defined by DSM-5. Participants will be recruited through Veneto Regional Center for Eating Disorders, and through Clinical Services of the Department of General Psychology at University of Padua. Age- and sex-matched control participants will be recruited as well.

The research groups. The PI and the whole research group at UNIPD have developed long-lasting international collaborations in the field of affective, cognitive and behavioral neuroscience, psychiatry, and particularly the area of neuro-visceral integration model for emotion regulation (prof. Juilan Thayer, The Ohio State University), which will provide a solid base for both the proposed projects as well as the planned research methods and trainings.

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EXPERIMENTAL DATA:

To be acquired	X
Already acquired (ready to be used)	

Physiological recording/analysis and procedures will be similar across projects. HRV will be assessed with ECG recording. The ECG will be measured in a modified lead II chest configuration. R-R intervals will be exported to Kubios-HRV Analysis software 2.0 to extract time, frequency and non-linear domains HRV features. The study of non-linear metrics of HRV will be conducted as they have a high informative power in discriminating patients from controls, and in assessing depressive symptoms in medical patients [5]. EEG will be recorded through a pre-cabled high-density 128-channel HydroCel Geodesic Sensor Net and be referenced to the vertex. Time-frequency and source localization analyses will be conducted in Brainstorm. Each system is available at the Department of General Psychology (University of Padua). HRV and EEG features will be used as input for supervised classification algorithms (e.g., neural networks, SVM) to discriminate healthy from depressed subjects. The use of high-density EEG, which exhibits temporal resolution in the millisecond range, together with HRV will provide unique information on the time course and specificity of neural and visceral coupling in healthy individuals as well as in patients with somatic and psychopathological conditions. All patients will undergo (1) an assessment at baseline for biomedical, psychological and psychiatric variables and ECG and EEG recordings (2) a monitoring of the above variables every 3 months for a period of 12 months. In project 1, half of the participants will undergo 5 HRV-biofeedback sessions between the baseline assessment and the first monitoring evaluation. No other specific intervention will be involved in the study, and patients will receive treatment as usual. In project 3 an emotional Go/Nogo task will be included as a measure of attentional inhibition in the processing of unpleasant stimuli.

ETHICS COMMITTEE:

Obtained	*(participants and with depressive subclinical symptoms and controls) **(patients with cardiac diseases)
Conditioned submission	***(patients with depression or Anorexia
Not required	

*Comitato Etico della Ricerca Psicologica Area 17); **Comitato Etico della Ricerca Psicologica Area 17; a further visa to the Ethical Committee of the AUSSL 6 has been submitted; ***a request will be submitted only if a PhD student will be associated to the project