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## Short Commentary

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# ENS-CNS correlations and psychoanalytic psychiatry: A possible link

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### Abstract

On the basis of the literature on the relationships between the enteric nervous system (ENS) and the central nervous system (CNS), a possible link with psychoanalytic psychiatry springs out clearly. This brief note just is centred in highlighting such a theoretical remark.

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### Discussion

The gut, often said to be the “second brain” [1], interacts with the brain and vice versa. Despite the distance between these two organs. In particular, the gut microbiome, existing in the gastrointestinal (GI) tract, is involved in various normal behaviours and mental disorders depending on how the gut microbiome, gut and brain communicate of each other. Differently from other peripheral organs, the GI tract has an intrinsic nervous system with numerous neurons (about 500 million cells in humans) and glial cells, called the enteric nervous system (ENS), which is made by many intertwined neural networks distributed from the oesophagus to the anus. The ENS structurally comprehends two chief ganglionated plexi: the myenteric and the submucosal plexuses, which are connected by the central nervous system (CNS) and directly control either the movement of the GI tract and the secretion of gut hormones and gastric acid. Further, ENS neurons produce various neurotransmitters, including dopamine and serotonin, to communicate with other neurons inside or outside this system; and the communication by ENS neurotransmitters is influenced by the gut microbiome and its metabolites as they are anatomically adjacent [2].

The vagus nerve, as a component of parasympathetic nervous system regulating main involuntary body functions (such as digestion, respiration, and heartbeat), is the cranial nerve that connects the gut and the brain. It gathers information from various organs, such as the GI tract and respiratory and cardiovascular systems, and sends it to many brain areas [3]. Interestingly, damages to the vagus nerve are closely linked to some psychiatric disorders: for instance, vagus nerve stimulation is usually used to treat depression and chronic pain. All these outcomes suggest that communication between the gut and brain, through the vagus nerve, is important for maintaining brain homeostasis. Furthermore, the gut and the brain are physically connected also through the spinal cord: indeed, although vagus nerve relays the physiological information from the gut, it is also experimentally well-established that noxious information, including pain and injury, is conveyed through the spinal cord. Ascertained evidence, has suggested that the gut microbiome builds a unique ecosystem inside the GI to maintain brain homeostasis and that compositional changes in the gut microbiome are highly correlated with several mental disorders; these latter can be improved by controlling the gut microbiome composition [2].

Although various empirical studies on gut dysbiosis and mental disorders have been pursued, these studies are yet limited in that they show some correlation, but not a causal relationship, between the gut microbiome and mental health, so further studies should be conducted to clarify this last issue as well as to elucidate molecular or physiological changes in neural circuitries of the bidirectional gut-brain axis [2,4,5]. There is indeed a strong communication between gut microbiota and the CNS, this communication being mediated through the microbiota-gut-brain (MGB) axis. It seems that this bidirectional axis can be modulated by environmental factors, such as stress, pharmaceuticals (in particular antibiotics) and dietary habits. Moreover, modulations of this axis can also underlie mood alterations. As the hypothalamic-pituitary-adrenal (HPA) axis is a key element regulating the MGB axis and is also related to the pathophysiology of depression, it is therefore important to understand the relationships between such biological systems [6]. Alterations in the intestinal flora composition could then increase the permeability of the gut barrier, activate systemic inflammation and immune responses, regulate the release and efficacy of monoamine neurotransmitters, alter the activity and function of the HPA axis, as well as modify the abundance of the brain-derived neurotrophic factor (BDNF) [7]. Further empirical evidence has indeed showed that BDNF may be involved in the pathophysiology of schizophrenia [8]. Various mechanisms yet unclear link the gut microbiota with the HPA axis activity and current research shows evidence for a crosstalk between the gut-brain axis and the HPA axis from studies of patients with mood and psychotic disorders [9].

Then, another system that is revealing to be closely related to gut microbiota is the neuroendocrine system controlling the various chief body processes in response to stress, i.e., the hypothalamic-pituitary-adrenal (HPA) axis. Such an interaction is of crucial importance, in that various disorders of the microbiota-gut-brain axis have been ascertained to be associated with dysregulations of the HPA axis. The bidirectional communication between the gut microbiota and the HPA axis is closely interrelated with other systems, such as the immune system, the intestinal barrier, the blood-brain barrier, microbial metabolites and gut hormones, as well as the sensory and autonomous nervous systems [10]. An imbalanced human microbiome, then, may greatly influence proper neuroimmune reactions and the neurodevelopment with long-lasting effects and might therefore play a pivotal role in phenotypic aetiology of psychiatric illnesses, like schizophrenia [11]. All that justifies a psycho-neuro-immuno-endocrine conception of human being as explaining better and in a more complete and comprehensive view its biological essence.

On the other hand, a deeper understanding of the real connections, their effective direction and causal nature, between enteric and central nervous system might turn out useful also for the well-known psychosexual development theory of human psyche according to Freudian psychoanalysis, where some of its stages (i.e., the oral and anal one) just concern gastroenteric system, its functions and structural development. In particular, this psychic development theory relies, just from a more proper physiological stance, on the epi-ontogenetic neurodevelopment of gastrointestinal system (including ENS), relatively to the peripheral nervous system [12], according to the original Freud-

ian presuppositions. Thus, current and future research on the correlations between ENS and CNS, as briefly claimed above, might provide suitable changes, further interpretations as well as support and possible empirical evidence (coming therefore from neurogastroenterology) to Freudian theory and its psychoanalytic psychiatry counterparts [13], which states that certain mental illnesses have their roots just in these abnormal developmental stages.

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