

## Body Image in Anorexia Nervosa: The Link Between Functional Connectivity Alterations and Spatial Reference Frames

To the Editor:

A better knowledge about the neural bases of body image disturbances in patients with anorexia nervosa (AN) is necessary to improve treatment strategies for this serious mental disorder. Overestimation of one's own body size, greater body dissatisfaction, and greater self-ideal discrepancies, showed by AN patients (1), result in a vicious cycle that leads them not to perceive their thin form as it really is. Such complex symptoms are central for AN, affecting outcome (2) and relapse (3).

Behavioral dysfunctions and abnormal neural functional correlates related to body image distortion were explored in AN patients with behavioral and neuroimaging studies. Functional magnetic resonance imaging studies of AN patients, using body image or words concerning the body as tasks, mainly showed 1) posterior parietal region alterations, related mainly to perceptive body attitudes and 2) prefrontal and insula alterations, related mainly to affective body attitudes (4). However, the complexity of the neural correlates of body image distortion in AN have not been completely defined. In particular, the existence of neural correlates related to the proprioceptive and somatosensory components of body image distortion still require investigation. Such elements can be considered part of the complex construct of body image disturbances in AN (5).

In a recent issue of *Biological Psychiatry*, Favaro *et al.* (6) added new insight to the literature exploring the neural correlates of the body image distortion in individuals with AN through a resting-state functional magnetic resonance imaging scan. This study aimed to explore whether subjects with AN and recovered from AN compared with control subjects show abnormal functional connectivity of networks involved in visuospatial and somatosensory processing. The authors chose to investigate the spontaneous organization of four functional neural networks of interest (somatosensory and visual). Their findings pointed out that both groups of AN patients displayed hypoconnectivity in the ventral visual network (i.e., the AN group showed an area of decreased connectivity in the left occipitotemporal, and the recovered AN group showed an area of significant decreased connectivity in the right middle frontal gyrus junction). Furthermore, AN patients showed hyperconnectivity in the somatosensory network (i.e., increased degree of coactivation in the left superior parietal cortex including the primary somatosensory cortex and premotor cortex). In particular, the authors linked the decreased activation of the areas of ventral visual network to processes subserving body image disturbance. They also suggested that the increased activation of the somatosensory network areas (in AN patients only) could show altered processing of somatosensory information about the body, including long-term memory and retrieval of spatial representation of body size. Yet how may these impairments explain body image disturbance and the need for body weight control behaviors?

Neuropsychological research distinguishes among various spatial reference frames (egocentric vs. allocentric) (7) that are also used by human memory to represent the locations of objects in the environment (8). The neural substrates representing these reference frames are still under debate. Nevertheless, the ventral visual network and the somatosensory network, as considered by Favaro and colleagues, includes some cortical areas that are involved in the egocentric–allocentric spatial frame of references. For example, Zaehle *et al.* (7) showed that the two frames involved bilateral frontoparietal areas. They suggested a hierarchical processing network characterized

by widely overlapping areas. Particularly, the allocentric network also comprised the right superior parietal lobe and the occipitotemporal areas bilaterally and the egocentric network mainly involved the precuneus (7). Lesion neurologic studies also showed the role of the superior parietal lobule and the occipitotemporal areas in the egocentric–allocentric visual spatial representations (9). Furthermore, Gimsen *et al.* (10) showed that damage to the premotor cortex impaired egocentric spatial representations.

These frames also interact in episodic and prospective memory. Byrne and colleagues (11,12) suggested that short-term retention of perceptual information is achieved by egocentric representations, whereas long-term memory is achieved by allocentric representations. Within this model, the translation between them is performed by a specific transformation circuit, assumed to be in the retrosplenial cortex/intraparietal sulcus.

Considering the neuropsychological data mentioned earlier, we suggest that the findings of Favaro *et al.* (6) could support, at least in part, the hypothesis that AN patients have an impairment in the egocentric (perceptual)–allocentric (memory) transformation process, mainly related to dysfunctions of the posterior parietal areas (13,14). In this view, the abnormal functional connectivity the authors found may produce a relevant clinical effect: an altered memory of the body, not modified by contrasting egocentric parietal representations driven by perception, that primes the processing of any further body-related experience (15). In other words, the anorectic individual is locked to an allocentric (observer view) negative representation of her or his body (13,16,17).

Worthy of particular attention is that the coactivation of a brain area in the right parietal region (somatosensory network) significantly correlates with both fear of gaining weight and body image distortion. The authors linked such results to the role of the somatosensory network for both general and body-related visuospatial cognition. Interestingly, the allocentric frame recruits right-sided parietal areas (7). Moreover, the right superior parietal cortex exhibited specific activation for the coding and maintenance of allocentric spatial information (7). Such neuropsychological findings seem to confirm the role of egocentric–allocentric reference frame alterations in AN psychopathology.

Although there is not yet a clear definition for functional networks (18), additional neuroimaging studies should explore functional connectivity of AN patients taking into account spatial reference frame areas. Such studies could provide contributions to the knowledge of the complexity of body image distortion and, at the same time, generate useful elements to improve therapy strategies for patients with AN.

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