



Intrapersonal, interpersonal, and physical space in anorexia nervosa: a virtual reality and repertory grid investigation



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ABSTRACT

Anorexia nervosa (AN) is an eating disorder characterized by severe body image disturbances. Recent studies from spatial cognition showed a connection between the experience of body and of space. The objectives of this study were to explore the meanings that characterize AN experience and to deepen the examination of spatiality in relational terms, through the study of how the patient construes herself and her interpersonal world. More specifically this study aimed (1) to verify whether spatial variables and aspects of construing differentiate patients with AN and healthy controls (HCs) and are related to severity of anorexic symptomatology; (2) to explore correlations between impairments in spatial abilities and interpersonal construing. A sample of 12 AN patients and 12 HCs participated in the study. The Eating Disorder Inventory, a virtual reality-based procedure, traditional measures of spatial abilities, and repertory grids were administered. The AN group compared to HCs showed significant impairments in spatial abilities, more unidimensional construing, and more extreme construing of the present self and of the self as seen by others. All these dimensions correlated with the severity of symptomatology. Extreme ways of construing characterized individuals with AN and might represent the interpersonal aspect of impairment in spatial reference frames.

1. Introduction

Body image disturbance has been considered one of the most important symptoms in anorexia nervosa (AN) although its causes are still unclear (American Psychiatric Association, 2013; Dakanalis and Riva, 2013; Gardner and Brown, 2014; Lin and Soby, 2016; Phillipou et al., 2016). Slade and Russell (1973) found that patients with Eating Disorders (ED) overestimated their body size when compared with healthy controls, and interpreted this as a perceptual phenomenon. However, Smeets and Kosslyn (2001) found that there is no difference in perceptual sensitivity between AN patients and normal and thin control groups (Garfinkel et al., 1978; Smeets, 1997). Similarly, Smeets and Kosslyn (2001) demonstrated that AN patients' body image disturbance results from body size distortions in memory rather than perception.

A recent neurocognitive account, namely Allocentric Lock Theory (ALT), suggests a possible role of the way the body is "experienced" and "remembered" in relation to spatial processing that may contribute to body-image distortions in EDs (Dakanalis et al., 2016a, 2016b; Riva,

2014; Riva et al., 2014). A growing body of research from cognitive neuroscience indicates that our spatial experience, including that related to our body, is organized around two different reference frames (Byrne et al., 2007; Dakanalis et al., 2016a, 2016b): egocentric and allocentric. The egocentric frame is based on the body of the perceiver and has its principal source in "somatopereceptions", i.e., representations of the current state of the body from perceptual input (Riva et al., 2014; Serino et al., 2016). Conversely, within the allocentric frame, the body is an object similar to others in the physical world, with its representation (Longo et al., 2010) based on abstract knowledge, beliefs, and attitudes (Riva, 2014). According to Byrne's (2007) model of spatial memory, these frames play a critical role in the way memories are stored and retrieved: the short-term memory of perceptual information is shaped by egocentric parietal representations and long term memory is modeled by medial temporal allocentric representations. Following these premises, Allocentric Lock Theory (Dakanalis et al., 2016a, 2016b; Riva, 2014; Riva et al., 2014) assumes that impairments in the translation between the egocentric and allocentric reference frames, for exogenous (e.g., stress) or endogenous (e.g., brain

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abnormalities in the areas involved in spatial processing) reasons, could trap ED patients in a negative (e.g., my body is fat) long term memory of their body stored as an enduring allocentric representation. EDs may therefore be associated with an impairment in the ability to update the stored allocentric representation of the body with egocentric perception driven inputs.

There is some empirical support for this theory (Dakanalis et al., 2016a, 2016b; Malighetti et al., 2016; Serino et al., 2015). Serino and co-workers (2015) showed that both anorexic and bulimic patients, compared to matched healthy participants, displayed not only significantly poorer visuo-spatial, mental rotation, and short and long-term spatial mnesic abilities, but also they were significantly less accurate in retrieving the position of the memorized object in two virtual-based tasks, requiring the ability to store and retrieve an allocentric representation, and then to refer to this stored long-term representation and update it according to perceptual inputs.

However, it remains unclear how egocentric and allocentric spatial processing are related to the individual's perception of the self and others, and this will be the focus of the current study, which will adopt a multidimensional approach and draw upon personal construct theory (PCT) (Kelly, 1955). From this theoretical perspective, EDs are viewed as “strategies” for dealing with the developmental issues characterizing interpersonal relationships and the formation of identity (Button, 1993; Erikson et al., 2012). Kelly (1955) considered individuals as scientists involved in the anticipation of their worlds through the formulation and testing out of hypotheses, or constructions of events, and revision of these if they are invalidated (Winter and Button, 2010). PCT views psychological disorders as involving a lack of this revision process despite repeated invalidation (Kelly, 1955). In their constructivist model of AN, Button and Warren (2002) assumed that anorexic people try to avoid anxiety derived from repeated invalidating experiences in the relational field by focusing on issues such as eating and weight, with the aim of making their life more manageable. The eating and weight domains may offer ways of construing (i.e. placing an interpretation, Kelly, 1955 p.50) which enable the person to predict and control the world (Faccio et al., 2016; Salvini et al., 2012).

The central idea derived from PCT empirical investigations is that AN is associated with deficits in interpersonal construing characterized by relatively rigid and impoverished construing of the self and others (Winter and Button, 2010). Button (1993) suggested that in an attempt to avoid anxiety deriving from unpredictable situations, anorexic people's construing of the world is characterized mainly by constriction, a strategy that may serve to reduce uncertainty deriving from an “apparent incompatibility” in construing by restricting the world to events that are predictable. Furthermore, there is evidence of unarticulated, extreme, and ‘cognitively simple’ (unidimensional and undifferentiated) structures in anorexics' construing, and negative self-construing, compared to people presenting with bulimia and normal control groups (Button, 1993; Mottram, 1985; Neimeyer and Khouzam, 1985; Winter and Button, 2010). An extreme construction of self and others might make a person more vulnerable to psychopathology (Cipolletta, 2011; Fransella et al., 2004).

On the basis of these premises, the current study explored how anorexic patients' deficits in spatial abilities and spatial reference frame processing related to aspects of construing that have been associated with AN (namely unidimensional and extreme construing), particularly in relation to constructions of the self and others. Specifically, we hypothesized that:

1. compared to controls, anorexic patients will display unidimensional and extreme construing, and negative self-construing;
2. compared to normal controls, anorexic patients will display impairments in short and long-term spatial memory, navigation, mental rotation and visuo-spatial abilities especially in the capacity for representing and recalling representations of spatial information through the interaction between the allocentric and egocentric

reference frame;

3. the above aspects of construing characterizing anorexics will be positively interrelated with impairments in spatial cognition, and also correlated with measures of severity of anorexic symptomatology.

2. Materials and methods

2.1. Participants

Twenty-four young women participated in the study (mean age =23.04; SD=6.10): 12 participants with AN (mean BMI =16.87 kg/m² (SD=1.40)), recruited from a clinical center in Northern Italy; and 12 healthy control participants (HCs) matched for age, race/ethnicity, language and education (mean BMI =19.88 kg/m² (SD=1.51)). AN diagnoses according to the clinical criteria of the Diagnostic and Statistical Manual of Mental Disorders, Fourth Edition (DSM-IV-TR) (American Psychiatric Association, 2013) were assigned based on clinical interviews completed by experienced staff.

Exclusion criteria included visual impairments and vestibular disorders. The Ethics Committee of the Catholic University (Milan) approved the study.

2.2. Measures

2.2.1. Clinical assessment

The Eating Disorder Inventory (EDI 3) (Garner, 2004) was administered to evaluate the severity of symptomatology. This measure consists of 91 items organized into 12 primary scales (Drive for Thinness, Bulimia, Body Dissatisfaction, Low Self-Esteem, Personal Alienation, Interpersonal Insecurity, Interpersonal Alienation, Interoceptive Deficits, Emotional Dysregulation, Perfectionism, Asceticism, and Maturity Fears) that provide a standardized clinical evaluation of symptomatology associated with eating disorders. Items are scored using a six choice format (from always to never). The administration required 20 min.

2.2.2. Spatial assessment

In order to evaluate spatial abilities, the following tests were administered:

1. Corsi Block Test-Span and Supraspan (Corsi, 1972) to assess short and long-term spatial memory respectively. The test consisted of nine wooden blocks positioned on a wooden board, placed between the experimenter and the participant. In the Corsi Span, the participant had to reproduce a given sequence by tapping the wooden blocks in the same order as the researcher, with increasing sequence length on each trial. In the Corsi Supraspan, the participant had to repeat several times (max. 8) a given sequence of nine blocks. The procedure ended when the number of wrong reproductions exceeded the proportion of admissible errors per length.
2. Money Road Map (Money et al., 1965) to assess navigation abilities. This is a paper and pencil assessment of left right discrimination that concerns egocentric mental rotation ability in space. The test consisted of a city map on which was drawn a pathway with a 32 step dotted route. The participants had to imagine themselves traveling along this route to decide whether a right or left turn was demanded at each intersection. No time limit was imposed and the maximum score was 32 points (cut off of 10 errors).
3. Manikin's Test (Ratcliff, 1979) to assess mental rotation abilities. The test consisted of 32 sheets presenting a man from different perspectives who holds a ball. The participants had to evaluate in which hand the man was holding the ball. There was no time limit and the maximum score was 32 points.
4. Judgment of Line Orientation (Benton et al., 1978) to assess visuo-spatial abilities. The test consisted of 30 sheets showing two lines

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