Behaviour Research and Therapy 97 (2017) 213–221

Contents lists available at ScienceDirect

Behaviour Research and Therapy

journal homepage: www.elsevier.com/locate/brat

# A network analysis investigation of the cognitive-behavioral theory of eating disorders

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ARTICLE INFO

*Article history:*
Received 19 November 2016
Received in revised form
1 August 2017
Accepted 6 August 2017
Available online 7 August 2017

*Keywords:*
Psychopathology
Transdiagnostic
Network analysis
Eating disorder
Overvaluation

ABSTRACT

Network analysis has recently been introduced as a clinically relevant methodology for understanding the structure of mental disorders and for evaluating cognitive behavioral models of psychopathology. The current study uses network analysis to validate the transdiagnostic model of eating disorders by examining the association between overvaluation of shape and weight and eating disorder symptoms. Eating disorder symptoms were measured among a sample of 194 treatment-seeking children, adolescents, and adults presenting to an outpatient eating disorder clinic. We created transdiagnostic and disorder-specific symptom networks and assessed symptom strength and connectivity. Congruent with the transdiagnostic model, overvaluation of weight and shape emerged among the strongest symptoms in the network, and global network connectivity was higher among individuals with high overvaluation when compared to individuals with low overvaluation. An exploratory analysis revealed that overvaluation of weight and shape was central to anorexia nervosa, bulimia nervosa, and binge eating disorder. Results highlight the associative strength of overvaluation of shape and weight with eating disorder symptoms, regardless of the specific eating disorder diagnosis. Our findings corroborate overvaluation of weight and shape as a transdiagnostic treatment target and potentially useful severity specifier for binge eating disorder.



## 1. A network analysis investigation of the cognitive-behavioral theory of eating disorders

The fifth edition of the Diagnostic and Statistical Manual of Mental Disorders (DSM-5; American Psychological Association, 2013) expanded the eating disorder category to include a number of revised or altogether new disorders under the umbrella of Feeding and Eating Disorders. Importantly, this expansion encompassed a range of eating disorder presentations that includes heterogeneous behaviors, cognitions, and attitudes about food and body image. Although individual DSM-5 diagnoses have displayed clinical utility (Thomas et al., 2015), prevailing cognitive behavioral theories of eating disorders hold that there is a core psychopathology common across all diagnostic presentations (hereby referred to as the *trans*-diagnostic theory; Fairburn, Cooper, & Shafran, 2003; Murphy, Straebler, Cooper, & Fairburn, 2010). This core psychopathology is postulated to be the overvaluation of weight and shape.

Overvaluation of weight and shape refers to judging one's self-worth largely by body shape and weight with diminished value placed on perceived performance in other domains of life. For individuals with eating disorders, perceived success at achieving weight and shape goals can define most, if not all, of their self-image. The presence of weight and shape overvaluation in eating disorders and its association with subsequent psychopathology has been assessed in numerous research studies (Goldschmidt et al., 2010; Grilo, White, & Masheb, 2012; Grilo et al., 2009; Ojserkis, Sysko, Goldfein, & Devlin, 2012). For example, overvaluation of weight and shape is positively correlated with eating disorder symptoms (Goldschmidt et al., 2010; Ojserkis et al., 2012) and depression, and negatively correlated with global self-esteem

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http://dx.doi.org/10.1016/j.brat.2017.08.004
0005-7967/

(Ojserkis et al., 2012). Even within the diagnosis of binge eating disorder, which has no specific diagnostic criterion related to body image, in one study, overvaluation of weight and shape acted as a severity specifier such that individuals with high levels of shape and weight overvaluation reported greater eating-related psychopathology and depression (Grilo et al., 2008). Thus, across diagnoses, overvaluation of weight and shape seems to be a powerful etiologic mechanism for related eating disorder symptoms such as restricting, binge eating, and purging.

The leading model of eating disorders informing enhanced cognitive behavioral therapy (CBT-E; Fairburn et al., 2003) emphasizes the centrality of overvaluation of weight and shape in eating disorder psychopathology and hypothesizes two distinct ways in which overvaluation influences and maintains eating disorder symptoms. One, overvaluation of weight and shape is hypothesized to be the direct causal factor of many, if not most, eating disorder symptoms. Two, overvaluation of weight and shape is hypothesized to influence eating disorder psychopathology beyond its direct causal effects by influencing the connections among the symptoms themselves. For example, Fairburn and Beglin (2008) metaphorically equate an eating disorder to a house of cards, with overvaluation of weight and shape as the central card holding up the house. In this way, the remission of shape and weight overvaluation is hypothesized to disrupt the relationship among eating disorder symptoms, thereby leading the house to collapse. Thus, a primary task in the third stage of CBT-E is to systematically target (both directly and indirectly) and decrease overvaluation of weight and shape.

A contemporary approach to understanding the structure of psychopathology, referred to as the *network approach,* has been proposed as a transformational method to elucidate the interactive structure of mental disorders and has direct implications for psychological treatment (McNally, 2016). Recently, researchers have used network analysis to examine the inter-relationship among symptoms across a number of mental health disorders, including depression (Bringmann, Lemmens, Huibers, Borsboom, & Tuerlinckx, 2015), persistent complex bereavement disorder (Robinaugh, LeBlanc, Vuletich, & McNally, 2014), post-traumatic stress disorder (McNally et al., 2015), and—mostly recently—eating disorders (Forbush, Siew, & Vitevitch, 2016). In contrast to the commonly-used latent trait approach whereby symptoms (e.g., restriction, binge eating, compensatory behaviors) are theoretically and statistically assumed to be independent indicators of an underlying disorder (e.g., anorexia nervosa), the network approach posits that symptoms are constitutive of a disorder such that the associative relationships among them initiate and maintain the disorder without the influence of an underlying entity (Borsboom & Cramer, 2013; McNally et al., 2015). For example, rather than appearance concerns, dietary restriction, and binge eating being independently caused by anorexia nervosa, a network conceptualization may posit that the experience of appearance concerns causes dietary restriction which, in turn, causes binge eating and subsequent heightened appearance concerns. Importantly, compared to latent trait models, considering individual symptoms as comprising a network of reciprocal relationships is much more consistent with contemporary cognitive behavioral models of psychopathology, which are typically conceptualized by considering how patterns of behaviors and emotions might be self-reinforcing, contributing to the maintenance of the disorder. Thus, disorders come to be depicted through a schematic of boxes (i.e., symptoms) connected by lines (i.e., relationships) to conceptually represent the connections among cognitions and behaviors of the disorder at hand.

The advent of network analysis presents a unique opportunity to validate such models. Although ruling out the effect of stable unobserved variables can only be accomplished from within-subject network analyses using longitudinal data, between-subject network analyses can help to inform these such models. Indeed, the vast majority of psychopathology network studies to date have made use of this approach (Fried et al., 2017) by utilizing components of graph theory to explore the undirected associative relationships between symptoms in unique ways. In particular, between-subject network analysis allows for the examination of *central* symptoms, i.e., symptoms that have the highest correlation with the entire disorder and conceptually represent important targets for intervention. Between-subject network analysis also allows for the investigation of symptom *connectivity*, which measures the overall magnitude of the symptom inter-relationships within a disorder (see Fried et al., 2017 for a detailed review of network analysis and its implications for clinical intervention).

The network approach therefore provides an ideal model for testing the transdiagnostic model of eating disorders. Perhaps most importantly, the quantification of symptom centrality provides a method for evaluating whether overvaluation of weight and shape indeed represents the core psychopathology of eating disorders, as suggested by the transdiagnostic theory. Recently, Forbush et al. (2016) examined the associative structure of eating disorder symptoms within a transdiagnostic eating disorder sample using network analysis. Findings indicated that constructs related to body image (e.g., body checking) were among the most central components of the eating disorder symptom network. However, the model did not directly assess the centrality of overvaluation of weight and shape or its association with eating disorder symptom connectivity, which is critical given the importance of overvaluation both as a direct cause of pathological eating disorder behavior and as an indirect mechanism maintaining the house of cards.

In the current study, we aimed to directly examine the centrality of overvaluation of weight and shape within an eating disorder symptom network and its association with eating disorder network connectivity. While the majority of network studies to date are exploratory in nature, we used a-priori hypotheses about the structure of the eating disorder network as a basis for conducting our study. Specifically, our study hypotheses were informed by the understanding of eating disorder psychopathology put forth by the CBT-E model. In line with this model, we hypothesized that: a) overvaluation of weight and shape would act as the central component of a transdiagnostic eating disorder symptom network; and b) individuals with high levels of overvaluation would have greater global symptom connectivity when compared to individuals with low levels of overvaluation of weight and shape. Lastly, we included an exploratory aim in order assess eating disorder network properties that do not necessarily parallel the CBT-E model, most notably regarding differences in the associative role of overvaluation across specific eating disorder diagnoses. As such, our exploratory aim was to evaluate the extent to which overvaluation is central to symptom networks in anorexia nervosa (AN), bulimia nervosa (BN), and binge eating disorder (BED).

## 2. Method

### 2.1. Participants and procedures

Participants were individuals age 10 and older who were seeking eating disorder treatment at an outpatient specialty clinic. As part of routine care, participants completed a battery of questionnaires including demographic information and indices of eating disorder symptoms. These individuals were given the option to save their de-identified data for research purposes. A total of 202 of the 242 (83% response rate) individuals consented to contribute