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Review

Depictive and metric body size estimation in anorexia nervosa and bulimia nervosa: A systematic review and meta-analysis

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HIGHLIGHTS

- Patients with Anorexia Nervosa and Bulimia Nervosa over-estimate their body with ES = 0.63
- The degree of overestimation is moderated by the assessment method and patient diagnosis.
- We suggest a revised framework for BSE that integrates neuroscientific findings with previous models of body representation.
- Within this framework, we provide a clinical interpretation of body size overestimation.

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ABSTRACT

A distorted representation of one's own body is a diagnostic criterion and core psychopathology of both anorexia nervosa (AN) and bulimia nervosa (BN). Despite recent technical advances in research, it is still unknown whether this body image disturbance is characterized by body dissatisfaction and a low ideal weight and/or includes a distorted perception or processing of body size. In this article, we provide an update and meta-analysis of 42 articles summarizing measures and results for body size estimation (BSE) from 926 individuals with AN, 536 individuals with BN and 1920 controls. We replicate findings that individuals with AN and BN overestimate their body size as compared to controls (*ES* = 0.63). Our meta-regression shows that metric methods (BSE by direct or indirect spatial measures) yield larger effect sizes than depictive methods (BSE by evaluating distorted pictures), and that effect sizes are larger for patients with BN than for patients with AN. To interpret these results, we suggest a revised theoretical framework for BSE that accounts for differences between depictive and metric BSE methods regarding the underlying body representations (conceptual vs. perceptual, implicit vs. explicit). We also discuss clinical implications and argue for the importance of multimethod approaches to investigate body image disturbance.

1. Introduction

A distorted representation of one's own body is a diagnostic criterion and core psychopathology of both anorexia nervosa (AN) and bulimia nervosa (BN) (American Psychiatric Association, 2013): despite being of a normal weight or even underweight, patients are convinced that they need to lose weight. This body image disturbance is considered to be a highly relevant factor for both AN and BN (Fairburn, Cooper, & Shafran, 2003; Pennesi & Wade, 2016; Tabri et al., 2015). Despite their relevance in research and clinical settings, the distinctive features of body image disturbance in AN and BN are still unknown. Specifically, it is unclear whether body image disturbance is characterized by body dissatisfaction in conjunction with a low ideal weight and/or includes distorted perception of one's own body size or the bodies of others.

Body size estimation (BSE) tasks were developed to investigate the perceptual component of how individuals perceive their body size, but have not yet yielded conclusive results. In this article, we provide an update and meta-analysis of the literature summarizing measures and results for body size estimations in AN and BN and suggest a revised

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theoretical framework for BSE. Our revised framework additionally accounts for differences between depictive and metric BSE methods, and clarifies the clinical interpretation of their results.

1.1. BSE as a research and clinical tool

BSE tasks were developed in the 1960s and 1970s in pursuit of an objective measure of body perception suitable for the investigation of pathogenic mechanisms in AN (Slade & Russell, 1973). In clinical settings, BSE is commonly used as a therapeutic tool or progress indicator. There are two distinct types of BSE methods to assess visual estimates of self-perceived body size: in depictive methods, participants estimate their body size based on individualized, weight-distorted mirror, photo or video images of their body in standard clothing. Typically, they are asked to select the correct option or adjust the body to their current or ideal body size. Usually, the whole body is presented, therefore depictive methods are also referred to as "whole body" methods (Cash & Deagle, 1997; Farrell, Lee, & Shafran, 2005; Gardner & Brown, 2014). Until recently, depictive methods predominantly used optical distortion techniques, with the distortion often implemented as mere widening or squeezing of a photo in the horizontal dimension. More sophisticated and biometrically plausible distortion methods were developed only recently (Piryankova et al., 2014; Tovée, Benson, Emery, Mason, & Cohen-Tovée, 2003).

In metric methods, participants estimate their size on a spatial measure by indicating the size of different body parts for example with a caliper, a rod or movable markers in a dedicated space in front of them (for example a wall). These distances are then taken in metric units, for example centimeters. In clinical settings, participants usually wear their own clothes and are not hindered from looking down at their body while doing the task, to make the task as naturalistic as possible. Unlike in depictive methods, participants do not express their judgments about pictures of their body, but reproduce their size as distances, with a focus on local spatial estimates and not on the global visual appearance of the body. While depictive methods use percent global distortion as outcome, outcomes in metric methods are measured in metric units, for example as shoulder, breast, or hips width in centimeters. It is customary, but not standard, to determine a whole body estimate as average of the different body part estimates; however, in contrast to depictive methods, this score represents an aggregate of several local estimates and not a global estimate. Therefore, composite whole body estimates may differ from whole body estimates as derived in depictive methods. Metric methods are also referred to as "body part methods" (Cash & Deagle, 1997; Farrell et al., 2005; Gardner & Brown, 2014). Table 1 provides an overview of different BSE methods.

The most commonly used outcome in BSE tasks is the body perception index (BPI) which is calculated according to the formula BPI = (estimated/actual body size) × 100 (Slade & Russell, 1973). Values below 100 indicate an underestimation and values above 100 indicate an overestimation in terms of percent of the actual body size. It is important to bear in mind that the BPI is a relative measure standardized to the individual's size; hence, the same absolute overestimation would result in a higher BPI when actual body size is smaller. However, switching to absolute units has not been found to improve the clarity of results (Smeets, Smit, Panhuysen, & Ingleby, 1998).

On a theoretical level, BSE tasks have so far usually been discussed in the context of the "dual model" framework of body representations (Cash & Deagle, 1997; Farrell et al., 2005; Gardner & Brown, 2014). Generally, models in this framework distinguish between an action-serving representation often labeled as *body schema* and a representation serving perception of the own physical appearance, attitudes towards one's body and conceptual issues, often called *body image* (de Vignemont, 2010). As yet, BSE research has generally been motivated by the assumption that a perceptual distortion of body image, namely an overestimation of the self-perceived body size in the mental picture of the own body, may foster body dissatisfaction and may be a pathology mechanism of AN and BN (Farrell et al., 2005; Gardner, 1996; Gardner & Brown, 2014).

A major flaw of this framework is the inconsistency in how different models belonging to it conceptualize body image and interpret BSE: some authors, typically in neurology and cognitive neuroscience, define body image as a mental picture of the body and thereby mainly perceptual (Paillard, 1999). Others, typically in the eating disorder literature, suggested a sub-division into a perceptual and an attitudinal component (Gadsby, 2017; Gardner & Bokenkamp, 1996), or even in a system of perceptual component, attitudinal component and cognitions (Gaudio & Quattrocchi, 2012). Consequently, BSE was usually interpreted as being indicative for a perceptual distortion, although this was not properly defined and several studies suggested there might not be a perceptual distortion at all (Fernandez-Aranda, Dahme, & Meermann, 1999; Gardner & Bokenkamp, 1996; Smeets, 1997; Smeets, Klugkist, van Rooden, Anema, & Postma, 2009). Generally, suitability of the "dual model" framework as appropriate structure for studying body representation has been questioned (de Vignemont, 2010). To overcome this conceptual confusion, this study re-analyzes previous studies within an updated theoretical framework (Longo, 2015, 2016; Longo, Azañón, & Haggard, 2010) that is sensitive to the aforementioned distinction between perceptual and attitudinal components of body

Table 1
Overview on methods used in included studies.

Method	Description	Size	# of included studies	Example
Metric methods				
Image marking	The width of body parts, typically shoulders, waist, hips is indicated by marking their endpoints on a wallpaper	Lifesize	8	Askevold (1975) Uys and Wassenaar (1996)
Movable markers	The width of body parts, typically face, chest, waist and hips is indicated by adjusting movable markers, such as light points or a caliper	Lifesize	14	Slade and Russell (1973) Mizes (1992)
Tape measure	The width or circumference of body parts is indicated by adjusting a tape measure or rod to the estimated size	Lifesize	2	Horne, Van Vactor, and Emerson (1991) Smeets et al. (2009)
Depictive methods				
Photo Distortion	Distorted static photos of the participant in standard clothing are shown and the participants choose or adjust the correct one, or answer whether the respective photos are wider or thinner than themselves	Screen to lifesize	11	Collins (1987) Tovée et al. (2003) Urdapilleta, Cheneau, Masse, and Blanchet (2007)
Video Distortion	A video of the participants in standard clothing is taken and presented after optical distortion. Some earlier studies distorted optically only using a distorting mirror. Participants are typically asked to adjust their current size.	Screen to lifesize	16	Smeets et al. (1999) Probst, Vandereycken, van Coppenolle, and Pieters (1995) Touyz, Beumont, Collins, McCabe, and Jupp (1984)