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Do you see what I see? Investigating the efficacy of a novel body-scaled action intervention in reducing body size overestimation in anorexia nervosa

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Do you see what I see? Investigating the efficacy of a novel body-scaled action intervention in reducing body size overestimation in anorexia nervosa

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by

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BODY SIZE ESTIMATION IN ANOREXIA NERVOSA

Abstract

Perceptual body image disturbances, or the misalignment between the ways in which people perceive their body and objective reality, are a pervasive problem in anorexia nervosa. People with anorexia nervosa will often perceive their body to be significantly larger than it actually is. Despite the prevalence of this body size disturbance in individuals with anorexia nervosa, little effort has been made to specifically reduce the body size overestimation that occurs in this illness. Therefore, the premise of this proposed study is to address this research gap through the introduction of a novel intervention that employs verbal, visual, and physical body size feedback to reduce body size overestimation in individuals with anorexia nervosa. The experimental design of this study will include three conditions (anorexia nervosa intervention participants, anorexia nervosa control intervention participants, and healthy control participants), and body size estimation at three time points (zero weeks, eight weeks, and one year) to determine the efficacy of the intervention. In addition, this study will investigate the strength of the relationship between body size overestimation and lack of motivation to recover in individuals with anorexia nervosa. Considering the high rate of relapse and mortality in anorexia nervosa, body size overestimation may be a factor inhibiting long-term recovery, and thus imperative to reduce to improve illness outcomes.
Introduction

Premise of the study

In the mirror I see that I’m fat, but I do understand that it can’t be true. Cause I know the size of my own clothes. And then you also have other people and their opinions about me and what they tell me. And I actually don’t know which reality I shall believe in. It’s rather confusing and bewildering. (Espeset, Gulliksen, Nordbø, Skårderud, & Holte, 2012)

Personal accounts like this are all too common among individuals with anorexia nervosa; they often perceive their body to be much larger than it actually is. This disparity between subjective and objective body size in individuals with anorexia nervosa will be examined in the proceeding study. More specifically, how can this disparity be reduced and what are the implications of such reduction?

Diagnostic criteria

The Diagnostic and Statistical Manual for Mental Disorders (5th ed.; DSM–5; American Psychiatric Association, 2013) characterizes anorexia nervosa as an illness in which individuals 1) restrict their energy intake to the point of having a significantly low body weight, 2) have a strong fear of weight gain, or continuously engage in behaviors to lose weight, despite their already low body weight, and 3) deny the seriousness of their low body weight, give personal body weight or shape too much influence on their self-evaluation, or have disturbances in how they experience their own body weight or shape. Disturbances in how their own body weight or shape is experienced will be the diagnostic criterion of critical interest in this examination of subjective versus objective body size.
The DSM-5 recognizes levels of severity, however, they are based on body weight. Considering that what is a healthy body weight differs among individuals, a measure known as body mass index (BMI) is used as it considers the height and weight of individuals when determining what is underweight (BMI of <18.5), normal weight (BMI of 18.5-24.9), overweight (BMI of 25-29.9), or obese (BMI of ≥30). In the DSM-5, the four BMI categories that indicate severity are, extreme (BMI of <15), severe (BMI of 15-15.9), moderate (BMI of 16-16.9), and mild (BMI of ≥17). For example, an average height 5’4” women with anorexia nervosa who weighs 85 pounds (BMI of 14.6), would be considered extreme. However, anorexia nervosa is first and foremost a psychological illness, therefore, severity based on BMI is fallible, and has been found to not be an indicator of eating-disorder psychopathology (Machado, Grilo, & Crosby, 2017).

Risk factors

What causes an individual to develop anorexia nervosa? There are a variety of risk factors, either sociocultural, familial, or individual, that are thought to predispose an individual to developing anorexia nervosa.

Sociocultural risk factors. Sociocultural risk factors are widespread in Western societies due to the Western beauty standard that endorses thinness as beauty, specifically in women. This is likely the driving factor behind why anorexia nervosa is far more common in women than men (Turnbull, Ward, Treasure, Jick, & Derby, 1996; National Institute of Mental Health (NIMH), 2016). Considering the pervasiveness of this beauty standard in everyday life, it is no surprise that it has been found that the aspect American women (15-64 years old) want to change most about their appearance is their body weight (Etcoff, Orbach, Scott, & D’Agostino, 2006). It is evident that the thin beauty standard plays a role in the body weight dissatisfaction seen in
women, as well as the development of anorexia nervosa, as this illness is considerably more prevalent in Western countries than non-Western countries (Makino, Tsuboi, & Dennerstein, 2004). However, although over half of American women want to change their body weight (Etcoff et al., 2006), presumably towards thinness, not all American women develop anorexia nervosa; only a small percentage do (lifetime prevalence of 0.9% in women (.03% in men) (NIMH, 2016). Therefore, it is intuitive that both familial and individual risk factors must be met for an individual to develop anorexia nervosa, as these factors likely mediate how the Western beauty standard affects an individual.

**Familial risk factors.** Familial risk factors, like having a close family member who has an eating disorder, is preoccupied with how their body looks, or who consistently diets, have been identified as specific risk factors in the development of anorexia nervosa (Tozzi, Sullivan, Fear, McKenzie, & Bulik, 2003). This suggests that an individual who is exposed to at least one family member who has an unhealthy relationship with their body and/or with food can lead these behaviors to become normalized, thus increasing the probability that the individual will engage in these behaviors themself. Interestingly, it has been found that an antecedent family risk factor for individuals with anorexia nervosa is having parents who exhibit high concern (e.g., are overprotective) (Shoebridge & Gowers, 2000). This finding is also supported by a study that found that parental pressure was a risk factor specific to eating disorders, and not other major psychiatric illnesses (e.g., bipolar disorder) (Horesh et al., 1996). Familial risk factors, such as having overbearing parents, are intimately connected to individual risk factors, as for example, a robust individual risk individual risk factor for anorexia nervosa is perfectionism (Halmi et al., 2000), which can stem from parental pressures.
**Individual risk factors.** Along with perfectionism, individuals with anorexia nervosa tend to exhibit obsessionality. Both are thought to play an important role in the onset and maintenance of anorexia nervosa (Matsunaga et al., 2000). High levels of perfectionism lead an individual to be rigid in their desire to uphold an ideal self, which for those with anorexia nervosa, always includes being as thin as possible as it is idealized as the “perfect” body. High levels of perfectionism can also lead individuals to have very dichotomous thinking (e.g., everything is either good or bad). Therefore, anything short of their desired level of thinness can elicit a strong “failure” response (Halmi et al., 2000).

Obsessional behavior often accompanies perfectionism, and is behavior in which an individual must follow a specific action (e.g., like only eating vegetables), and when this action is transgressed (e.g., like eating a piece of bread), it induces considerable anxiety. Individuals with anorexia nervosa have been found to have rigid rituals surrounding food and exercise, which is considered obsessional behavior, as they often become upset when their rituals are not adhered to. One study highlighted how an individual with anorexia nervosa “had a lot of rules” regarding what she could eat, and she would plan all her days in advance to avoid meals with others. This individual also showed obsessionality in other areas of her life (e.g., having strict cleaning rituals) (Digon, Beardsmore, Spain, & Kuan, 2006). Therefore, obsessive-compulsive disorder (OCD), a psychological illness marked by recurrent obsessions and compulsions, is often comorbid with anorexia nervosa. One study found that individuals with OCD were 17 times more likely to develop anorexia nervosa than those without OCD (Cederlöf et al., 2015). Not only is OCD often comorbid with anorexia nervosa, more than half of those with anorexia nervosa are diagnosed with a comorbid psychological illness, with anxiety and mood disorders being the most prominent comorbidities (Westmoreland, Krantz, & Mehler, 2016). Therefore,
individuals with anorexia nervosa are often afflicted with other psychological illnesses, which may very well contribute to the high rate of mortality in this illness.

**Mortality**

Anorexia nervosa is the psychological illness with the highest rate of mortality (Birmingham, Su, Hlynsky, Goldner, & Gao, 2005; Morris & Twaddle, 2007; Insel, 2012; Westmoreland et al., 2016; Sjögren, 2017). This section will use the phrase “times more likely to die” often. This phrase will be used in reference to the standard mortality ratio, which is the ratio of observed to expected deaths in each study. Therefore, the standard mortality ratio is the rate of observed deaths in the specific population (e.g., women with anorexia nervosa) divided by the expected deaths in the reference population (e.g., women). A meta-analysis of 36 studies concluded that individuals with anorexia nervosa are 5.86 times more likely to die. Similarly, this meta-analysis found that in individuals in anorexia nervosa, one in five deaths are due to suicide (Arcelus, Mitchell, Wales, & Nielsen, 2011). Another study that examined women (n=6,009) who had at least one incidence of inpatient treatment for anorexia nervosa, found that women with anorexia nervosa are 6.2 times more likely to die (Papadopoulos, Ekbom, Brandt, & Ekselius, 2009). A different study followed individuals with anorexia nervosa (n=326) for over 20 years and found that individuals with anorexia nervosa are 10.5 times more likely to die (Birmingham et al., 2005). Considering that all studies (even in the meta-analysis) were longitudinal, and most spanned 10+ years, some form of treatment for participants with anorexia nervosa was received, and naturally varied in type and duration between individuals. However, this variation exists in longitudinal studies regarding any psychological illness. Therefore, the clinical importance of the mortality rates seen in anorexia nervosa are even more striking when viewed in the context of other psychological illnesses.
The meta-analysis of 36 studies, used above, also concluded that individuals with bulimia nervosa (a closely related binge-purge eating disorder) are 1.93 times more likely to die (Arcelus et al., 2011). A meta-analysis of 37 studies found that individuals with schizophrenia are 2.58 times more likely to die (Saha, Chant, & McGrath, 2007). A meta-analysis of 25 studies found that mild to moderately depressed individuals are 1.81 times more likely to die (Cuijpers & Smit, 2002). A study examining bipolar disorder patients (n=15,386) found that individuals with bipolar disorder were 2.5-2.7 times more likely to die (Ösby, Brandt, Correia, Ekbom, & Sparén, 2001). Of course these mortality rates cannot be compared directly with each other, for reasons such as lack of distinction between causes of death, differences in follow-up periods, comorbidities, and variety among populations.

This being recognized, the high mortality rate in anorexia nervosa may indicate a failure of treatment and inability to recover that is specific to anorexia nervosa. For example, a patient with anorexia nervosa stated, “Because you have to be really thin to die, and I’m fat, so it won’t happen to me” (Tan, Hope, Stewart, & Fitzpatrick, 2006). This suggests that if individuals with anorexia nervosa perceive themselves to be “fat,” they will also likely lack motivation to recover, as they will not perceive themselves to be in danger.

**Recovery & Treatment**

**Recovery.** What constitutes as recovery from anorexia nervosa? Recovery from anorexia nervosa is notoriously ambiguous (Strober, Freeman, & Morrell, 1997; Pike, 1998; Steinhausen, 2002; Darcy et al., 2010; Bachner-Melman, Lev-Ari, Zohar, & Lev, 2018) and there are no agreed upon guidelines on what recovery is by either researchers or clinicians (Khalsa, Portnoff, McCurdy-McKinnon, & Feusner, 2017). A meta-analysis of 27 longitudinal studies aimed to examine recovery rates through a compilation of different study criteria. For example, some
studies only used weight recovery (i.e. reaching and maintaining a normal weight as defined by BMI) as the recovery criterion, whereas other studies only used the absence of psychological symptoms. The remaining studies used some mixture of both (Khalsa et al., 2017). However, it is important to note that weight recovery and psychological recovery are not always synonymous. For example, a patient could gain weight rapidly on a regimented high-caloric diet, and may be considered weight-recovered, but show no signs of psychological recovery. In addition to the variance in recovery criteria, each study in the meta-analysis had its own time requirements for an individual to be considered recovered (e.g., maintaining a normal weight for at least 12 weeks), and studies had different follow-up periods (e.g., 15 months versus 22 years). Similarly, what constitutes as relapse varies widely, with studies reporting relapse rates from 9%-52% (the majority of studies reported a relapse rate of 25+%). This lack of consensus on recovery and relapse in anorexia nervosa is troubling considering that for depression, bipolar disorder, and schizophrenia, standardized guidelines on recovery, relapse, and remission exist for researchers to use (Khalsa et al., 2017).

However, studies still attempt to examine recovery and relapse in anorexia nervosa, even if criteria differ widely. One study followed initially weight-recovered (BMI>20) women with anorexia nervosa for an average of 15 months after discharge from an inpatient program. This study focused on weight and how it changed in individuals with anorexia nervosa during the follow-up period. Relapse was operationalized by patient BMI being ≤17.5 for three consecutive months. Relapse rate was 35%. Some predictors of relapse were discussed in this study. These included previous suicide attempts, severity of OCD symptomatology, and high concern about shape and weight when discharged (Carter, Blackmore, Sutandar-Pinnock, & Woodside, 2004). Another study followed women with anorexia nervosa and focused primarily on psychological
measures of recovery. Illness outcomes were measured by the Psychiatric Status Rating Scale for Anorexia Nervosa, which in this study was based on the DSM-IV criteria for anorexia nervosa (e.g., includes amenorrhea as a criterion), and categorizes prognosis into good, intermediate, or poor. The goal of this measure was to determine degree of psychological symptomatology in these women in the span of 21 years. At the 21-year follow-up, 51% were considered fully recovered, 21% were partially recovered, and 10% still met the DSM-IV criteria for anorexia nervosa. A whopping 16.7% of participants died from anorexia nervosa related causes (e.g. complications from malnourishment) (Löwel et al., 2001). From these studies, it is evident that both weight and psychological relapse and recovery rates are not optimal in those with anorexia nervosa.

Although it is clear that criteria vary widely, the most striking finding of the meta-analysis (Khalsa et al., 2017) was that for studies examining relapse, the longer the follow-up period, the higher the rate of relapse (regardless of operationalization) (Khalsa et al., 2017). This suggests that treatment is not promoting long-term weight or psychological recovery, as every individual involved in this meta-analysis was treated for their anorexia nervosa. However, treatment type and duration likely played a role in which participants relapsed, and which participants did not.

**Treatment.** Treatment for anorexia nervosa is diverse, and the care one receives is dependent upon a plethora of factors such as financial income (e.g., what treatment someone can afford), age (e.g., if an individual still lives at home, family therapy may be necessary), willingness to receive treatment (e.g., if an individual is voluntarily or involuntarily partaking in treatment), and severity at diagnosis (e.g., how intensive treatment should be). Treatment for anorexia nervosa typically consists of psychotherapy and weight restoration.
The most common psychotherapy used for individuals with anorexia nervosa is cognitive behavioral therapy (CBT). Although CBT is generally supported by clinicians, it is remarkable how slim empirical evidence is on its effectiveness as compared to other therapies for anorexia nervosa (Butler, Chapman, Forman, & Beck, 2006; Wilson, Grilo, & Vitousek, 2007; Guarda, 2008; Fairburn et al., 2009). One study was able to demonstrate CBT to be more effective in preventing weight relapse than nutrition counseling in inpatient individuals with anorexia nervosa (Pike, Walsh, Vitousek, Wilson, & Bauer, 2003). What CBT “looks like” varies between treatment provider, level of treatment, and type of treatment (e.g., individual or group CBT therapy). The main premise of CBT is to change maladaptive thoughts, beliefs, or attitudes to promote healthier feelings and behaviors. CBT for anorexia nervosa is often broken into three phases: the behavioral phase, the cognitive phase, and the maintenance and relapse prevention phase. An individual in the behavioral phase works on practicing new healthier behaviors (e.g., eating three meals a day) and coping with any dissonance that may come from them. The cognitive phase focuses on restructuring maladaptive thoughts and beliefs (e.g., “I will only be happy if I lose weight”) and developing new beliefs (e.g., “my worth does not depend on my body size”). The maintenance and relapse prevention phase aims to keep an individual healthy and happy in all domains (not only in domains specific to anorexia nervosa), to avoid stress and relapse (The Center for Eating Disorders at Sheppard Pratt (sheppardpratt.org)).

The main method to promote weight restoration is to increase caloric intake, however, there is no consistent method used in weight restoration. Meal plans are the best option as they slowly increase caloric intake and naturally incorporate more food back into a patient’s diet. Sip feeding, or using nutritional supplement drinks, is not favorable as it allows patients to shy away from confronting solid foods. Tube feeding is the last resort for weight restoration, used in
extreme cases such as hospitalizations. Tube feeding is used primarily when a patient is severely emaciated and refuses to intake any calories (Cockfield & Philpot, 2009). The effectiveness of treatment, both psychotherapy and weight restoration, in anorexia nervosa relies on one complex factor: motivation to recover.

**Motivation to recover**

Individuals with anorexia nervosa are notoriously known for their persistent lack of motivation to recover (Colton & Pistrang, 2004; Ametller, Castro, Serrano, Martinez, & Toro, 2005; Reid, Burr, Williams, & Hammersley, 2008; Sjögren, 2017), as well as for their illness denial and resistance to treatment (Vitousek, Watson, & Wilson, 1998). Amotivation to recover is thought to come from an ambivalence that many individuals with anorexia nervosa have towards their illness, as they see their illness as both burdensome and positive (Colton & Pistrang, 2004).

One study asked individuals with anorexia nervosa to write letters to their illness, one as if it were from a friend, and one as if it were from an enemy. For letters written as if anorexia nervosa were a friend, some positive themes were: guardian (“Anorexia, my friend, you are the source of my security, my guard”), attractiveness (“When I’m out socializing, I feel more men are interested in me and I feel as though this has a lot to do with you”), control (“I really need you to provide direction in everything I do”), and difference (“You make me feel special by making me different” and “You give me something that none of my friends or family have”) (Serpell, Treasure, Teasdale, & Sullivan, 1999). For letters written as if anorexia nervosa were an enemy, some negative themes were: social (“I hate you for what you have done; ruined friendships, relationships, and career prospects”), take over (“There are times when I think you’ve engulfed me and when people look at my body, they don’t see me anymore, only
you”), hate (“I’m sick and tired of you ruling my life” and “You make me devious, unfriendly and unhappy, and very lonely”), and family (“Do you realize the worry you have caused (partner) and the rest of my family?”) (Serpell et al., 1999). This study emulates how individuals with anorexia nervosa have a complex relationship with their illness, seeing both the positives and negatives of it, which creates an ambivalence towards their illness that lessens their motivation to recover (Sjögren, 2017). In addition to this study, another study found that individuals with anorexia nervosa often report feeling ambivalence towards their recovery, and were unsure if their recovery would lead to positive or negative changes (Dawson, Mullan, & Sainsbury, 2015). Similarly, motivation to recover is a predictor of both short and long-term recovery (Wayde, Frayne, Edwards, Robertson, & Gilchrist, 2009). Therefore, it is clear that a lack of motivation to recover is frequent in individuals with anorexia nervosa, and that it inhibits recovery from this illness.

**Anorexia Nervosa Stages of Change Questionnaire (ANSOCQ).** How is motivation to recover in anorexia nervosa operationalized? The transtheoretical model of behavior change (TTM) is the most widely used framework to assess motivation to recover in eating disorders (Hoetzel, von Brachel, Schlossmacher, & Vocks, 2013). The TTM categorizes individuals into five stages of change based on both the intention and the execution of a healthy behavior change. The stages of change are, precontemplation (not acknowledging problem behavior), contemplation (acknowledging problem behavior but unwilling to change it), preparation (preparing to change problem behavior), action (actively changing problem behavior), and maintenance (maintaining the healthy behavior change). The TTM framework is observed in numerous methodologies for determining motivation to recover, however, the Anorexia Nervosa Stages of Change Questionnaire (ANSOCQ) is the only TTM measure specific to anorexia
Body image disturbances & Body size estimation

Body image is a multidimensional construct (Banfield & McCabe, 2002) defined as the personal representations one has of their own body (Slade, 1994). Body image disturbances are delusions regarding one’s body size, or other bodily characteristics, that are not objectively true (Banfield & McCabe, 2002). Body image disturbances are a pervasive problem in anorexia nervosa (Cash & Brown, 1987; Sepúlveda, Botella, & León, 2002; Madsen, Bohon, & Feusner, 2013; Engel & Keizer, 2017), and are even recognized as a diagnostic criterion, “disturbance in the way in which one’s body weight or shape is experienced”, for anorexia nervosa in the DSM-5 (American Psychiatric Association, 2013). Body image disturbances in anorexia nervosa can be split into two subcategories: cognitive/affective disturbances and perceptual disturbances. Cognitive/affective disturbances are defined as negative thoughts or feelings regarding one’s own body size (Cash & Deagle, 1997; Skrzypek, Wehmeier, & Remschmidt, 2001). An example of a cognitive/affective disturbance would be a belief such as, “My stomach is too fat, it’s gross.” These disturbances are often measured through explicit questionnaires, such as the subscale on the Eating Disorder Inventory that assesses body dissatisfaction (Banfield & McCabe, 2002).

Perceptual disturbances are the difficulties one has in gauging their own body size, which results in a disparity between how one perceives their body size and objective reality (Cash & Deagle,
An example of this disturbance would be estimating your body size to be much larger than it actually measures to. Considering the nature of perceptual disturbances, they are often measured through a procedure known as the body size estimation task.

Although body size estimation tasks vary widely, all are grounded in examining how accurately an individual perceives their own body size. Studies have shown that individuals with anorexia nervosa significantly overestimate their body size on these tasks when compared to healthy controls (Pierloot & Houben, 1978; Smeets, Smit, Panhuysen, & Ingleby, 1997; Skrzypek et al., 2001; Keizer et al., 2011; Gardner & Brown, 2014; Hagman et al., 2015; Engel & Keizer, 2017). Body size estimation tasks fall into two separate categories: depictive or metric. Depictive body size estimation tasks are predominantly conducted on a digital interface in which individuals estimate their whole body size. An example of a depictive body size estimation task is asking an individual to determine which body represents their own when presented with a series of manipulated images of their body (that distort BMI to above and below their actual BMI) (Thaler, Geuss, & Mohler, 2018).

In contrast, metric body size estimation tasks are predominantly conducted in real-time physical space, and require individuals to estimate the size of various body parts (Thaler et al., 2018). A widely used metric body size estimation task is the visual size estimation task, in which individuals estimate the width of difference body parts (e.g. waist). These estimates are compared to actual measurements to determine accuracy of estimation. This task will be used in the proceeding study as it provides benefits for measuring perceptual disturbances beyond those of depictive tasks. Although the visual size estimation task may draw upon explicit body representations, as individuals are visually assessing their body, it has been argued that in this task, participants will recruit more implicit body representations due to the fact that they are
measuring the body in parts, not as a whole (as in depictive tasks). In contrast, depictive tasks are thought to rely almost entirely on explicit body representations, as these tasks often prompt one to compare one’s whole body to another (Mölbert et al., 2017). This in turn may lead to depictive tasks measuring more cognitive/affective disturbances than perceptual disturbances.

A seminal study that used the visual size estimation task found that individuals with anorexia nervosa overestimate their personal body size by 27%-58%, as compared to healthy controls. The visual size estimation task used a technique in which participants took part in adjusting two light points on a wall to indicate the width of different body parts--in this study, these were the face, chest, waist, and hips. These body parts were chosen as they reflect the areas where adiposity (body fat) is most likely to accumulate (Slade and Russell, 1973). This study also found that individuals with anorexia nervosa do not have a significant deficit in estimating the size of “non-body” objects (e.g., a wooden block), personal height, or the size of other people. This is likely because these measures are not affected by personal adiposity. This would suggest that individuals with anorexia nervosa have a specific deficit in regards to personal body size estimation, as it is related to personal adiposity. Furthermore, women with anorexia nervosa perceived themselves to actually weigh more than the healthy females they were presented with in the study (Slade and Russell, 1973). This finding is further supported by a later examination of individuals with anorexia nervosa, in which a 70-pound woman with anorexia nervosa viewed another as “sickly and emaciated”, and was surprised to find out that the other woman was actually 25 pounds heavier than her (Garner & Garfinkel, 1982).

More recently, the visual size estimation task has been used to determine if body size overestimation persists after eating disorder treatment is completed--in this case either for anorexia nervosa, bulimia nervosa, or an other specified eating disorder (OSFED) in which
individuals suffer from feeling fat despite being normal or underweight. This study employed a version of the visual size estimation task in which participants stood approximately three feet away from a blank wall and estimated the width of their shoulders, waist, and hips by placing arrow stickers horizontally on the wall to indicate the width of the body part. Three groups were tested, those who were still in treatment for their eating disorder (ED), those who completed treatment for their eating disorder (CEDT), and healthy controls (HC). Not much is specified about the treatment individuals received, other than that it was in line with the “national guidelines for care for ED [eating disorders] in The Netherlands” and that these guidelines mainly prompted CBT. Researchers found that both ED and CEDT participants significantly overestimated their waist and hips as compared to HC, although, ED participants did overestimate more than CEDT participants (Engel & Keizer, 2017). Furthermore, in this study participants reported bodily attitudes. Results showed no difference in bodily attitudes between CEDT and HC participants, yet ED participants had significantly more negative bodily attitudes (Engel & Keizer, 2017). These results indicate that individuals with anorexia nervosa overestimate their body size as compared to healthy controls, even after treatment. Considering that CEDT participants overestimated their body size, yet did not differ from HC on bodily attitudes, current treatment for anorexia nervosa seems to address cognitive/affective disturbances much more than perceptual disturbances.

Recognizing the fact that traditional treatment methods for anorexia nervosa were failing to address perceptual disturbances, researchers developed hoop training. This training attempts to address the problematic nature of perceptual disturbances by utilizing a physical task that is believed to better pinpoint spatial perceptions related to body size overestimation.
A pilot study examined the efficacy of hoop training among anorexia nervosa patients in treatment that were within a few pounds of their target healthy weight. Training was conducted once each week for a total of 5-10 minutes over the course of two months. Participants completed the training with a therapist. When presented with a set of eight hoops of various sizes, each individual was prompted to choose which one would best fit their body. Participants were not able to touch the hoops during this part of the task, and rather, visually assessed which one would fit by looking at them on the ground. After they chose the hoop they believed would fit them best, they stepped in it and pulled the hoop up their body and over their head. They were then prompted with questions such as, “was this hoop too big for my body?” and were allowed to choose another hoop if they desired. The study found a greater decrease in body size overestimation on tasks measuring proprioception and body-scaled action in anorexia nervosa patients who completed the hoop training, as compared to patients who did not (Keizer, Engel, Bonekamp, & Van Elburg, 2018). This suggests that a body-scaled action intervention may have benefits in reducing body size overestimation in anorexia nervosa.

In addition to this hoop training, body-scaled action in individuals with anorexia nervosa has been examined. One study prompted individuals with anorexia nervosa to walk through two partition doors, and examined the degree to which they compensated for a body larger than their own, by measuring shoulder rotation. Separate from this test, participants were asked to estimate their body size by moving the partition doors to the size they would need to fit right through. Findings indicate that individuals with anorexia nervosa overestimate their body width when compared to healthy controls, and that individuals with anorexia nervosa show a greater rotation of their shoulders than healthy controls when moving through doors, suggesting that individuals with anorexia nervosa are perceiving and compensating for a larger body than they physically
have (Keizer et al., 2013). Similarly, another study investigated how anorexia nervosa individuals estimated their ability to pass through a door-like structure, or their body-scaled action abilities. Individuals with anorexia nervosa were more likely to predict that they could not pass through a given structure, even though their body dimensions indicated they could have. However, when asked to estimate the ability of the third-person model to pass through these same structures, individuals with anorexia nervosa were more accurate in determining whether the model could fit through the structure (Guardia et al., 2013). These findings suggest that individuals with anorexia nervosa do indeed compensate for a larger body, even when just imagining body-scaled action, and that individuals with anorexia nervosa can accurately determine the body-scaled action of others, but have difficulty doing so for themselves.

Considering the findings of the body-scaled action studies, and the preliminary efficacy of hoop training, the proceeding proposed study will introduce a novel body-scaled action intervention at an outpatient treatment facility for anorexia nervosa patients. The intervention aims to reduce body size overestimation in anorexia nervosa. Building upon the conceptual framework of the hoop training task, this body-scaled action intervention will add: 1) objective body size feedback, which is essential in helping individuals understand their own body size (Vossbeck-Elsebusch et al., 2015), 2) a control intervention group of anorexia nervosa participants, in which these participants will perform the same activities, but these activities will focus on the bodies of others and not their own (this control intervention is intended to eliminate the confound of extra time spent in a treatment modality), and 3) greater time spent in the intervention and receiving body size feedback. Furthermore, while some studies have examined body image disturbances, and even body size overestimation in regards to relapse or recovery (e.g., Carter et al., 2004), to my knowledge, no studies have specifically examined the
relationship between motivation to recover from anorexia nervosa and degree of body size overestimation. This study will examine the complexities of this relationship.

Overview of the study

The goal of the following proposed study is to investigate the efficacy of a novel body-scaled action intervention in improving body size estimation accuracy in individuals with anorexia nervosa, and to determine if body size estimation accuracy is associated with motivation to recover in these individuals. Therefore, the main research questions of this study are: 1) does a body-scaled action intervention improve body size estimation accuracy in individuals with anorexia nervosa? and 2) does body size estimation accuracy correlate with motivation to recover from anorexia nervosa? This study will focus on women being treated for anorexia nervosa in an outpatient treatment program. To investigate the research questions, the visual size estimation task will be conducted at three time points; once at the start of outpatient treatment, again eight weeks after the start of outpatient treatment, and finally one year after the start of outpatient treatment. Half of anorexia nervosa participants will be assigned to the body-scaled action intervention, and the other half will be assigned to the control intervention. In addition, healthy control participants will complete the visual size estimation task at three mirroring time points. The efficacy of the body-scaled action intervention will be determined through changes in body size estimation accuracy before and after the respective treatment. Hypotheses are: 1) anorexia nervosa participants will, on average, overestimate their body size on the visual size estimation task at all time points, as compared to healthy controls, 2) at the end of eight weeks, anorexia nervosa participants who were assigned to the body-scaled action intervention will show a greater reduction in body size overestimation as compared to anorexia nervosa participants in the control intervention, 3) there will be no difference in height
estimation accuracy between anorexia nervosa participants and healthy control participants, and 4) body size overestimation will be negatively correlated with motivation to recover as measured by the ANSOCQ.

Methods

Participants

Anorexia nervosa participants. 72 women with a DSM-5 diagnosis of anorexia nervosa will be recruited upon entering an outpatient treatment program for anorexia nervosa at the Center for AN. This sample size was determined by a power analysis (resulting in n=108 or n=36 per condition) that assumed a moderate effect size (as evidenced by Gardner & Brown, 2014) and a moderate correlation between repeated measures, with 1-\(\beta\)=0.80 and \(\alpha\)=0.05. The “Center for AN” is a placeholder name for a facility that runs an outpatient treatment program for anorexia nervosa. The Center for AN outpatient treatment program for anorexia nervosa will be a voluntary program that will employ CBT group therapy, nutrition counseling, and monitored group dinners during each visit, much in line with established outpatient treatment programs for anorexia nervosa (e.g., The Center for Eating Disorders at Sheppard Pratt (sheppardpratt.org); Eating Recovery Center (eatingrecoverycenter.com); Walden Behavioral Care (waldeneatingdisorders.com)). This program will run three days per week, Monday-Wednesday from 5-9 p.m.. Patients 18 years old and above will be recruited on a rolling basis as they join the program. This age minimum was chosen as women are considered to be done physically developing by this age (Rogol, Clark, & Roemmich, 2000). Therefore, body size after this age is assumed to be generally stable among healthy individuals. Prior to the start of outpatient treatment, a psychologist at the Center for AN will conduct an initial assessment with all incoming patients. During this assessment the psychologist will determine if the patient meets
the DSM-5 criteria for anorexia nervosa. If they meet the criteria and age requirement, the psychologist will give the patient an information sheet that details the general premise of the study, monetary compensation (see Appendix C), and contact information for the researchers. All prospective participants will contact the researchers and make an appointment to complete the informed consent agreement (see Appendix A) at the Center for AN. Exclusion criteria for the study are minimal; the participant must be able to walk and stand without aid, have no known or diagnosed sensory deficits (with the exception of corrective lenses), and plan to be enrolled in the program for at least eight consecutive weeks. Participants will self-report any other diagnosed psychological or physiological illnesses, which may be considered in the results. However, considering that anorexia nervosa is often comorbid with other illnesses, it is important not to exclude participants with comorbid illnesses in effort to obtain a representative anorexia nervosa patient sample.

Healthy control participants. Healthy control participants will be 36 women who are at least 18 years old, with no self-reported history of psychological or serious physiological illnesses or sensory deficits (with the exception of corrective lenses). Participants must have a BMI in the normal range (18.5–24.9), and will be monetarily compensated for their participation (see Appendix C). Participants will be recruited via flyers posted at local universities and coffee shops. In addition, professors at local universities will be emailed the flyer and asked to disseminate it to students. All prospective participants will contact the researchers, and if eligible, make an appointment to come to the Center for AN. Upon arrival at the facility, participants will complete the informed consent agreement (see Appendix A), have their weight and height measured, and will complete the visual size estimation task and height estimation
If a participant’s BMI is not in the normal range, the experiment will still be conducted and data from the participant will be omitted.

**Materials**

**Visual size estimation task.** The visual size estimation task used will be that in which a participant uses two light points (projected on a wall) to indicate the width of different body parts (e.g., Slade & Russell, 1973). The two lights will be on a horizontal slide, that via pulley, will move the lights either closer together or farther apart. The horizontal slide will be mounted 5’ off the ground, and the lights will be projected onto a blank wall in a dimly lit, minimally decorated room at the Center for AN. Participants will stand 5’ away from the wall on a tape-marked “X”.

Before the task, the researcher will explain how the task works and will demonstrate, on their own body, where the participant should be estimating from. The body parts that will be estimated are: cheeks, shoulders, waist, and hips. For each participant, the order of body parts instructed to estimate will be counterbalanced. The participant will be instructed to estimate one body part (e.g., cheeks), by moving the light points, and will then be asked to turn around (180° so that they do not face the experimental wall). When the participant is turned around, the researcher will measure the distance between the two light points. The researcher will then set the light points as close together as possible, as to start “new” for each body part, and the participant will turn back around and repeat the task for the next body part. There will be a two minute maximum time limit for a participant to measure a body part, and after two minutes the researcher will ask the participant to finalize their choice. After the task is completed, the participant will be thanked and allowed to leave the study room. Since this experience may be upsetting to some, a psychologist will be available for a private discussion if the participant chooses.
Body perception index. To calculate accuracy of estimation, researchers will compute a body perception index (BPI) score (Slade and Russell, 1973; Engel & Keizer, 2017), which is estimated width divided by actual width, and that quotient will be multiplied by 100 ([estimated width/actual width] x 100) to yield a percentage of estimation accuracy for each body part. A total body size estimation score will be computed. This score will be the mean of the four individual BPI scores. Scores over 100 will indicate body size overestimation, whereas scores under 100 will indicate body size underestimation.

Height estimation task. The height estimation task will use a similar apparatus to that of the visual size estimation task. There will be a single light on a vertical apparatus that is 8’ tall. The light will be projected onto the same blank wall used in the visual size estimation task, and participants will stand on the same X marked area. With instruction from the researcher, the participant will move the light from the floor up, via pulley, until they reach their estimated height. As in the visual size estimation task, the participant will have two minutes to complete this task. Once the participant has indicated their height, the researcher will measure the height indicated on the wall and will then measure the height of the participant.

Height perception index. The height perception index (HPI) will be estimated width divided by actual width, and that quotient will be multiplied by 100 ([estimated width/actual width] x 100). A score of over 100 will indicate the participant overestimated their height and a score of under 100 will indicate that participant underestimated their height.

Body-scaled action intervention. The goal of the body-scaled action intervention is to reduce perceptual body image disturbances in participants with anorexia nervosa. This will be accomplished through having a participant engage in body-scaled action in which they will practice judging the ability of their own body (e.g., if they can walk through a door) and will
receive objective body size feedback. Half of the anorexia nervosa participants (n=36) will be randomly assigned to this condition. For each participant, the intervention will occur once per week for eight consecutive weeks, and is expected to last around 30 minutes per session. A researcher and a psychologist will be present to facilitate the intervention. The body-scaled action apparatus will be two movable partition doors, 8’ tall, with no space between them at the start. The participant will be asked to move the partition doors apart until the space between them is open enough for their body to fit snugly through, with the instruction that they will be walking straightforward and will not be able to rotate their body. After the participant has set the width of their walkway, they will use a measuring tape to measure the width of the walkway with assistance from the researcher (as to ensure proper measurement). This will allow the participant to both see the measurement and hear the measurement, as the researcher will say it out loud. The participant will then stand 5’ away from the walkway (on a tape-marked “X” on the floor) and the researcher will ask if they feel confident in their estimation or whether they would like to adjust their estimation. Once the participant has settled on their final estimation and knows the measurement, the researcher will ask the participant to walk straight through the walkway without turning their body. Once the participant has walked through, they will return back to the X marked area. The researcher will then adjust the partition doors to the participant’s widest body measurement, previously determined by the visual size estimation task. The participant will witness the movement of the partition doors and the researcher will then ask the participant to measure the width of the walkway again. Once the researcher says the measurement out loud, the participant will be asked to go back to the X marked area and walk through the walkway again, straightforward without turning their body. They will then return to the X marked area and the researcher will restate the width of their estimation and widest width of their body. The
participant will be asked to reflect on the experience with prompting from the researcher and/or psychologist. Through this experience it is expected that the participant will gain a better understanding of their body size and what their body can and cannot do (i.e. their body-scaled action abilities). The participant will then be thanked and allowed to leave. Since this experience may be upsetting to some, the psychologist will be available for a private discussion if the participant chooses. One advantage of this intervention being an add-on to outpatient treatment is that patient progress will be monitored closely. Therefore, if this intervention seems to have adverse effects on an individual, it can be stopped immediately. Although the main procedure of the intervention will be the same for all participants, this intervention is not to be rigid. The researcher, the participant, and the psychologist will work together to analyze feelings and discuss the experience.

**Control intervention.** The control intervention will be for anorexia nervosa participants not assigned to the body-scaled action intervention (n=36). The control intervention will have participants estimate the potential body-scaled action of others. This was chosen as previous studies have shown that individuals with anorexia nervosa do not have a deficit in estimating the body size or body-scaled action of others (Slade & Russell, 1973; Guardia et al., 2013; Keizer et al., 2013). Therefore, it is expected that the control intervention will not greatly improve personal body size estimation accuracy. Similar to the body-scaled action intervention, participants will stand on the X marked floor area in front of two movable partition doors. The partition doors will be closed at the start of the control intervention. Healthy control participants will be the body models, and will be selected based on willingness and availability. Each participant will see a different model each session, as to not have a participant estimate the same model more than once. The model will enter the room and stand in front of the closed partition doors. The
participant will be asked to look at the model as they will be estimating the model’s body size. The model will be asked to do one 360° turn and will then leave the room. The participant will then be asked to approach the partition doors and move them to the width that the model could fit snugly through, with the instruction that the model will be walking straight through without rotating their body. The model will then come in and stand 2’ in front of the participant on a “M” tape-marked area. The model will then be asked to walk straight through the walkway. Measurements of the walkway will be taken by the participant. The researcher will then set the partition doors to the actual widest width of the model’s body. The model will then go back to the M and walk through again. The model will be thanked and asked to leave. The participant will be assured that their discussion is private and will be asked to reflect on the experience.

One-year follow-up. Anorexia nervosa and healthy control participants will partake in a one-year follow-up. One year after their start of outpatient treatment (or their start of the study), participants will be contacted to schedule their one-year follow-up at the Center for AN. Participants will complete the visual size estimation task and height estimation task at this visit. After these tasks are completed, anorexia nervosa participants will be asked to sit down at a desk in a private area and complete the ANSOCQ (see Appendix D). Researchers will emphasize that there are no right answers on this questionnaire and that it is important that they answer honestly. Participants will be assured that no self-identifying data will be shared with anyone outside of the research team. Results will be categorized as precontemplation (no intention to change, score <1.5), contemplation (aware of problem but not committed to change, score 1.5-2.4), preparation (intention to change, score 2.5-3.4), action (changing behaviors etc., score 3.5-4.4), and maintenance (preventing relapse, score ≥4.5). ANSOCQ scores will be used to assess motivation
to recover (as a higher score indicates a higher motivation) and will be examined in relation to the score on the visual size estimation task.

**Procedure**

All participants will provide informed consent. Anorexia nervosa participants will be randomly assigned to either the body-scaled action intervention or control intervention prior to their start of outpatient treatment. All anorexia nervosa participants will complete the visual size estimation task and height estimation task prior to their start of outpatient treatment. The body-scaled action intervention and control intervention will start during their first week of treatment in the outpatient program. For eight consecutive weeks, participants will partake in their respective intervention once per week. At the end of eight weeks, all anorexia nervosa participants will complete the visual size estimation task and height estimation task again. One year after their start of outpatient treatment, all anorexia nervosa participants will complete the visual size estimation task, height estimation task, and ANSOCQ. All healthy control participants will complete the visual size estimation task and height estimation task three times: 1) start, 2) eight weeks after the start, and 3) one year after the start.

**Predicted Results**

**Body size estimation**

To determine if I can reject the null hypothesis, that there is no difference among groups and/or times on the dependent variable of BPI, a 3(group) x 3(time) mixed-model factorial analysis of variance (ANOVA) will be run. The three groups will be: anorexia nervosa intervention participants, anorexia nervosa control intervention participants, and healthy control participants. The three time points will be: time point 1 (at the start of the experiment), time point 2 (eight weeks after the start of the experiment), and time point 3 (one year after the start of
the experiment). I expect there to be a main effect of group and a main effect of time, as well as a group x time interaction effect.

The main effects suggest that there is a difference among groups, and among times, therefore, both group and time independently have an effect on BPI. I predict the main effects will be qualified by an interaction effect. The interaction effect between group x time on BPI will suggest that the effect of group on BPI is stronger at certain time points than others. To examine the nature of the interaction effect, the post hoc test Tukey will be conducted. It is expected that anorexia nervosa participants will have a higher BPI than healthy control participants at all time points, in support of H1. It is also expected that anorexia nervosa intervention participants will have a lower BPI than anorexia nervosa control intervention participants at time point 2, in support of H2. This would indicate that anorexia nervosa intervention participants showed the greatest reduction in body size overestimation (i.e. the intervention worked), whereas anorexia nervosa control intervention participants will show no or a small reduction, which may be due to treatment or the control intervention.

To further understand the nature of the group x time interaction effect, three separate one-way repeated measures ANOVAs will be conducted for each group to determine changes in BPI over time. First, a one-way repeated measures ANOVA will be conducted for anorexia nervosa intervention participants to determine BPI change over the three time points. It is expected that there will be a statistically significant difference between time points, and the post hoc test Tukey will be conducted to examine the difference. I predict that participants will have a progressively more accurate BPI over time. Therefore, time point 2 is expected to have a lower BPI than time point 1. This would suggest that the intervention worked in reducing body size overestimation, in support of H2. Time point 3 is expected to have a lower BPI than time point 2,
this would suggest that the intervention may have long-term effects in reducing body size overestimation. Second, a one-way repeated measures ANOVA will be conducted for anorexia nervosa control intervention participants to determine BPI change over the three time points. It is not expected that there will be a statistically significant difference between time points. This would suggest that body size overestimation persists after treatment for anorexia nervosa. Third, a one-way repeated measures ANOVA will be conducted for healthy control participants to determine BPI change over the three time points. It is expected that there will not be a statistically significant difference between time points. This is expected as healthy individuals should not change in their body size estimation, as they should not show significant body size overestimation, and are not being treated for such (see Figure 1, Appendix E).

**Height estimation**

To determine if I can reject the null hypothesis, that there is a difference among groups and/or times on the dependent variable of HPI, a 3(group) x 3(time) mixed-model factorial ANOVA will be conducted. I expect there to be no statistically significant difference among groups and/or among times on HPI, therefore, I predict no main effect for group or time, and no group x time interaction effect. This would suggest that participants with anorexia nervosa perceive their height normally (i.e. like healthy control participants), in support of H₃.

**BPI and ANSOCQ correlation**

To examine if body size overestimation is related to a lack of motivation to recover from anorexia nervosa, a correlation between BPI and ANSOCQ scores at the one-year time point will be run. It is expected that the correlation will yield a moderate to strong negative correlation between BPI score and ANSOCQ score. This would suggest that when individuals perceive their body size more accurately (i.e. less overestimation/lower BPI score) they may be more motivated
to recover (i.e. have a higher ANSOCQ score). This is predicted as if individuals with anorexia nervosa perceive their body size more accurately, they may be more aware of their illness (as they do not perceive themselves to be “fat”) and will be more motivated to recover, in support of H₄ (see Figure 2, Appendix E).

**Discussion**

**Goals of this study**

The goals of this study are 1) to determine if body size overestimation in anorexia nervosa can be reduced through a body-scaled action intervention, and 2) to determine if body size overestimation is related to a lack of motivation to recover from this illness. It is presumed that if body size overestimation can indeed be reduced in individuals with anorexia nervosa, they may be more motivated to recover and stay recovered--thus improving illness outcomes. Reduction in body size overestimation is thought to be related to motivation to recover, as if an individual is not perceiving their body as “fat,” they may be more inclined to recover.

**Strengths**

Why will this body-scaled action intervention work? The intervention is expected to reduce body size overestimation in anorexia nervosa, in part, by combatting the high levels of body avoidance seen in these individuals (Key et al., 2002). Body avoidance behaviors are those such as avoiding looking in the mirror or wearing tight fitting clothing. These behaviors tend to limit the discomfort an individual feels towards their body, as they confront their body less. High levels of body avoidance have been found to positively correlate with body size overestimation, even more so than cognitive/affective disturbances (“I don’t like my body”) and BMI. A possible explanation for this finding is that individuals with anorexia nervosa receive limited body size feedback if they are partaking in body avoidance behaviors (Vossbeck-Elsebusch et al., 2015).
This finding strongly supports the methodology of the intervention, which encourages individuals with anorexia nervosa to confront their body size through verbal, visual, and physical body size feedback. Therefore, this confrontation with one’s own body size is likely to reduce body size overestimation.

Excessive body checking is another characteristic behavior seen in individuals with anorexia nervosa. Body checking behaviors are those such as looking at one’s body excessively in mirrors, or excessively weighing oneself. Although it may seem like these behaviors are in opposition to body avoidance behaviors, they are actually part of the problem. When an individual with anorexia nervosa consistently checks their body size (e.g., in mirrors), they often perceive their body to be larger than it actually is, and this excessive body checking, with consistently upsetting results, may lead to body avoidance (Vossbeck-Elsebusch et al., 2015). For example, a young woman with anorexia nervosa, weighing 72 pounds at a height of 5’5” (BMI=12) stated, “I look in the mirror at least four of five times daily and really cannot see myself as too thin. Sometimes after several days of strict dieting, I feel my shape is tolerable, but most of the time, odd as it may seem, I look in the mirror and believe I am too fat” (Garner & Garfinkel, 1982). This individual also stopped weighing herself because her weight did not align with her perceived larger body size (Garner & Garfinkel, 1982). Therefore, her avoidance of objective body size feedback (i.e. her weight), could either support or oppose the intervention. In opposition, this could indicate that objective body size feedback just distresses individuals with anorexia nervosa, and will not help them see their body size more accurately. However, it could also indicate that objective body size feedback needs to not only be “seen” (e.g., seeing her weight on the scale), but also critically examined. This concept supports the intervention, as an individual will be critically examining the objective body size feedback they receive, which in
theory, will support them in not shying away from their body size even when faced with discomfort. Therefore, by promoting body size confrontation in a treatment modality, the intervention may help individuals with anorexia nervosa perceive their body size more accurately. Furthermore, it is often practice by doctors to “blind” weigh individuals with anorexia nervosa, so that they do not know their body size (Forbush, Richardson, & Bohrer, 2015), which may encourage body avoidance behaviors. The intervention will combat this practice, as individuals will confront their body size and will be encouraged to work through any body size discomfort they may have.

Limitations

What may inhibit the anticipated success of the body-scaled action intervention? One of the possibilities mentioned in the previous section holds true: what if objective body size feedback does more harm than good? Objective body size feedback may cause an individual to hyperfocus on their body in an unhealthy manner, especially if they underestimate their body size in the intervention. Although underestimation is not anticipated, this study may benefit from eliminating any individuals with anorexia nervosa who do not overestimate their body size on the first visual size estimation task, as this may indicate that they will not overestimate their body size in the intervention.

Furthermore, body size overestimation may depend on a variety of factors, such as age, self-esteem (Hsu & Sobkiewicz, 1991), body dissatisfaction (Hagman et al., 2015), or even a more practical matter such as if the participant recently ate (Santonastaso, Favaro, Ferrara, Sala, & Zanetti, 1995). Therefore, a limitation of this study is that cognitive/affective disturbances are not reported (e.g., degree of body dissatisfaction), nor are matters that may influence perceived body size (e.g., if an individual recently ate/what they). If the aforementioned measures are
Another potential limitation of this study is that I did not include a measure for eating disorder symptomatology among healthy control participants. For the purpose of this study, I was not interested in the variation in body size estimation in healthy individuals. However, this variation could be pertinent as a study found that in a nonclinical sample of individuals, those who showed more restrictive eating disorder pathology overestimated their body size more (Sand, Lask, Høie, & Stormark, 2011).

As with any longitudinal study on anorexia nervosa, treatment duration, adherence, and methodologies vary widely between participants. Therefore, it may be beneficial to include a qualitative measure of treatment received and duration to see if there are any trends in treatment and body size overestimation and/or motivation to recover. Also, it is possible that even if individuals with anorexia nervosa have a more accurate understanding of their body size after the intervention, their drive for thinness may not be reduced. Therefore, it is possible that reducing body size overestimation may not have any real effect on illness outcomes.

Conclusion & Future directions

In conclusion, this study investigates if a novel body-scaled action intervention can reduce body size overestimation in individuals with anorexia nervosa, and if body size overestimation in anorexia nervosa is related to a lack of motivation to recover from this illness. To my knowledge, there has only been one study conducted (a pilot study) with the aim of reducing body size overestimation in anorexia nervosa (Keizer et al., 2018), which showed preliminary success, and minimal literature on the relationship between body size overestimation and motivation to recover from anorexia nervosa. If we examine this gap in research in the
context of the high rate of relapse and mortality in anorexia nervosa, persistent body size overestimation may be a factor inhibiting long-term motivation to recover from this illness.

Future research should focus on 1) how to make this intervention more scalable, is there a way this could be done at home?, 2) if this intervention could benefit individuals with nonclinical eating disorder pathology, 3) how to investigate if there is a causal relationship between body size overestimation and motivation to recover from anorexia nervosa, and 4) what are the long term effects of this intervention at five years, ten years, etc., does it make a lasting difference in how the body is perceived?
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Questionnaire (ANSOCQ): information regarding its psychometric properties.


Appendix A

INFORMED CONSENT AGREEMENT

Study title: Body size estimation in anorexia nervosa

Principal investigator: Bianca DePietro

Background. The goal of this study is to examine body size estimation, and to determine what can influence how we perceive our bodies.

What you will do in this study. You will estimate your body size at three time points and may be assigned to participate in treatment that focuses on the body size of self or other in between time points. You may be asked to report information on eating behaviors or body image.

Study time and location. The study will take place at the Center for AN. You will complete the body size estimation task three times over one year (first at the start of the study, next eight weeks after the start of the study, and last one year after the start of the study). If you are admitting yourself into the Center for AN outpatient program for anorexia nervosa, you will participate in an additional intervention for eight consecutive weeks, once per week for a duration of 30 minutes per session.

Risks and benefits. This study may cause distress for individuals who have or are predisposed to body image issues, which may have repercussions on health behavior. A psychologist will always be available during the body size estimation tasks and during treatment for support. In addition to the psychologist, you will have access to a 24-hour hotline if you are experiencing any distress. This study has the potential benefit to promote recovery in individuals with anorexia nervosa, through helping them experience their body in a healthier way. An overarching benefit of this study is that it will help contribute to an understanding of body size estimation in anorexia nervosa and how it should be specifically targeted during treatment.
Compensation. All participants will be monetarily compensated for their time. Participants will be given $20 per body size estimation task participation, and $20 per intervention session.

Your rights as a participant. Participation in this study is completely voluntary and not part of the outpatient treatment program at the Center for AN. You may withdraw at any time with no questions asked, and no penalty.

Confidentiality. Your performance on the aforementioned tasks will only be accessed by the research team and data will in no way be traced back to you if published publicly.

Contact. If you have any questions regarding this study please do not hesitate to ask now or contact Bianca DePietro, email: bd1209@bard.edu. If you have any questions regarding participant rights please contact the Institutional Review Board, email: irb@bard.edu.

Consent. By signing below, I am agreeing to participate in this study and affirm that I am at least 18 years old. I am agreeing to be contacted via phone or email to schedule times to participate. I affirm that the research has been explained to me and that I am participating voluntarily, and may withdraw at any time.

__________________________________
Participant name (printed)

__________________________________  __________________
Participant signature                      Date

__________________________________
Researcher signature
Appendix B

DEBRIEFING SHEET

Study title. Investigating the efficacy of a novel body-scaled action intervention in reducing body size overestimation in anorexia nervosa

Principal Investigator. Bianca DePietro

Thank you for participating!

Purpose of the study. The purpose of this study is to determine 1) if individuals with anorexia nervosa overestimate their body size, as compared to healthy individuals, 2) if a body-scaled action intervention reduces body size overestimation in individuals with anorexia nervosa, and 3) if how much an individual with anorexia nervosa overestimates their body size is related to their motivation to recover.

We urge you not to discuss this study with anyone who is participating or who may participate in this study in the future, as this may potentially skew data.

Contact. If you have any questions or concerns regarding this study, please do not hesitate to contact Bianca DePietro, email: bd1209@bard.edu. And if you have any questions or concerns regarding your rights as a participant please contact the Institutional Review Board, email: irb@bard.edu.

Support. If you experienced absolutely any distress from this study please contact the Center for AN psychologist (phone number and email here), the 24-hour support hotline (phone number), or the National Eating Disorder Association (NEDA) helpline (800) 931-2237 or text “NEDA” to 741741 to bet directed to a crisis text line.

Additional readings.

and affordance perception persist in eating disorder patients after completing treatment.

Scientific reports, 7(1), 16184.

Appendix C

BUDGET PLANNING

**Visual size/height estimation task.** Both apparatuses will consist of metal infrastructure and lights and will cost at the most $500. Research assistants will be unpaid undergraduate students partaking in the lab for college credit.

**Interventions.** The intervention will consist of two partition doors, tape for the floor marked areas, and a tape measure. This will cost at most $500.

**Compensation.** Participants will be compensated $20 per body size estimation task participation and $20 per intervention session. With 108 participants (and 72 anorexia nervosa participants), 324 body size estimation tasks will be conducted and 576 intervention sessions—totaling in about $18,000. Compensation for the control intervention body models will be $20 per visit and compensation for a Center for AN psychologist will be $50 per involvement in a body size estimation task or an intervention session. The psychologist will also be compensated if he is reached out to by the participant during non-compensatory

**Timeline of study.** Data collection will be indefinite until the appropriate sample size is reached for each group. If this study is funded by outside sources, then a reasonable data collection cutoff should be considered.
Appendix D

ANOREXIA NERVOSA STAGES OF CHANGE QUESTIONNAIRE (ANSOCQ)

(Rieger et al., 2002)

DIRECTIONS: Each of the items below is made up of five statements. For each item, please read the five statements carefully. Then select the statement (or statements) which best describe/s your current attitude or behavior (not how you have been in the past or how you would like to be). If you have any problems, please ask for assistance. Your answers are completely confidential.

1. The following statements refer to gaining weight:
   a) As far as I am concerned, I do not need to gain weight.
   b) In some ways I think that I might be better off if I gained weight.
   c) I have decided that I will attempt to gain weight.
   d) At the moment I am putting in a lot of effort into gaining weight.
   e) I am working to maintain the weight gains I have made.

2. The following statements refer to body weight:
   a) As far as I am concerned, I do not need to weigh at least _____kg (insert your minimal normal weight).
   b) In some ways I think that I might be better off if I weighed at least _____kg. c) I have decided that I will attempt to reach at least _____kg.
   d) At the moment I am putting in a lot of effort to reach at least _____kg.
   e) I am working to maintain a weight of at least _____kg.

3. The following statements refer to parts of your body which may particularly concern you in terms of weight gain (such as hips, thighs, stomach, or buttocks):
a) There is no way I would be prepared to gain weight on these body parts.

b) Sometimes I think I would be prepared to gain weight on these body parts.

c) I have decided that I am prepared to gain weight on these body parts.

d) I am presently trying to gain weight on these body parts.

e) I am working to maintain the weight I gained on these body parts.

4. The following statements refer to your appearance:

a) I do not want to be a normal weight because I would be less satisfied with my appearance at a weight of at least ______ kg (insert your minimal normal weight).

b) I have occasionally thought about being a normal weight because in some ways I would be more satisfied with my appearance at a weight of at least ______ kg.

c) I have decided to reach a normal weight because I would be more satisfied with my appearance at a weight of at least ______ kg.

d) I am presently trying to reach a normal weight because I will be more satisfied with my appearance at a weight of at least ______ kg.

e) I am working to maintain a normal weight because I am more satisfied with my appearance at a weight of at least ______ kg.

5. The following statements refer to your health:

a) I do not need to be a normal weight because there are no risks to my health when I weigh below ______ kg (insert your minimal normal weight).

b) I have occasionally thought about being a normal weight because of the risks to my health when I weigh below______ kg.

c) I have decided to reach a normal weight because of the risks to my health when I weigh below ______ kg.
d) I am presently trying to reach a normal weight because of the risks to my health when I weigh below ______ kg.

e) I am working to maintain a normal weight because of the risks to my health when I weigh below ______ kg.

6. The following statements refer to the importance of body shape and weight:

a) I do not exaggerate the importance of my body shape or weight in determining my happiness and success.

b) Sometimes I think that I exaggerate the importance of my body shape or weight in determining my happiness and success.

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c) I have decided that I need to reduce the importance that I place on my body shape or weight in determining my happiness and success.

d) I often try to challenge the importance that I place on my body shape or weight in determining my happiness and success.

e) I have succeeded in reducing my tendency to place too much importance on my body shape or weight in determining my happiness and success and want it to stay this way.

7. The following statements refer to a fear of fatness:

a) My fear of becoming fat is not excessive.

b) I occasionally think that my fear of becoming fat is excessive.

c) I have decided that I need to do something about the fear I have of becoming fat because it is controlling me.

d) I know that my fear of becoming fat has caused problems and I am now trying to correct this.
e) I have succeeded in reducing my fear of becoming fat and want it to stay this way.

8. The following statements refer to weight loss:

a) I would prefer to lose more weight.

b) Sometimes I think that it might be time to stop losing weight.

c) I have decided that it is time to stop losing weight.

d) I am trying to stop losing weight.

e) I have managed to stop losing weight and hope to stay this way.

9. The following statements refer to body fat versus muscle:

a) I might think about gaining muscle on purpose, but I would never think of gaining fat on purpose.

b) Sometimes I think that I may need to gain some fat even though I would prefer to have only muscle.

c) I have decided that to be healthy I need to have some fat on my body.

d) I realise that I need to have some fat on my body and am working to achieve this.

10. The following statements refer to the rate of weight gain:

a) There is no way I would be prepared to gain at least 1 kg a week.

b) Sometimes I think I would be prepared to gain at least 1 kg a week.

c) I have decided that in general it would be best for me to gain at least 1 kg a week.

d) I am putting in a lot of effort to gain at least 1 kg a week.

e) I am working to maintain my weight but would be prepared to gain at least 1 kg a week if necessary.
11. The following statements refer to certain shape and weight standards which you may have for evaluating your body (such as only being satisfied with your body when your stomach is at or when you are below a certain weight):

a) The standards I use to evaluate my body are not too strict.

b) Sometimes I think that the standards I use to evaluate my body may be too strict. c) I have decided that the standards I use to evaluate my body are too strict and need to be changed.

d) I am putting in a lot of effort to change the strict standards which I use to evaluate my body.

e) I have managed to let go of the strict standards which I used in the past to evaluate my body and am hoping to keep it this way.

12. The following statements refer to certain foods which you may avoid eating (such as food high in calories or fat, red meat or dairy products):

a) There are certain foods which I strictly avoid and would not even consider eating.

b) There are certain foods which I try to avoid, although sometimes I think that it might be okay to eat them occasionally.

c) I think that I am too strict in the foods which I allow myself to eat and have decided that I will attempt to eat foods which I usually avoid.

d) I am putting in a lot of effort to regularly eat foods which I usually avoid.

e) I used to avoid eating certain foods which I now eat regularly.

13. The following statements refer to daily food consumption:

a) There is no need for me to eat 3 standard-size meals and a snack each day.

b) Sometimes I think that I should eat 3 standard-size meals and a snack each day.
c) I have decided that I need to eat 3 standard-size meals and a snack each day.

d) I am putting in a lot of effort to eat 3 standard-size meals and a snack each day.

e) I am working to maintain a current eating pattern which includes 3 standard-size meals and a snack each day.

14. The following statements refer to time spent thinking about food and your weight (such as thoughts about becoming fat, counting the calories or fat content of food, or calculating the amount of energy used when exercising):

a) There is nothing wrong with the amount of time I spend thinking about food and my weight.

b) The amount of time I spend thinking about food and my weight is a problem sometimes.

c) I have decided that I need to use strategies to help me reduce the amount of time I spend thinking about food and my weight.

d) I am using strategies to help me reduce the amount of time I spend thinking about food and my weight.

e) I used to spend too much time thinking about food and my weight which I have managed to reduce and am working to keep it this way.

15. The following statements refer to certain eating behaviors (such as needing to eat food at a specific rate or time, moving food around on the plate, being unable to eat all food on a plate, taking longer than others to eat meals, having difficulty eating with others, needing to chew food a certain number of times or needing to stick to the same food plan each day):

a) There is nothing that I need to change about the way I eat my meals.

b) I sometimes think that I need to change aspects of the way I eat my meals.

c) I have decided that I will try to change aspects of the way I eat my meals.

d) I am putting in a lot of effort to change aspects of the way I eat my meals.
e) I have succeeded in changing aspects of the way I eat my meals and want it to stay this way.

16. The following statements refer to feelings associated with eating (such as feeling guilty) and not eating (such as feeling in control):

a) There is no need for me to change the feelings I associate with eating and not eating.

b) I sometimes think that I need to change the feelings I associate with eating and not eating.

c) I have decided that I will try to change the feelings I associate with eating and not eating.

d) I am putting in a lot of effort to change the feelings I associate with eating and not eating.

e) I have succeeded in changing the feelings I associate with eating and not eating and want it to stay this way.

17. The following statements refer to methods which you may use to control your weight (such as restricting your eating, exercising, vomiting, taking laxatives or other pills). You may select more than one statement for the different methods you use to control your weight. Please indicate which weight control method/s you are referring to in the blank space/s provided.

a) There is nothing seriously wrong with the methods (____________________) I use to control my weight.

b) I have been thinking that there may be problems associated with the methods (____________________) I use to control my weight.

c) I have decided that I will attempt to stop using certain methods (____________________) to control my weight.
d) I am putting in a lot of effort to stop using certain methods (________________) to control my weight.

e) I have managed to stop using certain methods (________________) to control my weight and I would like to keep it this way.

18. The following statements refer to certain emotional problems (such as feeling depressed, anxious or irritable):

a) I do not have any emotional problems which I need to work on.

b) I sometimes think that I may have certain emotional problems which I need to work on.

c) I have certain emotional problems which I have decided to work on.

d) I am actively working on my emotional problems.

e) My emotional problems have improved and I am trying to keep it this way.

19. The following statements refer to certain characteristics (such as perfectionism, low self-esteem or feeling a need for control):

a) I do not have any problems in the way I approach life which I need to work on.

b) I sometimes think that I may have certain problems in the way I approach life which I need to work on.

c) I have certain problems in the way I approach life which I have decided to work on.

d) I am actively working on problems in the way I approach life.

e) The problems in the way I approach life have improved and I am trying to keep it this way.

20. The following statements refer to relationship problems (such as relationships with family or friends):

a) I do not have any problems in my relationships with others which I need to work on.
b) I sometimes think that I may have certain problems in my relationships with others which I need to work on.

c) I have certain problems in my relationships with others which I have decided to work on.

d) I am actively working on problems in my relationships with others.

e) The problems in my relationships with others have improved and I am trying to keep it this way.

Each item on the ANSOCQ is scored from 1 (precontemplation stage) to 5 (maintenance response). The highest possible score is thus 100.

On the ANSOCQ, multiple statements may be endorsed for each item. If more than one statement is endorsed, the average score for the item is calculated. For example, endorsing both the precontemplation and contemplation statements would yield an item score of 1.5.

On the ANSOCQ, an overall stage classification score can also be obtained by dividing the total score by the number of items scored (typically 20).

The following average scores correspond to the various stages of change:

\(<1.5 = \text{precontemplation} \quad 1.5–2.4 = \text{contemplation} \quad 2.5–3.4 = \text{preparation} \quad 3.5–4.4 = \text{action} \quad >4.5 = \text{maintenance}\)
Figure 1. The average BPI scores for each group (anorexia nervosa intervention participants (AN intervention), anorexia nervosa control intervention participants (AN control intervention), and healthy control participants (healthy control)) at all time points. It is expected that AN intervention participants will show a significantly greater reduction in body size overestimation after the intervention. There is expected to be no significant change in AN control intervention participants over time. Furthermore, healthy control participants are expected not to overestimate their body size significantly, and are not expected to show change in body size estimation over time.
Figure 2. The correlation between BPI score and ANSOCQ score at the one-year follow-up for anorexia nervosa participants. It is expected that there will be a moderate to strong negative correlation between BPI and ANSOCQ scores. This would indicate that when participants are more accurate in estimating their body size (lower BPI score), they will also be more motivated to recover (higher ANSOCQ score).