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Thought–shape fusion in anorexia and bulimia nervosa: a comparative experimental study

Myrsini Kostopoulou · Eleftheria Varsou · Anastassios Stalikas

Abstract 'Thought–shape fusion' (TSF) is a cognitive distortion specific in patients with eating disorders and occurs when the thought about eating a forbidden food increases a person's estimate of her weight/shape, elicits a perception of moral wrongdoing and makes her feel fat. This study aimed to experimentally induce, study and compare TSF between patients with bulimia nervosa (BN) and patients with anorexia nervosa (AN). 31 patients diagnosed with a current eating disorder, of which 20 met DSM-IV-TR criteria for BN and 11 for AN, participated in a mixed-model experimental design with the aim of eliciting TSF and investigating the effects of corrective behaviors (checking and mental neutralizing). Verbal analogue scales constituted the main outcome measures. TSF was experimentally induced and expressed in a similar way in both clinical groups, apart from 'feeling fat' which was higher in BN patients. TSF induction triggered heightened levels of anxiety, guilt and urges to engage in corrective behaviors in both groups. Body dissatisfaction only increased in the BN patients. Mental neutralizing and to a lesser extent checking reduced most effects of the experimental procedure, but this effect was larger for BN patients. The nature of TSF seems to have similarities between BN and AN patients; however, the precise connection between TSF and different types of eating disorders remains to be explored in future clinical trials.

Keywords Eating disorders · Cognitive distortions · Thought–shape fusion · Anorexia nervosa · Bulimia nervosa · Mixed-model experimental design

Introduction

There is evidence that cognitive distortions play a significant role in the maintenance of clinical disorders, such as depression [1], eating disorders [2–4], obsessive–compulsive disorder [5, 6], hypochondriasis [7] and panic disorder [8]. Cognitive distortions occur if the thinking is consistent, non-veridical and skewed [9] and they are hypothesized to reinforce the patients' underlying maladaptive beliefs, emotions and behaviors. Previous literature has long acknowledged a prominent dysfunctional thinking style in patients with AN [10] with a set of maladaptive cognitive distortions maintaining the eating disorders symptoms, such as dichotomous reasoning ("If I gain one pound, I will get fat"), personalization ("people laugh at me because I am fat") and magnification ("to gain wait is personal catastrophe") [3, 4, 11, 12]. Exploring the role of specific cognitions in eating disorders has important implications for treatment, given that cognitive behavior therapy (CBT) interventions seem to achieve advantageous therapeutic effects by eliminating patients' cognitive distortions [13].

TSF was first conceptualized as a specific and distinct cognitive distortion present in patients with eating disorders [14]. The distortion was postulated as a variation of 'thought–action fusion' a distortion common in obsessive–compulsive disorder, where thinking about a negative event

M. Kostopoulou · A. Stalikas
Department of Psychology, Panteion University,
136 Syngrou Avenue, 176 71 Athens, Greece

M. Kostopoulou (✉)
11 Kyprou Street, Kifissia, 145 62 Athens, Greece
e-mail: myrsi@hol.gr

E. Varsou
Department of Psychiatry, Eating Disorder Outpatient Clinic,
Eginition Hospital, University of Athens, 72-74 Vasilissis Sofias
Avenue, 115 28 Athens, Greece

increases the probability of its occurrence and is morally equivalent to carrying out a negative action [6, 15–20]. Previous research suggests that 'thought–action fusion' may contribute to obsessive compulsive disorder by increasing personal responsibility of thoughts [21]. Expanding on this finding, the authors [14] identified three TSF components: (a) 'likelihood TSF' which consists of the belief that thinking about eating a forbidden food increases the probability that the person will gain weight or change shape, (b) 'moral TSF' where thoughts about eating a forbidden food are perceived as morally equivalent to actually eating it and (c) 'feeling TSF' where the person feels fatter as a result of the thought that she has eaten a forbidden food.

Further experimental studies of TSF have been conducted in patients with AN [22] and those with BN [23]. Both demonstrated that TSF was associated with eating psychopathology and that its experimental elicitation led to negative emotional reactions and urges to engage in checking and mental neutralizing aimed at canceling out the effects of TSF. High TSF has also been found through experimental inductions in mixed eating disordered groups [24, 25] and in normal-weight compared to overweight women [26].

The objective of the present study was to experimentally induce, study and compare TSF between outpatients with AN and those with BN. Exploring the distortion between the two clinical groups under the same experimental setting allowed us to control for possible differences pertaining to the procedure or the experimental setting.

An experimental paradigm extended from the original study [14] was applied with the aim of triggering TSF. We added a measure of body dissatisfaction because body image assessment is considered to be central in the pathology, etiology and treatment of eating disorders [27], and discrepancies between perceived and ideal body image seem to play a key role in eating disturbances [28]. We did not use a control group due to the specificity and association of TSF with eating disorders [14, 20, 22].

The following three experimental questions were defined:

1. Is the nature and extent of TSF different between BN and AN patients?
2. Are there any significant differences between BN and AN patients in levels of anxiety, guilt, estimates of personal weight, body dissatisfaction and perceptions of direct and indirect control after TSF provocation?
3. Are there any significant differences between the two clinical groups in the nature and the effects of the corrective behaviors used after TSF provocation?

Materials and methods

Participants

A total of 31 women diagnosed with a current eating disorder participated in the study. Twenty who met the DSM-IV-TR [29] criteria for BN had a mean age of 25.3 years (SD = 5.56; age range = 17–37) and a mean body mass index (BMI) of 21.24 (SD = 2.57, BMI range = 17.97–27.40). Eleven patients met DSM-IV-TR [29] criteria for AN, of which five belonged to the 'binge-eating/purging' subtype and six belonged to the 'restricting' subtype. Their mean age was 29.27 years (SD = 9.09; age range = 18–49) and their mean body mass index (BMI) was 16.09 (SD = 1.78; BMI range = 12.39–18.59).

All participants were recruited from the Outpatient Eating Disorders Unit of the Athens University Psychiatric Clinic and at the time they were being treated for their eating disorder. No men were being treated at the unit during the time the study was conducted; therefore, the clinical sample constituted of women only. Prevalence studies do suggest the majority of eating disorder patients are women [29]. The psychiatrist among the authors, who was head of the Outpatient Eating Disorders Unit, conducted the psychiatric assessment and diagnosis for each participant using clinical interviews. All patients had been weighed and measured for diagnostic purposes. To eliminate the confounding effects of comorbidity influences and enhance the study's internal validity, potential patients were excluded from the study if, according to DSM-IV-TR [29] criteria, they had a history of, or current comorbid, schizophrenia or other psychotic disorders, if they had been diagnosed with comorbid borderline personality disorder, substance-related disorder or impulse control disorder, or if they were being treated as inpatients. In total, five patients were diagnosed with the above psychiatric diagnoses and were excluded from the study.

Measures

Verbal analogue scales. Participants were asked to verbally rate their responses on all experimental variables, apart from "body dissatisfaction" (see below), on a scale from 0 to 100 (0 = 'not at all', 100 = 'very high'). Participants' responses were written down by the experimenter.[1]

Body dissatisfaction rating scale (BDRS). As a shorter variant of the original 'body image assessment' (BIA) [30–33] which has shown a test–retest reliability between 0.71 and 0.90 [34], the BDRS was developed specifically for this study to assess levels of body dissatisfaction. The

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[1] The experimenter was female and is referred to throughout the procedure as "she".

BDRS consisted of five female body shapes ranging from 'very thin' to 'very fat' (1 = 'very thin', 2 = 'thin', 3 = 'medium', 4 = 'fat' and 5 = 'very fat') to which participants were asked to rate their (a) perceived and (b) ideal body shape, choosing a number between 1 and 5. The difference between ideal and perceived body shape equaled the 'Body Dissatisfaction Score' (BDS). Higher scores reflected greater discrepancies between perceived and ideal ratings of body shape, indicating a higher level of body dissatisfaction. Test–retest reliability of this measure calculated from an independent sample of 50 college students was found to be 0.83, its internal consistency was high ($\alpha = 0.82$) and its discriminant validity was found to be satisfactory [23].

Procedure

Participants were asked to take part in a study which investigated the way thinking about food affects the way one feels about oneself. They then signed a written informed consent form. They took part in the experiment individually at the Athens University Psychiatric Clinic, Outpatient Eating Disorders Unit and the duration of the procedure was approximately 30 min. The experiment was conducted in three consecutive assessment times 'Baseline assessment' (Time 1, duration 5 min), 'TSF experimental provocation' (Time 2, duration 15 min), 'Checking/neutralization' (Time 3, duration 10 min).

Baseline assessment (Time 1). Using verbal analogue scales, participants were asked to report an estimate of their weight, to rate how fat they felt at that particular moment, their current level of anxiety and guilt, and the control they believed they had over not eating a forbidden food at that exact time and 24 h later. All answers were written down by the experimenter. They were then required to rate their perceived and ideal body shape using the BDRS. At the end of Time 1, the experimenter instructed the participants to close their eyes for 2 min and to think of something that made them feel relaxed or that triggered positive feelings (e.g., an image, a thought, a memory, a wish).

TSF experimental provocation (Time 2). Participants were asked to think of a food or a combination of foods that they considered to be fattening or forbidden and that would make them gain weight if they actually ate it. They were prompted to complete in writing the sentence 'I am eating…' by filling in the gap the imagined forbidden food(s). The experimenter used low-paced instructions and guided the participants to conjure up an image of themselves eating in very large quantities the food(s) they had thought of. To enhance the vividness of the image, participants were prompted to visualize relevant details (e.g., color(s) of the food(s), taste, texture, smell, surrounding environment, pace of eating and swallowing) and then to continue

thinking about eating as long as they needed up to a point where they felt elevated anxiety and dysphoria. They were instructed to inform the experimenter when they would reach this point, and the experimenter stressed that the importance of the study was to elicit responses that had an emotional rather than a rational/right or wrong content. To measure TSF, participants were asked to state if they felt fatter after thinking about eating a forbidden food, if they believed they had gained weight or changed shaped and if this thought was morally unacceptable to them. Using verbal analogue scales, they were asked to rate how fat they felt, an estimate of the likelihood that they had gained weight or changed shape and how morally unacceptable it was for them to have thought that they had eaten the forbidden food(s). They were then asked to estimate their personal weight, their subjective levels of anxiety, guilt and their current feelings of control over not eating the forbidden food at that specific time ('direct control') and 24 h after the experiment ('indirect control'). Their perceived and ideal body image was measured using the BDRS. The experimenter asked participants whether they felt the urge to do something to minimize or cancel out the effects of the thought that they had eaten a forbidden food. She then used verbal analogue scales to assess ratings of the participants' urge to check that they had not gained weight or changed shape and their urge to erase the sentence they initially wrote during the experimental provocation time ('I am eating…'). The experimenter informed participants that she would leave the experimental room for 5 min and upon returning she asked them if they had used any corrective thoughts or behaviors, which she then noted down.

Checking/neutralization (Time 3). After the type of corrective behavior was recorded for each participant, the same TSF ratings and all remaining experimental variables assessed in Time 2 were retaken. At the end of the experiment, participants were instructed to close their eyes and think of something that made them feel good and relaxed. The experimenter ensured that anxiety levels had decreased to tolerable levels, debriefed the participants and thanked them for their participation in the study.

Statistical analysis

To answer the first experimental question, descriptive statistics for the number of patients who exhibited TSF were conducted for each clinical group. Statistical data were then analyzed with Chi-square and t tests for independent samples to test for mean statistical differences in TSF between BN and AN patients. The second experimental question was analyzed with t tests for dependent samples and the Wilcoxon signed-ranks test for each clinical group to test for changes in ratings before and after TSF induction. Independent samples t tests and the Mann–Whitney

test were then conducted to assess for experimental group differences. To statistically analyze the third experimental question, Chi-square analyses, t tests for dependent samples and the Wilcoxon signed-ranks test were conducted for each clinical group separately to test for the effects of neutralization. Independent samples t tests were last conducted to assess for differences in the effects of corrective behaviors between the two clinical groups.

Results

Experimental question 1

Mean ratings and standard deviations of TSF components for BN and AN patients are shown in Table 1.

TSF was experimentally induced in both clinical groups. The operation of the TSF effect revealed for example that BN patients felt fatter by 70 %, meaning fatter by over two-thirds of their current size, while a high sense of moral unacceptability was observed in both groups, ranging between 39.10 and 57.25 % after they thought about eating a forbidden food.

Chi-square analyses yielded no significant associations between clinical group and patients' subjective reports of TSF components (all $p > 0.05$). t tests for independent samples further revealed no statistically significant differences between the two clinical groups regarding their mean beliefs in weight gain, shape change and moral unacceptability, apart from "feeling fat" which was higher in the BN group at baseline (t (29) = 2.89, $p < 0.01$) and during the experimental elicitation of TSF (t (14.77) = 2.25, $p < 0.05$), compared to patients with AN.

Experimental question 2

T tests for dependent samples and the Wilcoxon signed-ranks test for variables with skewed distributions were initially conducted separately for each clinical group to test for changes in patients' ratings before and after TSF induction. As depicted in Table 2, significant increases were observed after TSF induction in BN patients' anxiety ($Z = 2.23$, $p < 0.05$), guilt ($Z = 2.13$, $p < 0.05$) and body

dissatisfaction levels (t (19) = 2.99, $p < 0.01$). Body dissatisfaction increased because patients' perceived body image increased (t (19) = 2.86, $p = 0.01$), while their ideal body image remained stable. After TSF provocation, anxiety (t (10) = 4.46, $p < 0.01$) and guilt (t (10) = 3.15, $p < 0.01$) also increased in the AN group, but not body dissatisfaction. No changes were observed in estimates of personal weight, and direct and indirect control in either group.

Independent samples t tests and the Mann–Whitney test for variables with skewed distributions were then conducted to assess for experimental group differences. As depicted in Table 3, higher baseline anxiety, body dissatisfaction and estimates of personal weight were observed in BN patients, while AN patients had higher baseline indirect control levels. No significant baseline differences were observed between the two groups in guilt levels and perceptions of direct control. After TSF provocation, BN patients had higher body dissatisfaction and estimates of personal weight, while AN patients had higher levels of direct and indirect control. Thus, anxiety and direct control had a relatively higher increase in AN patients, while changes in body dissatisfaction, estimates of personal weight and perceptions of indirect control implied group differences that could not be attributed to the effects of the experimental procedure.

Experimental question 3

Initial Chi-square analyses yielded no significant differences between BN and AN patients' subjective reports of their general urges to neutralize (χ^2 (1) = 0.20), weigh themselves (χ^2(1) = 0.50), check their body size (χ^2(1) = 0.53), erase the sentence they had written (χ^2(1) = 0.22) and neutralize in any other way they chose (χ^2 = 0.22) (all $p > 0.05$).

Twenty-eight of the total 31 patients used some form of corrective action in order to rule out the thought that they had eaten a forbidden food, the majority of whom ($n = 25$) used mental neutralizations and the remaining used checking behaviors. Mental neutralizations included the creation of general positive mental images or thoughts, the content of which was not directly related to the thought

Table 1 Experimental elicitation of TSF

TSF components	Bulimia nervosa ($n = 20$)		Anorexia nervosa ($n = 11$)		χ^2 (d.f.)	t (d.f)
	n	Mean TSF[a] (SD)	n	Mean TSF[a] (SD)		
Weight gain	8	27.75 (39.69)	3	14.55 (32.05)	0.50 (1)[b]	0.95 (29)[b]
Shape change	10	29.50 (40.74)	3	19.09 (33.90)	1.51 (1)[b]	0.72 (29)[b]
Moral unacceptability	16	57.25 (40.33)	7	39.10 (30.10)	0.99 (1)[b]	1.21 (29)[b]
Feeling fat	11	70.00 (30.95)	4	34.10 (47.58)	0.99 (1)[b]	2.25 (14.77)*

* $p < 0.05$

[a] All scores are on a 0–100 scale

[b] $p > 0.05$

Table 2 Mean variable levels before and after TSF experimental provocation

(n = 20)	Bulimia nervosa (n = 20)		Anorexia nervosa (n = 11)	
	Baseline	After TSF provocation	Baseline	After TSF provocation
Anxiety	71.50 (23.51)	84.25 (22.02)*	37.27 (41.01)	87.27 (17.94)**
Guilt	69.00 (33.55)	85.75 (27.40)*	57.27 (39.01)	87.27 (14.21)**
Body dissatisfaction	1.35 (1.04)	1.75 (1.16)**	0.27 (1.14)	0.64 (1.75)
Direct control	52.75 (36.26)	63.75 (32.96)	79.10 (29.48)	87.73 (28.93)
Indirect control	39.75 (30.84)	42.50 (33.85)	70.46 (34.24)	80.00 (51.77)
Personal weight	59.53 (8.58)	62.10 (12.39)	43.64 (7.54)	47.59 (11.42)

All scores are on a 0–100 scale, except 'personal weight' (in kg) and 'body dissatisfaction' (1–5 scale)

* $p < 0.05$, ** $p < 0.01$

Table 3 Significance of group differences before and after TSF provocation

Group differences	Experimental variables t (d.f.)					
	Anxiety	Guilt	Body dissatisfaction	Direct control	Indirect control	Personal weight
Before TSF provocation	2.55 (13.71)*	0.88[a]	3.12 (29)**	1.95[a]	2.55*[b]	5.08 (29)**
After TSF provocation	0.39[a]	0.17[a]	2.13 (29)*	2.28**[a]	2.44 (29)*	3.20 (29)**

* $p < 0.05$, ** $p < 0.01$

[a] U-value using Mann–Whitney test

about having eaten a forbidden food (e.g., "I am lying on the beach", "I will get better and enjoy my life after all") or thoughts and mental images which directly aimed at canceling out the previous thought (e.g., "I will stick to my food schedule", "I am thin", "I did not eat, I only thought about it").

T tests for dependent samples and the non-parametric Wilcoxon signed-ranks test for variables with skewed distributions were initially conducted for each clinical group separately. Table 4 shows that in BN patients, neutralization led to significant reductions in the belief that they had gained weight and that their body shape had changed, and in their subjective feelings of fatness, anxiety, guilt and body dissatisfaction. In addition, their urge to use corrective behaviors ($t = 2.35$ (19), $p < 0.05$), to weigh themselves ($t = 2.40$ (19), $p < 0.05$) and to check their shape ($t = 3.21$ (19), $p < 0.01$) significantly decreased. Though moral unacceptability and estimates of personal weight did not change, their perceptions of direct control ($Z = 2.05$, $p < 0.05$) and indirect control ($t = 2.22$ (19), $p < 0.05$) over not eating a forbidden food increased. After neutralization, AN patients showed decreases in feelings of fatness ($t = 2.27$ (10), $p < 0.05$), anxiety ($t = 4.95$ (10), $p < 0.01$), guilt ($t = 6.04$ (10), $p < 0.001$), urges to use corrective behaviors ($t = 2.37$ (10) $p < 0.05$) and to erase the original sentence ($t = 2.42$ (10), $p = < 0.05$). No significant changes were observed in the remaining variables.

Independent samples t tests were then conducted to assess for differences in the effects of corrective behaviors between the two clinical groups. As shown in Table 5, feeling fat, body dissatisfaction and estimates of personal weight were higher in the BN group before and after neutralization. Therefore, these changes cannot be attributed to the experimental procedure. The comparison of direct and indirect control before and after neutralization between BN and AN revealed a relatively higher increase in direct control in AN, while indirect control increased in BN patients and decreased in AN patients.

Discussion

TSF was experimentally induced in both clinical groups without significant differences between them with respect to their beliefs that they had gained weight, changed shape or felt it was morally unacceptable to think about eating a forbidden food. The only observed difference was 'feeling fat' which was higher in the BN patients before and after TSF induction. The experimental provocation further increased anxiety and guilt levels in both groups; however, anxiety increased in more patients with AN. Body dissatisfaction increased in the BN group only, while perceptions of direct control increased relatively more in the AN group. Similar urge levels to correct thoughts about eating were found and these actually took the form of mental neutralizing and to a lesser extent checking. Neutralizing reduced BN and AN patients' feelings of fatness, anxiety, guilt and their urges to further use corrective behaviors, but there was a relatively larger effect of neutralization for BN patients. Neutralizing did not have an effect on moral unacceptability and estimates of personal weight.

TSF reflects a person's underlying tendency to place undue importance on thoughts about eating, shape and weight and to interpret such thoughts as personally

Table 4 Mean levels of urges to correct and changes in experimental effects after checking/neutralization

	Bulimia nervosa (n = 20)		Anorexia nervosa (n = 11)	
	Before neutralization	After neutralization	Before neutralization	After neutralization
Weight gain	27.75 (39.6)	4.50 (13.95)**	14.55 (32.05)	16.36 (36.68)
Shape change	29.50 (40.75)	8.50 (21.59)*	19.09 (33.90)	16.36 (36.68)
Moral unacceptability	57.25 (40.51)	48.00 (40.47)	39.09 (39.10)	41.82 (34.88)
Feeling fat	70.00 (30.95)	49.25 (29.92)*	34.09 (47.58)	20.91 (29.48)*
Anxiety	84.25 (22.02)	48.75 (28.65)**	87.27 (17.94)	40.00 (33.76)**
Guilt	85.75 (27.40)	40.00 (34.18)**	87.27 (14.21)	31.82 (35.16)**
Personal weight	62.10 (12.39)	59.78 (8.33)	47.59 (11.42)	45.68 (9.03)
Body dissatisfaction	1.75 (1.16)	1.25 (0.97)*	0.64 (1.75)	0.00 (1.00)
Direct control	63.75 (32.96)	75.50 (28.74)*	87.73 (28.93)	93.36 (9.24)
Indirect control	42.50 (33.85)	56.00 (31.40)*	80.00 (51.77)	76.36 (25.80)

All scores are on a 0–100 scale, except 'personal weight' (in kg) and 'body dissatisfaction' (1–5 scale)

* $p < 0.05$, ** $p < 0.01$

significant [20]. When a patient with an eating disorder believes that it is morally wrong to think that she has eaten a forbidden food, then the focus on shape and weight for self-evaluation is likely to persist. Such thoughts may lower mood and trigger depressive symptoms such as self-criticism or personalization [35] and further induce repeated shape checking [19] or unsuccessful attempts at thought suppression [20]. Moral TSF which was high in both clinical groups may act as a maintaining mechanism in the core psychopathology of AN and BN. For example, previous literature suggests that bulimic episodes may be related to threats in the patients' self-image [36]. If the patient perceives the thought about eating to be morally wrong, then this could constitute a threat to her self-image (e.g., "I am immoral since I thought of myself eating"), thereby increasing the probability of a bulimic episode taking place as a response to the thought. The associated increased anxiety, guilt and feelings of fatness that we observed as a consequence of TSF may further reinforce bulimic episodes as emotional compensating mechanisms. This is in line with previous literature which suggests that

under negative emotional states, a person's responsiveness to a food's stimuli and properties is increased [37] and thus bulimic episodes are more likely to take place [38–40], especially when the patient is anxious [41]. Recently, susceptibility to TSF was found to be associated with negative affect [42]. Bulimic episodes in turn decrease negative emotions [43] and are thereby reinforced due to their potential to achieve emotional regulation [44]. Furthermore, the increased levels of feelings of fatness and body dissatisfaction observed in BN patients support findings of their prominence in this group of patients [45] and their rarity in AN patients [46]. Body dissatisfaction could serve to lower mood and control over eating and lead to bulimic episodes, because it tends to predict dysfunctional behaviors related to eating and weight control [47, 48]. The relation between TSF and elevations in body dissatisfaction has implications for treatment given that interventions for BN are believed to improve by the inclusion of an explicit focus on body dissatisfaction [49].

In AN, the rise in feelings of guilt induced by TSF as well as the relatively higher increase in anxiety and perceptions of direct control—compared to BN patients—may imply the activation of a primal fear of fatness [50] and a threat in AN patients' central need for control over food, which constitutes the core psychopathology of the disorder [51]. Fear of loss of control may increase perceptions of control and actual attempts at food restraint as a coping mechanism; in this way, TSF may maintain the vicious cycle of AN. A successful sense of self-control is reinforced, but at the same time this feeling may also trap the AN patient into the vicious cycle of anorexia. Deeper feelings of inadequacy, perfectionism and low self-esteem have been considered to underlie AN patients' need for control [51–53], which in turn make food control a successful behavioral target [54].

Though corrective behaviors led to significant reductions in the experimental effects in both groups, this finding

Table 5 Significance of group differences before and after neutralization t (d.f.)

Experimental variables	Before neutralization	After neutralization
Weight gain	0.95 (29)	1.03 (11.62)
Shape change	0.72 (29)	0.75 (29)
Moral unacceptability	1.21 (29)	0.43 (29)
Feeling fat	2.25 (14.77)*	2.54 (29)*
Anxiety	0.39 (29)	0.76 (29)
Guilt	0.17 (29)	0.63 (29)
Personal weight	3.20 (29)**	4.38 (29)**
Body dissatisfaction	2.13 (29)*	3.40 (29)**
Direct control	2.02 (29)	2.98 (25.13)**
Indirect control	2.44 (29)*	1.94 (24.41)

* $p < 0.05$, ** $p < 0.01$

was relatively higher in the BN patients. For example, perceptions of direct and indirect control increased in BN after neutralization. One explanation may be that control was a possible compensating mechanism arising from feeling threatened of losing control over food after TSF activation. Mental neutralizations and body checking may maintain TSF by offering patients short-term emotional relief, but at the same time preventing them from realizing the irrationality of their thoughts, in line with the counterproductive effects of cognitive strategies such as thought suppression [55]. Though in this study, body checking was not preferred to mental neutralizing as a corrective action, it has recently been found to increase body dissatisfaction, feelings of fatness and the strength of body-related self-critical thinking, contributing to the maintenance of shape concerns [56]. The reduction of such TSF-related corrective behaviors may have therapeutic advantages for patients with eating disorders. However, the relative resilience of AN patients to the effects of neutralization questions the inclusion of CBT treatment techniques aiming to reduce neutralization and this should be a subject of future research.

Consistent with Radomsky et al.'s study [22], we observed a lack of TSF effect on weight and moral wrongdoing. Specifically, TSF had no significant effect on the estimates of AN and BN patients' actual weight, and future studies could investigate this hypothetical connection in a larger clinical sample. Neutralization did not reduce patients' feelings of moral wrongdoing, both in the AN and the BN group, despite the fact that their levels of guilt did significantly decrease. One explanation may be that a person's emotional appraisal of her morally wrong behavior may decrease in time after the occurrence of a negative event contrary to her cognitive appraisal, which may reflect endurable beliefs about the moral unacceptability of an action. It may be that the perception of having acted in an immoral way affects the core of one's personality and thus takes time to diminish. Previous research suggests that while feelings of guilt and anxiety about a past event can change with future events, it is unlikely that a belief in the moral unacceptability of an action will undergo change with a single new action [22]. Such moral appraisals related to thoughts about eating may require more intensive cognitive interventions when a patient with an eating disorder is being treated with CBT. Our results of TSF in AN are similar to Radomsky et al's, though we did not find an effect of neutralization on "likelihood of weight gain". One difference is that our study consisted of an outpatient group, while Radomsky et al.'s comprised of AN inpatients. Inpatients with AN tend to have more severe psychopathology and receive more intensive treatment during hospitalization. Thus, the inherent behavioral dissimilarities one expects to find between AN inpatients and

outpatients during an experiment could account for this observed lack of effect of neutralization.

Strength and limitations

This was the first study that experimentally induced and explored TSF in patients with BN and AN, under the same experimental conditions. One limitation was the assessment of experimental variables solely through verbal analogue scales. This choice was based, first, on the fact that verbal analogue scales were the sole measure of TSF in Shafran's original study [14] and, second, on our goal to achieve an immediate and direct assessment of the experimental effects. As is the case with all analogue scales, we assessed the subjective evaluation of each participant and not the objective rating of her experience. In addition, the relatively small sample size of the AN patients and the lack of power may have prevented experimental effects from reaching statistical significance. This poses a limitation to the study's strength to generalize results. Finally, the absence of a control group during the neutralization/checking stage did not permit the controlling of the effects of a possible spontaneous decline in urges to neutralize, a phenomenon found in previous experiments [17, 57].

Conclusion

The results of the present study provide some empirical support to the similarities of the cognitive distortion TSF between BN and AN patients, and to existing cognitive models of EDs which emphasize the maintaining role of cognitive distortions [3, 4, 12, 41, 45, 51, 52, 58]. Future cognitive interventions that will focus on eliminating TSF and associated feelings of body dissatisfaction in BN patients and possible needs for control in AN patients may be promising treatment options for eating disorders in patients who have high TSF. The precise role of TSF in different eating disorders remains to be explored in future studies, which should ideally include larger sample sizes.

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