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Does implicit emotion regulation in binge eating disorder matter?

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ABSTRACT

Objective: To examine if implicit emotion regulation (occurring outside of awareness) is related to binge eating disorder (BED) symptomatology and explicit emotion regulation (occurring within awareness), and can be altered via intervention.
Methods: Implicit emotion regulation was assessed via the Emotion Conflict Task (ECT) among a group of adults with BED. Study 1 correlated BED symptomatology and explicit emotion regulation with ECT performance at baseline (BL) and after receiving BED treatment (PT). Study 2 generated effect sizes comparing ECT performance at BL and PT with healthy (non-eating disordered) controls (HC).
Results: Study 1 yielded significant correlations ($p < .05$) between both BED symptomatology and explicit emotion regulation with ECT performance. Study 2 found that compared to BL ECT performance, PT shifted ($d = -.27$), closer to HC. Preliminary results suggest a) BED symptomatology and explicit emotion regulation are associated with ECT performance, and b) PT ECT performance normalized after BED treatment.
Conclusions: Implicit emotion regulation may be a BED treatment mechanism because psychotherapy, directly or indirectly, decreased sensitivity to implicit emotional conflict. Further understanding implicit emotion regulation may refine conceptualizations and effective BED treatments.
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1. Introduction

Emotion regulation can be defined as goal directed processes that function to influence the intensity, duration, and type of emotion experienced (Gross & Thompson, 2007). Such emotion regulation can occur both explicitly and implicitly (Bargh & Williams, 2007; Gross & Thompson, 2007; Mauss, Evers, Wilhelm, & Gross, 2006). Explicit emotion regulation includes processes which demand conscious effort for initiation and require some form of monitoring throughout implementation (Gyurak, Gross, & Etkin, 2011). In contrast, implicit emotion regulation (IER) is a process evoked automatically by a stimulus, completed without monitoring, and occurs without awareness and insight.

There has been substantial interest in explicit emotion regulation and IER within psychiatric research. Similar to cognitive control (Miller & Cohen, 2001), effective explicit emotion regulation requires an ability to detect emotional content and subsequently adjust action (i.e., approach or avoid the stimulus) accordingly (Lang & Davis, 2006; LeDoux, 2000). Traditional psychological interventions have targeted both cognitive regulation strategies, such as in thought challenging tasks in Cognitive Behavioral Therapy (Persons, 1989), and explicit emotion regulation strategies, such as in distress tolerance skills in Dialectical Behavior Therapy (Linehan, 1993a; Linehan, 1993b). Preliminary data suggest that IER may be related to psychiatric functioning in individuals with Generalized Anxiety Disorder (GAD) and Depression (Etkin, Prater, Hoeft, Menon, & Schatzberg, 2010; Etkin & Schatzberg, 2011), yet IER remains unexplored among many other psychiatric conditions. If IER is indeed related to psychiatric conditions, then perhaps interventions can be developed that purposefully target IER, potentially improving the overall efficacy of current treatment approaches which solely target cognitive and explicit emotion regulation strategies.

In regards to eating disorders (ED) specifically, there similarly has been an exponential research growth on the role of emotion regulation in binge eating (Gianini, White, & Masheb, 2013; Whiteside et al., 2007). Such research consistently links greater difficulties with *explicit* emotion regulation, including deficits in emotion recognition, among individuals with ED compared to those without (Brockmeyer et al., 2014; Gilboa-Schechtman, Avnon, Zubery, & Jeczmien, 2006; Harrison, Sullivan, Tchanturia, & Treasure, 2010; Haynos & Fruzzetti, 2011; Oldershaw, 2009; Racine & Wildes, 2013). Indeed, compared to individuals without binge eating disorder (BED), those with BED report both increased experiences of negative affect and lowered ability to both identify and describe their emotional states (Zeeck, Stelzer, Linster, Joos, & Hartmann, 2010). In addition, extensive data document associations specifically

Abbreviations: BED, binge eating disorder; ECT, Emotional Conflict Task; GAD, Generalized Anxiety Disorder; BL, baseline; PT, post treatment; HC, healthy (non-eating disordered) controls; CBT, Cognitive Behavioral Therapy; IRT, Integrative Response Therapy; BMI, Body Mass Index; iI, incongruent–Incongruent; iC, incongruent–Congruent; cC, congruent–Congruent; cI, congruent–Incongruent; EDE, Eating Disorder Examination; OBE, objective binge episode; ERQ, Emotion Regulation Questionnaire; DERS, Difficulties in Emotions Regulation Scales.

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between explicit emotion regulation and binge eating (Lilenfeld, Wonderlich, Riso, Crosby, & Mitchell, 2006; Whiteside et al., 2007; Womble et al., 2001).

Limited research on *IER* in ED has been conducted within anorexia nervosa (AN) or bulimia nervosa (BN). For example, compared to healthy controls, women with AN or BN demonstrated more attentional biases (yielding a large effect size) to a Stroop Task presentation of angry faces (Stroop, 1935). To date, it is unknown whether IER processes differ between individuals with and without BED. Similarly, no data exist regarding the existence, strength, and direction of associations between IER and specific BED symptomatology (i.e., binge eating frequency, weight and shape concerns) within a BED population, either before or after a BED manualized treatment. Such knowledge would be useful, for example, by potentially refining current theoretical models of binge eating, such as Escape Theory (Heatherton & Baumeister, 1991) and/or the Affect Regulation Model (Polivy & Herman, 1993; Wiser & Telch, 1999). Escape Theory proposes that binge eating is used as an attempt to escape self-awareness. The Affect Regulation Model conceptualizes binge eating as an attempt to alter painful emotional states, maintained via negative reinforcement through provision of temporary relief from aversive emotions. Moreover, such knowledge may indicate if IER is indeed related to binge eating and can be altered via intervention. Thus, it would serve as an important yet currently overlooked intervention target which might ultimately improve treatment outcomes.

One of the few assessments of IER is the use of a behavioral task called the Emotional Conflict Task (ECT; 28). The ECT has been validated for use in healthy control and psychiatric populations (Etkin, Egner, Peraza, Kandel, & Hirsch, 2006; Etkin & Schatzberg, 2011; Etkin et al., 2010) and is the only emotion regulation task now supported by lesion evidence (Algom, Chajut, & Lev, 2004). The ECT is a variant of the classic Stroop paradigm (Haynos & Fruzzetti, 2011) in which words are presented in colors either congruent with the word itself (red in red ink) or incongruent with the word (red in blue ink) to provide a measure of cognitive, rather than emotional, conflict (MacLeod, 1991). In the ECT, emotional conflict arises from incompatibility between the task-relevant and task-irrelevant emotional dimensions of a stimulus, hence representing an emotional analog to the color-word Stroop task (First, Spitzer, Gibbon, & Williams, 2002). Specifically, participants in the ECT are presented with photographs of emotional faces (fearful or happy) with a word ("fear" or "happy") written over them. The word written on the photo either matches the facial expression (e.g., in a no-conflict trial the happy face has the word "happy"), or is incongruent with it (e.g., in a conflict trial the happy face has the word "fear"). The task is for participants to indicate whether the facial expression is happy or fearful by pressing a button, and not to respond based upon the overlaying word. Implicit emotion regulation is evidenced by trial-to-trial changes in one's ability to respond to conflicting sequential presentations. The emotion regulation process is implicit because individuals are unaware of the modulation of the emotional control elicited by the stimuli on their behavioral response (Maier & di Pellegrino, 2012). Relatedly, despite careful probing, participants do not report any awareness of the task's key processes.

To date, ECT studies in clinical populations showed slowed ECT performance. For example, individuals with GAD and comorbid GAD and depression demonstrate slower ECT performance compared to healthy controls and depression-only patients (Etkin & Schatzberg, 2011; Etkin et al., 2010). Although exaggerated ECT performance has not yet been demonstrated by a particular clinical population, it is nonetheless plausible and would indicate abnormal IER (i.e., prolonged heightened sensitivity; inability to down-regulate). Indeed, assessing IER may provide additional detail regarding symptom manifestation and differentiation from healthy controls.

The present study sought to address these gaps in the literature and investigate the nature of ECT measured IER within BED. Specifically, a two part study was conducted to explore both IER's associations with explicit emotion regulation and BED symptomatology, and potential differences in IER between adults with and without BED.

2. Method

2.1. Study purpose

To investigate IER in BED via two preliminary observational studies. Study 1 (BED Correlates Study) correlated BED symptomatology and explicit emotion regulation with ECT measured IER among adults with BED at baseline (BL) and after receiving a BED treatment (PT). We hypothesized that BED symptomatology and explicit emotion regulation would correlate with ECT measured IER at each assessment time point (BL or percent change at PT).

Study 2 (ECT Performance Study) compared ECT measured IER between BED participants (assessed at BL and PT) and healthy (non-eating disordered) controls (HC). We hypothesized that a) BED BL ECT performance would differ (be either faster or slower) from HC and b) BED PT ECT performance would shift after BED treatment so as to more closely resemble HC performance.

2.2. Participants

BL and PT data for BED participants (n = 43) were collected as part of a larger randomized clinical trial of a treatment outcome study comparing two manualized BED treatments: Cognitive Behavioral Therapy (CBT; n = 19; 44%; based largely on the restraint model of binge eating) and Integrative Response Therapy (IRT; n = 24; 56%; based on affect regulation models of binge eating (Robinson, 2013)). The current study's sample was selected from the larger BED trial's sample of n = 86 participants because they were not taking psychotropic medications nor had used a benzodiazepine within 48 hours of completing the task, and thus were eligible.

HCs were recruited separately, during the same time period as the BED trial, and consented to participate in a one-time assessment.

2.2.1. BED participants

Adult BED participants (n = 43) met DSM-5 criteria for BED. Exclusion criteria included: 1) concurrent psychotherapy; 2) regular purging or other compensatory behaviors over the past six months; 3) current psychosis; 4) current alcohol/drug abuse or dependence; 5) severe depression with recent (e.g., within past month) suicidality; 6) current use of weight altering medications (e.g., phentermine); 7) severe medical condition affecting weight or appetite (e.g., cancer requiring active chemotherapy); 8) current pregnancy or breast feeding; and 9) imminently planning or undergoing gastric bypass surgery. BED participants with both BL and PT ECT data were included in the present analysis. There was no monetary incentive for the BED participants; they received BED treatment as part of their participation in the larger study.

2.2.2. Healthy control comparison participants

Adult HC participants (n = 23) were recruited via online advertising for participation in a one-time assessment battery and paid $50. Exclusion criteria included current: 1) ED; 2) psychosis; 3) alcohol/drug abuse or dependence; 4) severe depression with recent (e.g., within past month) suicidality; 5) use of weight altering medications (e.g., phentermine); 6) severe medical condition affecting weight or appetite; and 7) pregnancy or breast feeding.

All participants spoke and read English as surveys and the ECT were presented in English. No participants were taking psychotropic medications or had used a benzodiazepine within 48 hours of completing the ECT, as the impact of such medications on ECT performance is currently unknown.

Eligibility was assessed via a telephone screen followed by an in-person clinical interview and informed consent. The Institutional Review

Board of Stanford University Medical Center reviewed and approved the study. All studies took place at Stanford University.

2.3. Assessment

BED and HC participants completed two (BL and PT) and one assessment battery, respectively. Each battery included the same measures which were administered in the following order: SCID, ED symptomatology measures, explicit emotion regulation measures, and ECT.

2.3.1. Demographics

Demographics included age, income, marital status, ethnicity and race, employment status and educational background. The Structured Clinical Interview for DSM-IV (SCID-I; 33) yielded co-morbid psychiatric disorders and allowed ascertainment of exclusion criteria. Weight was assessed on a balance beam scale, with the participant in light-weight clothing and shoes removed. Height was measured with a stadiometer. For both variables, the average of two measurements was used. Body Mass Index (BMI) was calculated as weight (kilograms) divided by the square of height (meters).

2.3.2. ED symptomatology measures

All participants completed the Eating Disorder Examination (EDE; (Fairburn & Cooper, 1993) to ascribe a BED diagnosis or absence of ED. Additional EDE variables included: 4 subscales, 1 global score, and the number of objective binge episodes (OBE) over the previous 28 days.

2.3.3. Explicit emotion regulation measures

The Emotion Regulation Questionnaire (ERQ; 37) is a brief 10-item questionnaire measuring two emotion regulation strategies: reappraisal (e.g., “When I want to feel less negative emotion, I change the way I'm thinking”) and suppression (e.g., “I keep my emotions to myself”) using a 7 point likert scale ranging from 1 = strongly disagree to 7 = strongly agree. The scale has good convergent and discriminate validity. Expressive suppression has been associated with lower psychological wellbeing (Gross & John, 2003).The Difficulties in Emotions Regulation Scales (DERS; (Gratz & Roemer, 2004) has 36 items assessing various aspects of emotion regulation on a 5 point likert scale ranging from 1 = almost never to 5 = almost always. Participants rate how often statements such as “I feel at ease with my emotions” apply to them using a five-point Likert scale, with higher scores reflecting greater difficulties with emotion regulation. The DERS has high internal consistency, good test–retest reliability, and adequate construct and predictive validity. The total DERS score (with higher scores indicating more difficulty in emotion regulation) was used in this analysis.

2.3.4. The Emotion Conflict Task (ECT)

The ECT was delivered as previously described (Egner, Etkin, Gale, & Hirsch, 2008; Etkin et al., 2006). Stimuli were presented via a PC Dell Desktop computer. The task consisted of 148 presentations of happy or fearful facial expression photographs drawn from a larger set (Ekman & Friesen, 1978), overlaid with the words “FEAR” or “HAPPY.” The persons featured in the facial photographs were all adults, 45% male. Stimuli were presented for 1000 ms, with a varying interstimulus interval of 3000–5000 ms (mean = 4000 ms), in a pseudorandom order, counterbalanced across trial types for expression, word, response button, and gender. Participants indicated facial affect with a button press response. The ECT yields various scores for the 4 possible combinations of incongruent (non-matching face and word) and congruent (matching face and word) presentations: incongruent–Incongruent (iI), incongruent–Congruent (iC), congruent–Congruent (cC), and congruent–Incongruent (cI). *Overall Adaptation*, the core ECT variable and the dependent variable of interest in the present study, was derived from mathematical equations of these aforementioned 4 combinations and represents a particular dimension of a IER response. Specifically, Overall Adaptation surmises, via a sum, how participants' are adapting overall to both incongruent and congruent stimuli pairs [=(iI–cI) + (cC–iC)]. A clinical populations' deviation in either direction (e.g., slower or faster) from HC scores on Overall Adaptation may have clinical implications. For example, clinical population scores that are faster than HC scores implies that the former has relatively exaggerated reactions to conflicting stimuli; they are ‘over-performing’ in a way that does not appear to down-regulate or adapt, as the HC's performance does. Stated differently, faster scores may indicate heightened sensitivity and eagerness to resolve it. Alternatively, clinical population scores that are slower than HC scores imply that the former has relatively attenuated reactions to conflicting stimuli; here, they are ‘under-performing’ with failure to speed up to an expected, normative pace.

2.4. Analysis

Descriptive analyses present demographic information. To capture change from BED-BL to BED-PT: i) difference scores for ECT measured IER (i.e., overall adaptation) and ii) percent change scores (which take into account baseline functioning) for BED symptomatology and explicit emotion regulation variables were used. Study 1 employed Pearson correlation coefficients to assess associations between BED ECT performance at BL and after receiving BED treatment at PT. Study 2 used effect sizes (Cohen's d; (Cohen, 1988) to estimate differences between (Gianini et al., 2013) BED-BL vs BED-PT and (Whiteside et al., 2007) BED-BL and BED-PT vs HC on ECT overall adaptation, the dependent variable. Effect size interpretation was based on standard conventions for Cohen's d (.20 = small, .5 = medium, .8 = large). Analyses were done with SPSS (SPSS, Inc., version 20). While the larger BED trial randomized participants to two treatments, CBT and IRT, no between group difference tests between treatment conditions were conducted in the present study due to the relatively small sample size per condition.

3. Results

3.1. Baseline characteristics

Participant characteristics are presented in Table 1. No significant differences on demographic variables (gender, age, ethnicity, race, employment status, educational background) were found between the BED-BL and HC groups except for body mass index (BMI) which was, as expected, significantly higher in the BED-BL than HC group (mean(SD) BED: 32.82(6.65) versus HC: 23.92(5.09), $p < .001$). None of the demographic variables were related to ECT measured IER for BED or HC.

3.2. Explicit emotion regulation

The BED-BL group had significantly greater explicit emotion regulation scores on the DERS than the HC group. There were no significant BL between group differences on either ERQ subscale (see Table 2).

3.3. BED symptomatology

As expected, the BED-BL group had significantly higher BED symptomatology than HC across all EDE variables (all p's < .001; see Table 2).

3.4. ECT

Overall ECT accuracy was within acceptable limits (>80%) for all participants. There were no significant between group differences on accuracy (mean (SD): BED-BL = 97.33%(1.41%); BED-PT = 96.56%(4.49%); HC = 96.27%(3.44%).

3.4.1. Study 1: BED Correlates Study

BED Correlates Study results pertain to the BED-BL and BED-PT groups only (Table 3).

Table 1
Sample demographics.

	BED n = 43	Healthy controls n = 22	t or X^2, p
Gender (no. (%))			ns
Female	37 (86)	16 (73)	
Male	6 (14)	6 (27)	
Age in years mean (SD)	46.95 (15.25)	41.30 (17.06)	ns
Body mass index mean (SD)	32.82 (6.65)	23.80 (4.94)	t = −5.30, p < .001
Ethnicity (no. (%))			ns
Hispanic/Latino	3 (7)	2 (9)	
Not Hispanic/Latino	40 (93)	20 (91)	
Race (no. (%))			ns
Caucasian	35 (82)	14 (64)	
Asian	7 (16)	6 (27)	
African American	0	0	
More than one race	1 (2)	2 (9)	
Unknown/unreported ethnicity	0	0	
Employment status (no. (%))			ns
Employed	27 (63)	10 (45)	
Retired	6 (14)	3 (14)	
Homemaker	1 (2)	1 (5)	
Unemployed	5 (12)	4 (18)	
Student	4 (9)	4 (18)	
Educational background (no. (%))			ns
Completed at least one graduate degree	15 (35)	3 (14)	
Completed some graduate school	8 (19)	6 (27)	
Graduated from a 4 year college	10 (23)	7 (32)	
Completed some college/2 year degree	8 (18)	6 (27)	
High school degree or equivalent	2 (5)	0	

Note. BED = the Binge Eating Disorder group; No. = number.

BED-BL EDE Weight Concerns was significantly correlated with BED-BL ECT overall adaptation performance. This indicates that BED participants who had more weight concerns at BL also had faster overall adaptation scores at BL. Total OBEs over the previous 28 days was also significantly correlated with overall adaptation, wherein participants who had more OBEs at BL also had faster overall adaptation performance at BL.

There were no significant correlations between the percentage change scores on either emotion or ED variables and BED-BL ECT overall adaptation performance.

BED-BL EDE restraint and BED-BL EDE global scores were significantly correlated with the difference between ECT overall adaptation performance from BL to PT. This indicates that participants with higher BL levels of restraint and global eating pathology had larger reductions (improvements) in ECT performance from BL to PT.

Table 3
Study 1 (BED Correlates Study) results: correlations between ECT performance with BED symptomatology and explicit emotion regulation.

			ECT: overall adaptation
		Baseline	Difference score (PT score –BL score)
Emotion variables			
ERQ reappraisal	BL	–	–
	%Δ	–	–
ERQ suppression	BL	–	–
	%Δ	–	–
DERS total score	BL	–	–
	%Δ	–	r = .387, p = .024
Eating variables			
OBE days	BL	–	–
	%Δ	–	–
OBE episodes	BL	r = −.343, p = .028	
	%Δ		
EDE restraint	BL	–	r = .511, p < .002
	%Δ	–	–
EDE weight concerns	BL	r = −.422, p < 0.006	–
	%Δ	–	–
EDE shape concerns	BL	–	–
	%Δ	–	–
EDE eating concerns	BL	–	–
	%Δ	–	r = .355, p = .036
EDE global score	BL	–	r = .445, p < .007
	%Δ	–	–

Note. r = correlations coefficient; – = not statistically significant at p ≤ 0.05; BL = baseline; PT = post-treatment; %Δ = percent change score; ERQ = emotion regulation questionnaire; DERS = difficulties in emotion regulation scale; EDE = eating disorder examination; OBE days = number of days with an objective binge episode over the previous 28 days; OBE episodes = total number of objective binge episodes over the previous 28 days.

Last, percent change scores in both EDE Eating Concerns and DERS total score were significantly correlated with the difference score from BL to PT on ECT overall adaptation performance. These significant positive correlations indicate that reductions (improvements) EDE Shape Concerns and DERS total scores were associated with reductions (improvements) in ECT performance over the course of treatment.

3.4.2. Study 2: ECT Performance Study

Study 2 results are in Fig. 1. There was no statistically significant difference between the BED-BL group and HC group on ECT performance, whether or not BMI was controlled for. The trend however, was that the BED-BL group showed higher or faster (exaggerated) ECT performance scores on Overall Adaptation than the HC group. The lowering, or slowing in performance scores from BL to PT was not statistically significant yet yielded a small effect size (d = −.27) and resulted in BED-PT ECT performance scores that more closely resembled the ECT performance scores of HC participants.

Table 2
BED symptomatology and explicit emotion regulation scores.

	BED BL n = 43	Healthy controls (HC) n = 22	t-Test (BED BL v HC)
Emotion variables	M(SD)	M(SD)	
ERQ reappraisal	25.88 (7.64)	29.59 (9.10)	ns
ERQ suppression	13.60 (4.09)	12.91 (5.68)	ns
DERS total score	86.16 (25.53)	71.64 (20.38)	t = −2.46; p < .017
Eating variables			
OBE days	12.44 (6.74)	0	t = −8.59, p < .001
EDE restraint	2.35 (1.24)	.40 (.77)	t = −6.07, p < .001
EDE eating concern	2.12 (1.06)	.06 (.22)	t = −9.01, p < .001
EDE shape concern	3.23 (1.15)	.37 (.65)	t = −10.75, p < .001
EDE weight concern	3.04 (.94)	.53 (.91)	t = −10.15, p < .001
EDE global score	2.69 (.77)	.35 (.54)	t = −12.49, p < .001

Note. BED = binge eating disorder; BED BL = the BED group at baseline; ERQ = emotion regulation questionnaire; DERS = difficulties in emotion regulation scale; OBE days = the number of days with an objective binge episode over the previous 28 days; EDE = eating disorder examination.

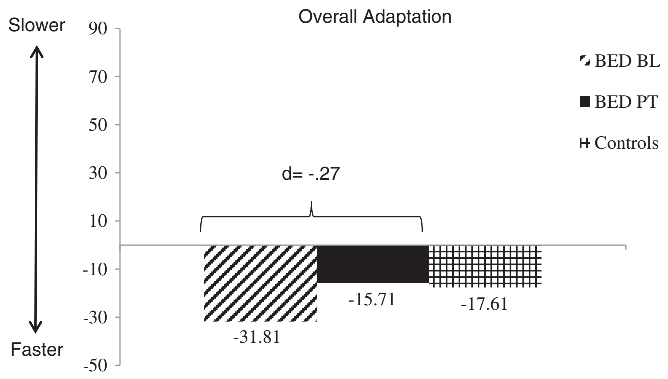

Fig. 1. Study 1 (ECT Performance Study) results: BED-BL to -PT change in ECT performance compared to healthy controls. ECT = emotion conflict task; BED BL = the Binge Eating Disorder group at baseline; BED PT = the Binge Eating Disorder group at post treatment; Controls = healthy (non-eating disordered) controls; d = Cohen's effect size.

4. Discussion

Substantial evidence exists linking explicit emotion regulation, which occurs within awareness, to BED-relevant pathology. Evidence linking implicit emotion regulation (IER), which occurs outside of awareness, and such BED-relevant pathology is scant, even though other implicit processes (such as association and processing tasks) have been shown to differentiate between those with and without AN or BN. This study makes an important contribution to the literature by being first to administer the ECT to adults with BED. The ECT, a measure of IER previously used in other psychiatric samples, is the only emotion regulation task now supported by lesion evidence (Maier & di Pellegrino, 2012). Study 1, the ECT Correlates Study, investigated associations between BED symptomatology and explicit emotion regulation with ECT measured IER among a group of adults with BED before (BL) and after (PT) receiving a BED intervention. Study 2, the ECT Performance Study, investigated whether BED participants' BL and PT IER differed from healthy control's (HC) IER.

Results from Study 1, the ECT Correlates Study, indicated that both BED symptomatology and explicit emotion regulation are associated with ECT measured IER before and after BED treatment. At BL, higher scores on the EDE weight concerns subscale—a representation of core BED symptomatology—were associated with faster (exaggerated) ECT performance. In addition, the severity of BL BED symptomatology (EDE-derived restraint and global scores) was related to greater improvement or normalization of IER at PT (i.e., after treatment ECT measured IER slowed to more closely approximated HC performance). Finally, the degree of improvement in explicit emotion regulation functioning (reductions in DERS total score) was associated with the degree of normalization (slowing) of ECT performance from BL to PT. Such associations support the notion that "adaptive functional outcomes" (in this case, reduction in DERS), as termed Gyurak and colleagues (Gyurak et al., 2011), are linked to IER. The findings similarly support reports from the implicit attitude literature that forms of behavior that are less easily controlled may be predicted by implicit forms of cognition (Asendorpf, Banse, & Mücke, 2002). In addition, because ECT measured IER was associated with both BED symptomatology and explicit emotion regulation before and after receipt of the BED intervention, it may serve as a viable alternative mechanism of investigating associations of eating disorder symptomatology, with or without concurrent associations with explicit emotion regulation.

Taken together, Study 1 results suggest that IER, as measured by the ECT, is important in understanding, and potentially may be a mechanism of change in, BED. To the authors' knowledge, these data are the first to link IER to both BED symptomatology and explicit emotion regulation both before and after a manualized BED intervention.

Study 2, the ECT Performance Study, compared BED participants' ECT measured IER before and after treatment with HC participants' ECT measured IER. At BL, BED participants had faster (exaggerated) IER scores when compared to HC. This exaggerated performance may imply an over-sensitivity to implicit emotional conflict among BED participants as compared their non-eating disordered counterparts. The faster BL IER scores among BED participants compared to HC participants is also consistent with clinical observations that individuals with BED often report notable discomfort in negative affect states and a concurrent eagerness to escape or reduce them as quickly as possible. Thus, it is feasible that individuals with BED appear to have both implicit and explicit emotion conflict regulation difficulties. Such data may allow refinement and/or broadening of Escape Theory (Heatherton & Baumeister, 1991) and/or the Affect Regulation Model (Polivy & Herman, 1993; Wiser & Telch, 1999). If implicit emotion elicits binge eating in the same way that explicit emotion is hypothesized to, then the former would serve as an important intervention target.

BED participants ECT measured IER slowed from pre- to post-receipt of a binge eating reduction intervention, and thereby more closely resembled that of HC participants. This findings parallels previous work demonstrating that behavioral treatment may lead to alterations in implicit attitudes (Teachman & Woody, 2003). Although it is not yet known how the interventions worked to improve BED participants IER, improvement was in the desired direction. Explanations for greater similarity between BED after treatment and HC IER may include: (a) normalization of IER processes is correlated with improvement in BED symptomatology at PT; and/or (b) the therapeutic interventions (directly or indirectly) improved IER. A treatment component analysis may elucidate aspects of treatment that are (or are not) associated with IER improvements. Such research may identify whether specific or non-specific therapeutic factors prompt changes in IER. The current findings offer preliminary evidence that IER can be enhanced through an explicit intervention.

It is interesting that there were no BL differences between the BED and HC groups on either ERQ subscale. It is possible that the ERQ was not sensitive enough to distinguish between the groups, even though the DERS, the other external emotion regulation measure, did. Of note, the HC ERQ scores were similar to norms that have been reported for this measure (Melka, Lancaster, Bryant, & Rodriguez, 2011).

Limitations of the present study are important to note. First, the sample was small, and limited in its racial, ethnic, and gender diversity. Only data from 43 BED participants who were present at both BL and PT assessments were included in this preliminary study. Replication of the response patterns described herein, ideally with a more diverse sample, is therefore needed. Related analytic limitations include the lack of between treatment group comparisons from the larger BED trial due to low sample size per group. Also, BED participants taking psychotropic medications were excluded given the potential interference between such medications and ECT performance; there was a preliminary need to first investigate such associations in a medication-free sample. Nonetheless, the current sample limits the generalizability. Finally, future studies should also consider matching BED participants and HC on BMI, which was not done in this preliminary study.

Study strengths include the use of the ECT as IER assessment. As mentioned, the ECT has been previously employed and well validated with psychiatric populations (Etkin & Schatzberg, 2011; Etkin et al., 2006; Etkin et al., 2010) and is the only emotion regulation task now supported by lesion evidence (Maier & di Pellegrino, 2012). Use of the ECT to assess IER in binge eating research may lead to validation and standardization of measurement procedures (e.g., protocols, target variables) allowing appropriate cross-study comparisons.

5. Conclusion

In summary, there are several benefits to incorporating IER measurement in BED research. First, and as these results demonstrate, IER is linked to BED symptomatology and explicit emotion regulation both before and after BED treatment. As such, IER may facilitate differentiation of those with BED from healthy controls. In addition, IER changes may be the means by which BED improves in treatment because psychotherapy, directly or indirectly, influenced it. In addition, because IER in BED is currently understudied, it is important to better understand how it does or does not play a role in binge eating (in the way that research has demonstrated explicit emotion regulation does Brockmeyer et al., 2014; Whiteside et al., 2007; Womble et al., 2001) and further elucidate its role in AN and BN (Davidson & Wright, 2002; Dobson & Dozois, 2004; Fairburn, Cooper, & Cooper, 1991; Miller & Cohen, 2001). Together, such data may potentially inform and refine existing and/or novel theories and interventions focusing on the role IER plays in the etiology and maintenance of binge eating, and ideally augment current rates of treatment response.

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Contributors

A. Robinson designed the study, ran the protocol, conducted the statistical analysis, and wrote the first draft of the methods and results sections. D. Safer facilitated in conceptualization of the study, manuscript editing, and conducted relevant literature reviews whose results were included in the manuscript. J. Austin wrote the first draft of the background and conclusion sections and developed tables and figures. A. Etkin provided expertise and guidance on administration of and facilitated with analysis of ECT data. All authors contributed to and approved of the final manuscript.

Conflicts of interest

All authors declare they have no conflicts of interest.

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