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1 The use of a positive mood induction video-clip to target eating
2 behaviour in people with bulimia nervosa or binge eating disorder: An
3 experimental study

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Abstract

Recent theoretical models and empirical research have indicated that momentary negative affect increases the likelihood of binge eating episodes for individuals with bulimia nervosa and binge eating disorder. However, relatively little research has explored the potential for positive mood to serve a protective effect in reducing the likelihood of overeating behaviour in bulimia nervosa and binge eating disorder. The current study included 30 women with bulimia nervosa or binge eating disorder in a within-subjects crossover design. Following exposure to a video designed to induce food craving, we found that a positive mood vodcast was associated with significantly lower levels of negative mood and food consumption in a taste test meal, when compared to a neutral vodcast ($p = .002$). These findings support a role for decreasing negative mood in reducing the likelihood of binge eating behaviour in women with bulimia nervosa and binge eating disorder.

KEYWORDS: Bulimia nervosa; Binge eating disorder; Mood induction; Positive affect; Vodcast

44

Introduction

45 Bulimia nervosa and binge eating disorder are eating disorders characterised by repeated
46 episodes of loss of control over eating (American Psychiatric Association, 2013). Recent
47 theoretical models suggest that difficulties in emotion regulation (Haedt-Matt & Keel, 2011;
48 Hawkins & Clement, 1984; Leehr et al., 2015) and the tendency to act impulsively in response
49 to negative emotions (i.e., negative urgency) (Wolz, Granero, & Fernández-Aranda, 2017)
50 interact to trigger loss-of-control eating episodes (K. D. Becker, Fischer, Smith, & Miller,
51 2016; Haedt-Matt & Keel, 2011; Hawkins & Clement, 1984).

52 The contribution of emotion regulation difficulties to disordered eating behaviours has
53 been partially supported by studies utilising momentary ecological assessments (i.e. repeated
54 electronic assessments throughout the day). These studies show that negative mood and
55 decreased positive affect often precede binge eating episodes and compensatory behaviours in
56 patients with bulimia nervosa or binge eating disorder (K. R. Becker, Fischer, Crosby, Engel,
57 & Wonderlich, 2018; Goldschmidt et al., 2014; Haedt-Matt & Keel, 2011; Lavender et al.,
58 2016) and that greater negative affect instability characterises days when loss-of-control eating
59 occurs (Berner et al., 2017; Stevenson, Dvorak, Wonderlich, Crosby, & Gordon, 2018).

60 Results across studies which have measured the effect of experimentally-induced negative
61 mood on eating behaviours are somewhat mixed in clinical populations (Evers, Dingemans,
62 Junghans, & Boevé, 2018). One meta-analytic review has found that experimentally-induced
63 negative mood led to greater food intake among people with binge eating disorder and those at
64 risk of developing binge-type eating disorders (Cardi, Leppanen, & Treasure, 2015). A more
65 recent meta-analysis found that the effect of negative mood on increased food consumption
66 was only marginally significant and significantly moderated by the method of mood induction
67 (Evers et al., 2018).

68 The role of positive affect in modulating eating behaviour has been less investigated. A
69 recent meta-analysis found that positive mood induction tended to increase food consumption
70 when pooling together data from healthy, sub-clinical, and clinical populations (Evers et al.,
71 2018). However, studies exclusively conducted in people with bulimia nervosa or binge eating
72 disorder suggest that positive mood is rather associated with a reduced likelihood to binge eat
73 or overeat (K. R. Becker et al., 2018; Munsch, Meyer, Quartier, & Wilhelm, 2012; Udo et al.,
74 2013; Yeomans & Coughlan, 2009). One possible explanation for these findings is that the
75 presence of a binge-type eating disorder moderates the effect of positive mood on eating
76 behaviour due to stronger expectations of negative emotional reactivity following overeating
77 (Levinson et al., 2017; Wegener & Petty, 1994) or due to greater accessibility of ongoing goals
78 to curb binge eating behaviour (Shah, 2003).

79 These explanations are in line with the predictions of a number of theories in the field of
80 positive psychology. For example, Wegener and Petty's (1994) hedonic contingency
81 hypothesis proposes that individuals experiencing positive affect are more likely to choose
82 future behaviours on the basis of the expected emotional consequences of that behaviour, which,
83 in the context of bulimia nervosa and binge eating disorder, would entail expectations of
84 negative emotions such as guilt and shame following loss of control over eating. Furthermore,
85 the "broaden-and-build" theory (Fredrickson, 2001) posits that positive emotions increase the
86 availability of momentary thought-action repertoires and undo lingering negative emotions,
87 thus reducing the likelihood that pre-existing unhelpful habits are triggered (e.g. associations
88 between negative mood and loss of control over eating).

89 The aim of the present study was to examine the impact of a a short video-clip designed
90 to induce positive mood on the consumption of a standardised test meal in a clinical sample of
91 participants with bulimia nervosa or binge eating disorder. It was hypothesised that the
92 reduction of negative mood would reduce the number of calories consumed during the test

93 meal, when compared to calories consumed following a neutral video-clip (neutral vodcast). It
94 was also hypothesised that listening to the positive mood vodcast would be associated with
95 lower desire to eat and lower expectations that eating would provide relief after the test meal,
96 as compared to the neutral vodcast condition. The success of the experimental manipulation
97 (positive mood induction) was checked by measuring negative mood after watching the
98 positive mood or neutral video-clips.

99 **Methods**

100 *Participants*

101 Thirty women with either bulimia nervosa or binge eating disorder took part in the study.
102 Participants were recruited through eating disorder charity websites (BEAT, Succeed) and
103 amongst King's College London students and staff. Diagnoses were confirmed with the
104 Structured Clinical interview for DSM-5 – research version (SCID) (First, 2015). The SCID
105 was administered by Master's-level and PhD-level psychology students who had received
106 specific training in correct use of the SCID.

107 Exclusion criteria for the participants were body mass index (BMI) lower than 18.5,
108 diagnosis of an eating disorder other than bulimia nervosa or binge eating disorder, self-
109 reported substance misuse, visual impairment not corrected by lenses, and difficulties
110 understanding written and spoken English. All participants provided written, informed consent
111 prior to taking part in the study and all procedures were conducted in accordance with the latest
112 Declaration of Helsinki. All participants were compensated for their time. The study was
113 approved by the Psychiatry, Nursing & Midwifery Research Ethics Committee at King's
114 College London (PNM/11/12-3).

115

116 *Self-report questionnaires*

117 At baseline, participants completed a demographic and clinical questionnaire requesting
118 information on gender, ethnicity, age, years of education, eating disorder diagnosis, illness
119 duration (in years), diagnosis of psychiatric disorders in the family, and psychiatric medication.
120 This questionnaire also included the Eating Disorder Examination Questionnaire (EDEQ)
121 (Fairburn & Beglin, 1994), a 36-item self-report instrument assessing eating disorder
122 psychopathology over the past 28 days. Items in the EDEQ are provided in the form of a 7-
123 point Likert scale, such that higher overall scores indicate greater eating disorder
124 psychopathology. Before and after the mood induction video-clip and taste test, participants
125 completed visual analogue scales to assess state-related changes in negative mood (ranging
126 from 0 - “not at all” - to 10 - “extremely”) and the Food Craving Questionnaire (state version)
127 (FCQ-S; (Cepeda-Benito, Gleaves, Williams, & Erath, 2000)), a 15-item self-report measure
128 to assess state-dependent food craving.

129

130 *Food craving induction*

131 Food craving was induced with a two-minute video clip along with exposure to the snack
132 foods used during the taste test. The video depicted various people eating highly palatable
133 foods and has been used to successfully induce food craving in a study involving participants
134 with bulimic-type eating disorders (Fregni et al., 2008).

135

136 *Vodcast conditions*

137 The positive mood vodcast was designed to be uplifting and consisted of positive
138 classical music (Mozart’s Toy symphony) along with spoken word statements from the Velten
139 (1968) laboratory positive mood induction task. The neutral vodcast consisted of classical

140 music by Holst (Planets: Neptune the Mystic) along with neutral statements from the laboratory
141 mood induction task by Velten (1968). Both vodcasts lasted 15 minutes and have been
142 previously used among healthy individuals and people with anorexia nervosa (Cardi, Esposito,
143 Clarke, Schifano, & Treasure, 2015).

144

145 *Taste test*

146 The taste test is a commonly-used, validated measure of palatable eating behaviour
147 (Robinson et al., 2017). Whilst watching the positive mood or neutral vodcasts, participants
148 were instructed to taste the snack foods of the taste test. They were told that they could eat as
149 much or as little of the snack foods as they wanted and were required to rate each item
150 according to appearance, smell and taste. These ratings were not included in the analyses
151 because they were only collected to ensure credibility of the study demand (i.e. participants
152 were told that they study aim was to test differences in taste amongst individuals). The snack
153 foods consisted of six chocolate chip cookies, eight “Celebrations” chocolates, 25g of potato
154 crisps, and 30g of salted peanuts. All food items were presented in individual porcelain bowls.

155

156 *Design and procedure*

157 The study used a randomised, within subjects, crossover design. The order of the vodcast
158 conditions was randomised across participants. Thirteen out of twenty participants with BN
159 received the positive mood vodcast first (59.1%), whilst five out of eight participants with BED
160 received the positive mood vodcast first (62.5%). This difference in proportions was not
161 significance ($p = .511$).

162 Participants were tested in the afternoon, between 4 pm and 6 pm, in a laboratory. They
163 were instructed not to eat any foods for the two hours prior to their participation in the study.

164 Levels of hunger were measured before starting the experiment using a visual analogue scale
165 ranging from 0 (not at all) to 10 (very much). During the first session, participants completed
166 the demographic and clinical questionnaires. At the beginning of each study session, they were
167 exposed to the snack foods of the taste test and asked to watch the food craving video clip.
168 Following the video-clip, participants completed the FCQ-S and the negative mood visual
169 analogue scale. Participants were then left alone in the room and asked to watch a 15-minute
170 vodcast (either neutral or positive mood induction, depending on the session). Whilst watching
171 the vodcast, they were told they could eat as much or as little of the snack foods as they wanted
172 and were requested to rate each item according to appearance, smell and taste. Finally,
173 participants completed the FCQ-S and the negative mood visual analogue scale once more.

174

175 *Statistical analysis*

176 All statistical analyses were conducted in R using the lme4 package (Bates, Mächler,
177 Bolker, & Walker, 2015; R Core Team, 2017). The mood manipulation check was conducted
178 with a linear mixed effects model with time (before vodcast, after vodcast) and condition
179 (neutral vodcast, positive mood vodcast) as fixed effects and a random intercept. The effect of
180 the positive mood vodcast on caloric consumption during the taste test was explored with a
181 linear mixed effects model with condition (neutral vodcast, positive mood vodcast) as the fixed
182 effects predictor and a random intercept. Similarly, the impact of the vodcast on FCQ-S (desire
183 to eat and anticipation of relief subscales selected *a priori*) was examined with linear mixed
184 effects models. Time (before vodcast, after vodcast) and condition (neutral vodcast, positive
185 mood vodcast) were entered as fixed effects along with a random intercept. All mixed effects
186 models were conducted with the *lmer* command, the *anova* command was used to produce
187 ANOVA-like output, and degrees of freedom were estimated with Satterthwaite approximation.
188 Post-hoc pairwise tests were conducted with the *lsmeans* package (Lenth, 2016). The *lsmeans*

189 package reports the effective degrees of freedom for the pooled sample variances, which is
190 approximated using the Welch-Satterwaite equation.

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Results

Sample characteristics

The majority of the sample, 73% ($n = 22$), had a diagnosis of bulimia nervosa and the remaining 27% of the sample ($n = 8$) had a diagnosis of binge eating disorder. Six participants reported taking psychotropic medication at the time of their participation in the study and seven participants reported a comorbid diagnosis of depression. Mean baseline hunger in the neutral vodcast condition, as recorded in the VAS, was equal to 5.77, $SD = 3.74$. Mean baseline hunger in the positive vodcast condition was equal to 5.84, $SD = 3.14$. There was not a significant difference in the baseline hunger of participants in the neutral vodcast condition, versus the positive vodcast condition ($t(28) = -0.09, p = .926$). The sample characteristics are summarised in **Table 1**. The two clinical samples were not statistically compared due to the small sample size of the group of participants with binge eating disorder.

Variable	Bulimia Nervosa ($n = 22$) Mean (SD)	Binge Eating Disorder ($n = 8$) Mean (SD)	Total sample ($N = 30$) Mean (SD)
Age (Years)	24.29 (5.87)	29.88 (11.75)	25.83 (8.10)
Body Mass Index	23.12 (6.93)	27.14 (4.77)	24.27 (6.56)
Duration of illness (Years)	5.31 (6.17)	3.29 (5.56)	4.70 (5.94)
Eating Disorder Examination Questionnaire (total score)	3.98 (1.23)	3.97 (1.22)	3.98 (1.20)

Note. SD = standard deviation.

Table 1. Sample characteristics

Manipulation check: negative mood visual analogue scale

The linear mixed effects model revealed a significant main effect of condition, with participants reporting significantly more negative mood in the neutral vodcast condition than the positive mood vodcast condition across time points. There was also a significant condition

222 by time interaction, which was explored further with post-hoc tests. Post-hoc tests showed that
 223 participants reported less negative mood after the vodcast in the positive mood condition (t
 224 (83) = -2.74, $p = 0.008$). There was no significant change from before to after vodcast in the
 225 neutral condition (t (83) = 0.89, $p = 0.376$). Additionally, there was a significant difference in
 226 negative mood ratings between the two conditions after the vodcast, with those in the positive
 227 mood condition reporting less negative mood (t (84) = -4.72, $p < 0.0001$). There was no
 228 significant difference in negative mood ratings between the two conditions before exposure to
 229 the vodcast (t (84) = -1.08, $p = 0.284$). The negative mood ratings for each condition, before
 230 and after watching the vodcast, are reported in **Table 2**. Wald tests associated with fixed effects
 231 entered in the linear mixed model are reported in **Supplementary Table 1**. The variance of the
 232 random intercept was equal to 4.851 and the variance of the residuals was equal to 4.188.

233

Vodcast condition	Time	Negative mood rating (0-10) Mean (SD)	F (df) statistic, p -value
Neutral	Before vodcast	6.14 (2.89)	Time: F (1, 83) = 1.83, $p = 0.179$ Condition: F (1, 85) = 16.62, $p = 0.0001$ Condition x time: F (1, 83) = 6.71, $p = 0.011$
	After vodcast	6.61 (2.79)	
Positive mood	Before vodcast	5.60 (3.36)	
	After vodcast	4.10 (3.05)	

234 *Note.* SD = standard deviation; DF = degrees of freedom

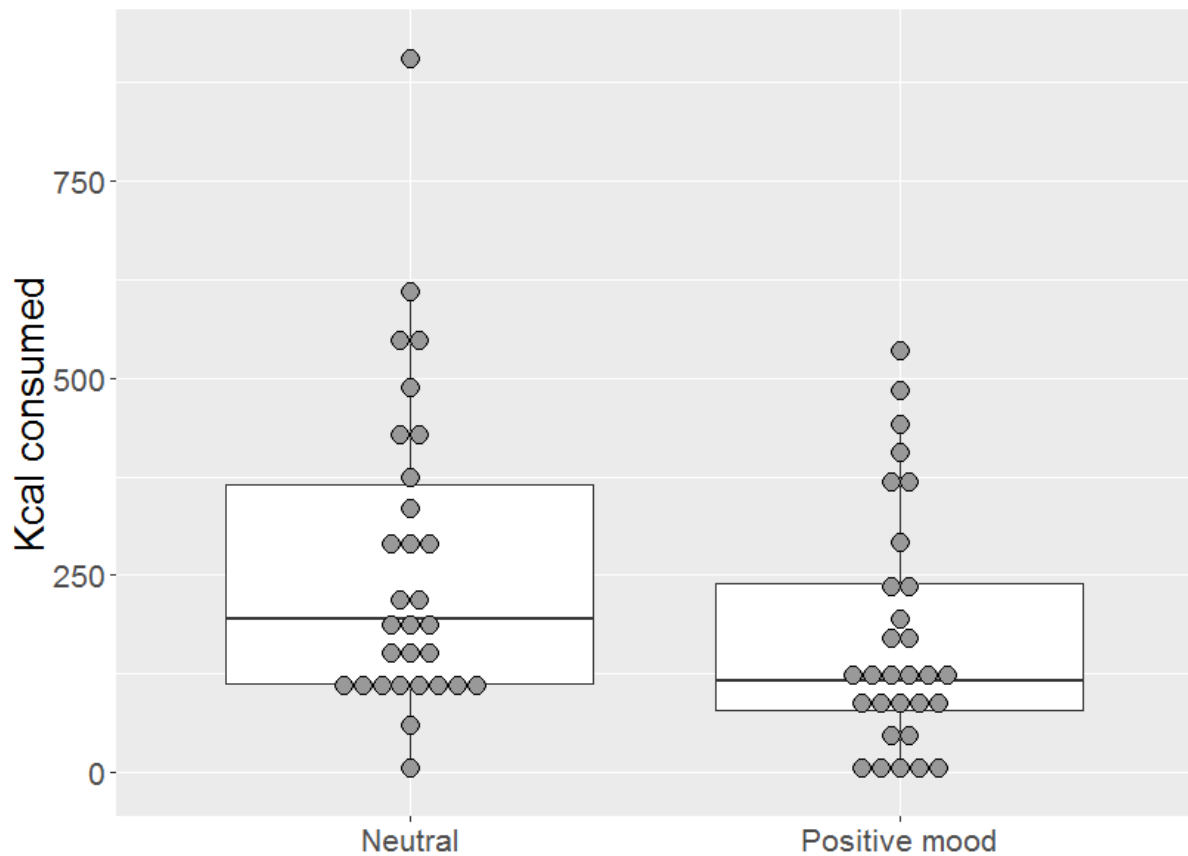
235 *Table 2.* Negative mood ratings in the positive mood and neutral vodcast conditions

236

237 *Test meal intake*

238 Caloric intake during the taste test in the positive mood and neutral vodcast conditions
 239 is presented in **Figure 1**. There was a significant difference between the two conditions, with
 240 participants consuming fewer calories in the positive, versus neutral, vodcast condition (F (1,
 241 29) = 10.98, $p = 0.002$). The Wald test for the mixed linear model revealed a significant fixed

242 effect of vodcast condition equal to -91.77 , $SE = 27.70$, $df = 29.00$, $t = -3.31$, $p = .002$. The
243 variance for the random intercept was equal to 20579, and the variance of the residuals was
244 equal to 11510. The effect of vodcast condition remained significant after controlling for
245 baseline mood. The results of this follow-up analysis are reported in **Supplementary Table 2**.
246



247
248 *Figure 1.* Caloric intake during the taste test in the positive mood and neutral vodcast
249 conditions, expressed in kilocalories (kcal)

250
251 *Desire to eat and Anticipation of relief*

252 The scores for “desire to eat” and “anticipation of relief” on the FCQ-S in both the
253 neutral and positive mood vodcast conditions are presented in **Table 3**. The linear mixed effects
254 model for “desire to eat” showed a significant main effect of condition. The participants

255 reported significantly more desire to eat in the neutral condition than the positive mood
 256 condition across time points ($t(86) = 3.43, p = 0.0009$). The variance of the random intercept
 257 was equal to 3.757 and the variance of the residuals was equal to 7.030. The Wald tests
 258 associated with the fixed effects of the linear mixed model are reported in **Supplementary**
 259 **Table 3**. The linear mixed effects model for “anticipation of relief” showed a significant main
 260 effect of condition and time. Participants reported higher scores in the neutral vodcast condition
 261 than in the positive mood vodcast condition across time points ($t(85) = 2.64, p = 0.010$). They
 262 also reported significantly more anticipation of relief before exposure to the vodcasts than after,
 263 across vodcast conditions ($t(84) = 2.07, p = 0.041$). The variance of the random intercept is
 264 equal to 5.159 and the variance associated with the residuals is equal to 3.796. The Wald tests
 265 associated with the fixed effects entered in the linear mixed model for anticipation of relief are
 266 reported in **Supplementary Table 4**.

267

Scale	Condition	Time	Rating (0-10) Mean (SD)	F (df) statistic, p-value
Desire to eat	Neutral	Before vodcast	10.73 (2.85)	Time: $F(1, 86) = 1.78, p = 0.185$ Condition: $F(1, 85) = 11.74, p = 0.0009$ Condition x time: $F(1, 85) = 0.86, p = 0.357$
		After vodcast	10.53 (3.72)	
	Positive mood	Before vodcast	9.55 (3.32)	
		After vodcast	8.45 (3.18)	
Anticipation of relief	Neutral	Before vodcast	7.60 (3.19)	Time: $F(1, 85) = 6.98, p = 0.010$ Condition: $F(1, 84) = 4.29, p = 0.041$ Condition x time: $F(1, 84) = 2.30, p = 0.133$
		After vodcast	7.40 (3.39)	
	Positive mood	Before vodcast	7.14 (2.91)	
		After vodcast	5.79 (2.36)	

268 *Note.* *SD* = standard deviation; *df* = degrees of freedom

269 *Table 3.* Scores for “desire to eat” and “anticipation of relief” in the positive mood and neutral
 270 vodcast conditions

271

272

Discussion

273 The aim of the present study was to explore the impact of a positive mood vodcast on food
274 consumption during a taste test in women with bulimia nervosa or binge eating disorder. Levels
275 of desire to eat and anticipation of relief were also assessed before and after the taste test and
276 watching the vodcast. The manipulation check was successful, showing that participants
277 reported significantly less negative mood after exposure to the positive mood vodcast. The
278 findings also showed that the positive mood vodcast led to a significant reduction in calories
279 consumed during the taste test. The vodcast intervention did not lead to a significant change in
280 self-reported desire to eat and anticipation of relief.

281 The present findings align with previous experimental work documenting reduction in
282 food consumption during a test meal following positive mood induction among obese
283 individuals and healthy people reporting bulimia nervosa-like symptoms (Udo et al., 2013;
284 Yeomans & Coughlan, 2009). The current findings therefore add to a body of existing literature
285 which suggests that this inhibitory effect of positive mood induction on hedonic food intake
286 may be specific to individuals with binge-eating tendencies, as opposed to the general
287 population (Evers et al., 2018).

288 A possible explanation for the effect of the positive mood vodcast on reduced calorie
289 consumption is that positive emotions increase the availability of momentary thought-action
290 repertoires whilst reducing the likelihood that pre-existing unhelpful habits are triggered
291 (Fredrickson, 2001). In a similar manner, this mechanism would explain the impact of the same
292 mood induction procedure in a sample of people with anorexia nervosa, who increased
293 consumption of a standard laboratory fruit smoothie after positive mood induction compared
294 to a control condition (Cardi, Esposito, et al., 2015).

295 The hypothesis that experimentally-induced positive mood reduces the access to automatic
296 and unhelpful eating behaviours and cognitions by increasing access to a repertoire of

297 alternative helpful eating behaviours and cognitions remains to be tested. The exposure to a
298 variety of personally-relevant high palatable foods and the measurement of self-reported
299 cravings and physiological reactivity during exposure would enable testing this hypothesis
300 more directly.

301 *Limitations*

302 The main limitation of the present study was the relatively small sample size, particularly
303 the small number of individuals with binge eating disorder. This prevented statistical
304 comparison of bulimia nervosa and binge eating disorder groups due to lack of power to detect
305 true differences. However, the overall goal of the study was to test the impact of positive mood
306 induction on the tendency to overeat, a symptom commonly shared by these two different
307 clinical presentations. We did not examine whether the food craving induction was successful
308 with self-report measures, nor did the current study measure positive mood directly, rather
309 measuring reductions in negative mood. Additionally, this study recruited women exclusively,
310 therefore limiting the generalisability of the current findings to men with bulimia nervosa and
311 binge eating disorder. The average duration of illness was 5.31 years for women with bulimia
312 nervosa and 3.29 years for women with binge eating disorder in the current study. Therefore,
313 it is still unclear to what extent positive mood induction may affect eating behaviour in women
314 with longer durations of illness. Future studies may benefit from exploring the impact of cue
315 induced food craving using visual analogue scales or physiological measures, and exploring
316 the impact of positive mood induction in everyday life settings through the use of ecological
317 momentary assessment.

318

319 *Clinical implications*

320 Current treatments for binge-type eating disorders are only effective for a subgroup of
321 patients (Eddy et al., 2017; Hay, 2013; Shingleton, Thompson-Brenner, Thompson, Pratt, &

322 Franko, 2015) and therefore the development of novel treatment approaches is warranted in the
323 field (Treasure, Cardi, Leppanen, & Turton, 2015; Treasure, Leslie, Chami, & Fernández -
324 Aranda, 2018). The current study indicates that positive mood induction techniques, which
325 successfully reduce negative mood, present a promising avenue to reduce the likelihood of
326 hedonic eating in women with bulimia nervosa and binge eating disorder. Considering the great
327 potential of mobile interventions (which are highly scalable and flexible), it would be
328 interesting to test whether the use of a mobile application offering a variety of personalised
329 strategies to induce positive mood would be beneficial in reducing unhelpful eating behaviours
330 in people with loss of control over eating.

331 **Conclusions**

332 The current study investigated the effect of listening to a vodcast designed to induce
333 positive mood on subsequent eating behaviour in women with bulimia nervosa and binge eating
334 disorder. The positive mood vodcast was associated with significantly reduced levels of
335 negative mood and reduced caloric consumption in a taste test meal, when compared to a
336 neutral mood vodcast. The current findings support the protective role of positive mood
337 induction exercises in deterring binge eating behaviour. We recommend that future research
338 studies explore the effect of repeated positive mood induction on clinical outcomes in larger,
339 longitudinal studies of bulimia nervosa and binge eating disorder to gauge the utility of
340 incorporating positive mood induction within treatment for binge-type eating disorders.

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References

American Psychiatric Association. (2013). *Diagnostic and statistical manual of mental disorders (DSM-5®)*: American Psychiatric Pub.

Bates, D., Mächler, M., Bolker, B., & Walker, S. (2015). Fitting Linear Mixed-Effects Models Using lme4. *2015*, *67*(1), 48. doi:10.18637/jss.v067.i01

Becker, K. D., Fischer, S., Smith, G. T., & Miller, J. D. (2016). The influence of negative urgency, attentional bias, and emotional dimensions on palatable food consumption. *Appetite*, *100*, 236-243.

Becker, K. R., Fischer, S., Crosby, R. D., Engel, S. G., & Wonderlich, S. A. (2018). Dimensional analysis of emotion trajectories before and after disordered eating behaviors in a sample of women with bulimia nervosa. *Psychiatry research*, *268*, 490-500.

Berner, L. A., Crosby, R. D., Cao, L., Engel, S. G., Lavender, J. M., Mitchell, J. E., & Wonderlich, S. A. (2017). Temporal associations between affective instability and dysregulated eating behavior in bulimia nervosa. *Journal of psychiatric research*, *92*, 183-190.

Cardi, V., Esposito, M., Clarke, A., Schifano, S., & Treasure, J. (2015). The impact of induced positive mood on symptomatic behaviour in eating disorders. An experimental, AB/BA crossover design testing a multimodal presentation during a test-meal. *Appetite*, *87*, 192-198.

Cardi, V., Leppanen, J., & Treasure, J. (2015). The effects of negative and positive mood induction on eating behaviour: A meta-analysis of laboratory studies in the healthy population and eating and weight disorders. *Neuroscience & Biobehavioral Reviews*, *57*, 299-309.

364 Cepeda-Benito, A., Gleaves, D. H., Williams, T. L., & Erath, S. A. (2000). The development and
365 validation of the state and trait food-cravings questionnaires. *Behavior Therapy*,
366 31(1), 151-173. doi:[http://dx.doi.org/10.1016/S0005-7894\(00\)80009-X](http://dx.doi.org/10.1016/S0005-7894(00)80009-X)

367 Eddy, K. T., Tabri, N., Thomas, J. J., Murray, H. B., Keshaviah, A., Hastings, E., . . . Keel, P. K.
368 (2017). Recovery From Anorexia Nervosa and Bulimia Nervosa at 22-Year Follow-Up.
369 *The Journal of clinical psychiatry*, 78(2), 184-189.

370 Evers, C., Dingemans, A., Junghans, A. F., & Boevé, A. (2018). Feeling Bad Or Feeling Good,
371 Does Emotion Affect Your Consumption of Food? A Meta-Analysis of The
372 Experimental Evidence. *Neuroscience & Biobehavioral Reviews*.

373 Fairburn, C. G., & Beglin, S. J. (1994). Assessment of eating disorders: Interview or self-
374 report questionnaire? *International Journal of Eating Disorders*, 16(4), 363-370.

375 First, M. B., Williams, J.B.W., Karg, R.S., Spitzer, R.L. (2015). Structured Clinical Interview for
376 DSM-5—Research Version (SCID-5 for DSM-5, Research Version; SCID-5-RV). In.
377 Arlington, VA.: American Psychiatric Association.

378 Fredrickson, B. L. (2001). The role of positive emotions in positive psychology: The broaden-
379 and-build theory of positive emotions. *American psychologist*, 56(3), 218.

380 Fregni, F., Orsati, F., Pedrosa, W., Fecteau, S., Tome, F. A., Nitsche, M. A., . . . Boggio, P. S.
381 (2008). Transcranial direct current stimulation of the prefrontal cortex modulates
382 the desire for specific foods. *Appetite*, 51(1), 34-41.

383 Goldschmidt, A. B., Wonderlich, S. A., Crosby, R. D., Engel, S. G., Lavender, J. M., Peterson, C.
384 B., . . . Mitchell, J. E. (2014). Ecological momentary assessment of stressful events
385 and negative affect in bulimia nervosa. *J Consult Clin Psychol*, 82(1), 30-39.
386 doi:10.1037/a0034974

387 Haedt-Matt, A. A., & Keel, P. K. (2011). Revisiting the Affect Regulation Model of Binge
388 Eating: A Meta-Analysis of Studies using Ecological Momentary Assessment.
389 *Psychological bulletin*, 137(4), 660-681. doi:10.1037/a0023660

390 Hawkins, R., & Clement, P. F. (1984). Binge eating: Measurement problems and a conceptual
391 model. In R. Hawkins, W. Fremouw, & P. Clement (Eds.), *The binge purge syndrome:
392 Diagnosis, treatment, and research* (pp. 229–251). New York: Springer.

393 Hay, P. (2013). A systematic review of evidence for psychological treatments in eating
394 disorders: 2005–2012. *International Journal of Eating Disorders*, 46(5), 462-469.

395 Lavender, J. M., Utzinger, L. M., Cao, L., Wonderlich, S. A., Engel, S. G., Mitchell, J. E., &
396 Crosby, R. D. (2016). Reciprocal Associations between Negative Affect, Binge Eating,
397 and Purging in the Natural Environment in Women with Bulimia Nervosa. *Journal of
398 abnormal psychology*, 125(3), 381-386. doi:10.1037/abn0000135

399 Leehr, E. J., Krohmer, K., Schag, K., Dresler, T., Zipfel, S., & Giel, K. E. (2015). Emotion
400 regulation model in binge eating disorder and obesity-a systematic review.
401 *Neuroscience & Biobehavioral Reviews*, 49, 125-134.

402 Lenth, R. V. (2016). Least-Squares Means: The R Package lsmeans. 2016, 69(1), 33.
403 doi:10.18637/jss.v069.i01

404 Levinson, C. A., Zerwas, S., Calebs, B., Forbush, K., Kordy, H., Watson, H., . . . Peat, C. (2017).
405 The core symptoms of bulimia nervosa, anxiety, and depression: A network analysis.
406 *Journal of abnormal psychology*, 126(3), 340.

407 Munsch, S., Meyer, A. H., Quartier, V., & Wilhelm, F. H. (2012). Binge eating in binge eating
408 disorder: A breakdown of emotion regulatory process? *Psychiatry Research*, 195(3),
409 118-124. doi:<http://dx.doi.org/10.1016/j.psychres.2011.07.016>

410 R Core Team. (2017). *R: A language and environment for statistical computing*. Vienna,
411 Austria: R Foundation for Statistical Computing.

412 Robinson, E., Haynes, A., Hardman, C. A., Kemps, E., Higgs, S., & Jones, A. (2017). The bogus
413 taste test: Validity as a measure of laboratory food intake. *Appetite*, *116*, 223-231.

414 Shah, J. (2003). Automatic for the people: How representations of significant others
415 implicitly affect goal pursuit. *Journal of personality and social psychology*, *84*(4), 661.

416 Shingleton, R. M., Thompson-Brenner, H., Thompson, D. R., Pratt, E. M., & Franko, D. L.
417 (2015). Gender differences in clinical trials of binge eating disorder: An analysis of
418 aggregated data. *Journal of consulting and clinical psychology*, *83*(2), 382.

419 Stevenson, B. L., Dvorak, R. D., Wonderlich, S. A., Crosby, R. D., & Gordon, K. H. (2018).
420 Emotions before and after loss of control eating. *Eating disorders*, 1-18.

421 Treasure, J., Cardi, V., Leppanen, J., & Turton, R. (2015). New treatment approaches for
422 severe and enduring eating disorders. *Physiology & behavior*, *152*, 456-465.

423 Treasure, J., Leslie, M., Chami, R., & Fernández - Aranda, F. (2018). Are trans diagnostic
424 models of eating disorders fit for purpose? A consideration of the evidence for food
425 addiction. *European Eating Disorders Review*, *26*(2), 83-91. doi:doi:10.1002/erv.2578

426 Udo, T., Grilo, C. M., Brownell, K. D., Weinberger, A. H., DiLeone, R. J., & McKee, S. A. (2013).
427 Modeling the effects of positive and negative mood on the ability to resist eating in
428 obese and non-obese individuals. *Eating Behaviors*, *14*(1), 40-46.
429 doi:<http://dx.doi.org/10.1016/j.eatbeh.2012.10.010>

430 Velten, E. (1968). A laboratory task for induction of mood states. *Behaviour Research and*
431 *Therapy*, *6*(4), 473-482. doi:[http://dx.doi.org/10.1016/0005-7967\(68\)90028-4](http://dx.doi.org/10.1016/0005-7967(68)90028-4)

432 Wegener, D. T., & Petty, R. E. (1994). Mood management across affective states: The
433 hedonic contingency hypothesis. *Journal of personality and social psychology*, 66(6),
434 1034.

435 Wolz, I., Granero, R., & Fernández-Aranda, F. (2017). A comprehensive model of food
436 addiction in patients with binge-eating symptomatology: The essential role of
437 negative urgency. *Comprehensive psychiatry*, 74, 118-124.

438 Yeomans, M. R., & Coughlan, E. (2009). Mood-induced eating. Interactive effects of restraint
439 and tendency to overeat. *Appetite*, 52(2), 290-298.

440 doi:<http://dx.doi.org/10.1016/j.appet.2008.10.006>

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