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**Original Article**

**Mindfulness-based Cognitive Therapy added to usual care improves eating behaviours in patients with Bulimia Nervosa and Binge Eating Disorder by decreasing the cognitive load of words related to body shape, weight and food.**

**“MBCT in BN and BED”**

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24 **ABSTRACT**

25

26 **Background:** This study aimed to investigate the effectiveness of mindfulness-based  
27 cognitive therapy (MBCT) as a complementary approach in patients with bulimia nervosa (BN) or  
28 binge eating disorder (BED), and to assess how the reduction of the cognitive load of words related  
29 to eating disorders (ED) could constitute an intermediate factor explaining its global efficacy.

30 **Methods:** Eighty-eight women and men participated in clinical assessments upon inscription,  
31 prior to and following 8-week group MBCT. Mindfulness skills were assessed using the Five Facet  
32 Mindfulness Questionnaire (FFMQ); eating behaviours were assessed using the Three Factor Eating  
33 Questionnaire (TFEQ); comorbid pathologies were assessed using the Beck Depression Index  
34 (BDI) and the State-Trait Anxiety Inventory (STAI). The cognitive load of words associated with  
35 ED was assessed through a modified version of the Stroop colour naming task.

36 **Results:** Mindfulness skills improved significantly ( $p < .05$ ) after group MBCT. The  
37 improvement of TFEQ scores was accompanied by reduced levels of depressive mood and trait  
38 anxiety. The positive impact of MBCT on TFEQ score was directly related to an improvement of  
39 the performance in the Stroop task.

40 **Conclusions:** MBCT represents an interesting complementary therapy for patients with either  
41 BN or BED, at least when cognitive and behavioural domains are concerned. Such efficacy seems  
42 to be mediated by the reduction of the cognitive load associated with ED stimuli, which offers a  
43 possible explanation of how MBCT could reduce binge-eating behaviours. Other studies are  
44 needed, in independent centres, to focus more directly on core symptoms and long-term outcome.

45

46 **Keywords:** binge eating disorder, bulimia nervosa, eating disorders, mindfulness-based  
47 cognitive therapy

48 **1. INTRODUCTION**

49 Lifetime prevalence estimates of the adult community are reported as 0.8% for bulimia  
50 nervosa (BN) and 1.4% for binge eating disorder (BED) [1]. Individuals with BN or BED lack  
51 control over their eating during binge episodes, feeling like they cannot stop eating, or cannot  
52 control the quantity of ingested food. Binge eating is defined as eating large amounts of food in a  
53 discrete period of time, coupled with a sense of loss of control over one's eating and emotional  
54 distress [2].

55 Recently, cognitive theories have been proposed to explain binge eating in terms of its  
56 antecedents, function, triggers, consequences, and maintaining factors. Despite clinically significant  
57 short-term improvements following cognitive behavioural therapy (CBT) for many individuals with  
58 BN and BED, approximately 50% of patients remain symptomatic in the long term after treatment  
59 [3]. It is suggested that a complementary therapy could be useful to treat these patients.

60 Mindfulness-based interventions are gaining increasing support as efficient approaches to  
61 encourage non-judgmental acceptance of experience [4]. Indeed, mindfulness-based treatments  
62 (MBT) emphasise skills and techniques that facilitate increased acceptance of internal experiences  
63 (i.e. thoughts, feelings, physical sensations) [5]. MBT strategies could target the cognitions that  
64 initiate and maintain disordered eating [6]. Using mindfulness in the treatment of eating disorders  
65 (ED) could help cultivate awareness of internal experiences, facilitate self-acceptance, increase  
66 cognitive flexibility, compassion and forgiveness, and generally improve one's ability to cope  
67 adaptatively with emotions [7–10]. Mindfulness-based cognitive therapy (MBCT) could thus have a  
68 positive impact on patients with ED as it tackles some of the core aspects of binge eating. Whilst  
69 just a few studies have investigated the application of mindfulness and acceptance-based  
70 approaches to disordered eating, early results are promising [5].

71 Mindfulness is a way of paying attention that is taught through the practice of meditation or  
72 other exercises. It is defined as a state of non-judgmental attention to immediate experience (such as  
73 thoughts, emotions and physical sensations) and an acceptance of moment-to-moment experience

74 [11–14]. Awareness and acceptance of transitory moment allow one to replace automatic thoughts  
75 and reactivity to events with conscious and healthier responses [15]. It encourages patients to view  
76 emotions and thoughts as transient events that do not require specific behaviours. Mindfulness  
77 practices decrease levels of negative affect [16–19]. Their effect is mediated by changes in  
78 metacognitions related to emotions and autobiographical memory [20].

79 Various forms of mindfulness-based interventions have been tested as treatments for  
80 individuals with a range of problematic eating behaviours, including emotional or stress-related  
81 eating, overeating and obesity [21]. These interventions typically consist of eight group sessions  
82 with a specific topic for each session. MBCT is an extension of Jon Kabat-Zinn's mindfulness-based  
83 stress reduction program.

84 Studies evaluating the impact of the 8-week mindfulness protocol for patients suffering from  
85 ED, and in particular BN and/or BED, are almost non-existent. Only Baer et al. [22] have explored  
86 an adaptation of MBCT for BED.

87 Cognitive load can be defined as the mental effort required for an individual to complete a  
88 task [23]. The cognitive load theory relies on the assumption that working memory is limited in  
89 capacity [24] and that performance drops when the cognitive load increases [25]. Cognitive load  
90 can be assessed with the Stroop task [23], which has been used before within the scope of eating  
91 behaviours [26,27]. In this task, subjects are asked to name the colour of words [28]. Processing of  
92 specifically salient words (such as those related to core aspects of a disorder) imposes a cognitive  
93 load that delays colour naming [29]. As a result, when words create an attentional bias, naming their  
94 colour takes longer than when words are neutral [30]. Because food- and body-related stimuli are  
95 more salient to individuals with ED [31], the Stroop task with words related to food, body shape  
96 and weight, is an interesting tool to use in this population.

97 The present study aims to investigate the effectiveness of MBCT, in addition to usual care, in  
98 patients with either BN or BED. We hypothesised that MBCT improves eating behaviours as  
99 quoted by the TFEQ. Since mindfulness should improve emotion regulation and decrease the

100 negative affect of unpleasant thoughts, we also hypothesised that MBCT decreases the cognitive  
101 load of ED-related words. Furthermore, interested in how mindfulness could translate into a higher  
102 regulation of eating behaviours, we hypothesised that the efficacy of MBCT on eating behaviours  
103 and cognitions was mediated by the reduction of the cognitive load of stressful cues.

104

105

## 106 **2. METHODS**

107 The research protocol was approved by the Ethics Committees of the hospital and the Ethical  
108 Group of the University (UFR SPSE). Each patient received a letter from the Head of the Psychiatry  
109 Department confirming the researchers involved, the objectives of the study, the clinical protocol  
110 and data anonymity prior to the signature of an informed consent form that systematically  
111 confirmed their participation. Subjects received no form of payment for participating in the  
112 research.

113

### 114 **2.1. Participants**

115 Eighty-eight patients attending a day hospital at a university hospital specialised in the  
116 treatment of ED were enrolled over a 3¾-year period between October 2014 and June 2018. Mean  
117 age on enrolment was 30.8 years (SD=8.5, range: 19-68), 88% (n=44) were female, and 75% (n=66,  
118 1 male) were diagnosed as suffering from BN. Mean body mass index (BMI) was 23.5 (SD=5.5,  
119 range: 16-40).

120 Patients were evaluated in a clinical interview with a senior psychiatrist to classify their ED  
121 based on DSM-5 criteria [2]. Subjects diagnosed with either BN or BED were included in the study.  
122 Exclusion criteria included patients diagnosed with anorexia nervosa (AN), schizophrenia, bipolar  
123 disorders or addiction. Five patients with BN had a BMI below 18.5 (but above 16.5). Nutritional  
124 interventions and treatments were allowed throughout the experiment.

125 Patients were assigned to one of six groups, containing from 9 to 12 participants. Some of  
126 them were initially placed on a waiting list (WL) prior to participating in the MBCT protocol, the  
127 waiting time for which varied from 2 to 6 months. The WL phase was not systematic in order to  
128 ensure adequate and coherent group sizes: 54% (n=33) of patients undertook the WL phase, during  
129 which they received usual care. Seventeen patients failed to complete tests and questionnaires for  
130 more than one evaluation timepoint; consequently, the final sample size was 71 patients. It was  
131 decided to include male patients from the outset, even though the proportion of the overall sample  
132 they could represent was unknown.

133

## 134 **2.2. MBCT protocol**

135 During the MBCT, in addition to usual care, patients took part in eight two-hour weekly  
136 sessions over a two-month duration. Sessions were conducted by a senior instructor and  
137 psychologist with more than 14 years of MBCT practice. The programme closely followed the  
138 standard program conceived by Segal et al. [32] but the psychoeducation was tailored to suit  
139 subjects presenting ED rather than depression. Similarly, different cognitive tools were used and the  
140 duration of the meditation practices was reduced from 45 to 30 minutes. The first phase (sessions 1  
141 to 4) focused on paying attention to the present moment by learning to observe one's mental  
142 dispersion; the second phase (sessions 5 to 8) focused on a recent problem from daily life in order to  
143 develop a different relationship with the unfavourable event and the associated emotions.

144

## 145 **2.3. Clinical assessments**

146 Tests & questionnaires were completed by patients at three timepoints: upon inscription on  
147 WL (T<sub>0</sub>), prior to group MBCT (T<sub>1</sub>), and at the end of the protocol (T<sub>2</sub>). Patients' weight and height  
148 were measured to determine their BMI (weight/height<sup>2</sup>).

149 The evolution of mindfulness skills was measured using the Five-Facets Mindfulness  
150 Questionnaire (FFMQ), a 39-item self-completed questionnaire measuring the five facets of

151 mindfulness: Observing (8 items), Describing (8 items), Acting with awareness (8 items), Non-  
152 judgmental (8 items), and Non-reactive (7 items). Items are rated on five-point Likert scales (1 =  
153 never or very rarely true, to 5 = very often or always true), each facet score ranges from 8 to 40,  
154 except for the non-reactive facet which ranges from 7 to 35. For each facet, higher scores indicate  
155 higher levels of mindfulness [33].

156 Eating behaviours were evaluated using the Three-Factor Eating Questionnaire (TFEQ), a 51-  
157 item self-assessment scale assessing three factors: Cognitive restraint (CR) (21 items), Disinhibition  
158 (16 items), and Hunger (14 items). Each item is scored either 0 or 1. Minimum scores for the three  
159 factors are 0, maximum scores 21, 16 and 14, respectively. Higher scores indicate higher levels of  
160 restrained eating, disinhibited eating and predisposition to hunger [34]. The TFEQ has psychometric  
161 support including predictive validity [35].

162 The Beck Depression Inventory (BDI) [36] and the State-Trait Anxiety Inventory (STAI) [37]  
163 were administered to assess comorbid depressive and anxiety symptoms respectively. The BDI is a  
164 21-question multiple-choice self-report inventory. Each question has four possible responses,  
165 ranging in intensity, scored from 0 to 3. Higher scores indicate more severe depressive symptoms.  
166 The STAI (form Y) is a 40-item self-evaluation questionnaire for assessing trait anxiety (20 items)  
167 and state anxiety (20 items). All items are rated on 4-point scales (e.g., from “Almost Never” to  
168 “Almost Always”). Higher scores indicate greater anxiety.

169

#### 170 **2.4. Eating disorder Stroop task**

171 Following a search of the international literature, we chose a modified version of the Stroop  
172 task published by Cooper & Todd [27], who validated the adaptation of the test to ED. A French  
173 translation of this ED-specific Stroop task was developed following consultation with the  
174 corresponding author.

175 Ten cards were generated. Each card was made up of 25 words printed on a white background  
176 in five rows of 5 words. Each word was printed in one of five colours: red, green, black, blue or



177 yellow. Each of the five stimulus words was repeated 5 times. In each block of five words, each of  
178 the five words and each of the five colours occurred once.

179 The ten cards were organised into five pairs and presented in a fully balanced design. In each  
180 pair, the target card followed the control card. The pairings were: congruent words & colours vs.  
181 incongruent words & colours; transport vs. food; household objects vs. weight; nature vs. body  
182 shape; and communication vs. depression.

183 Patients were instructed to name the colour of the ink in which each word was written as  
184 quickly as possible and to correct any errors immediately after their occurrence. The time taken to  
185 name the colour of all the words on each card was recorded using a digital stopwatch. Subsequently,  
186 the total time taken to name all neutral words (six cards: congruent colours, incongruent colours,  
187 transport, objects, nature, and communication) and all ED-related words (three cards: food, weight,  
188 and shape) were calculated.

189 The test was administered at timepoints  $T_0$ ,  $T_1$ , and  $T_2$ , following the clinical interview with  
190 the senior instructor and prior to completion of the clinical assessments.

191

## 192 **2.5. Statistical analysis**

193 All analyses, except path analyses, were performed with the PASW Statistics18 software.  
194 Normal distributions of variables were checked using Kolmogorov-Smirnov Test prior to analysis.  
195 Score changes were calculated for the WL period (difference between timepoints  $T_1$  and  $T_0$ ) and for  
196 the duration of MBCT (difference between timepoints  $T_2$  and  $T_1$ ). T-tests were performed for  
197 statistical comparison between WL and MBCT. Homogeneity of variances was confirmed using the  
198 Levene statistic. The significance level was set at  $p \leq .05$ .

199 Multivariate approaches were performed by logistic regression to evaluate the role of any  
200 potentially contaminating factors. This analysis used the condition MBCT versus WL as the  
201 dependent variable, and the following independent variables: change of TFEQ scores as the  
202 expected improvement, and changes of BDI (depression) and STAI-State (anxiety) scores as

203 potential confounders. The hypothesis was that any improvement of the TFEQ score as a parameter  
204 was independent of any improvement following MBCT, and not merely a reflection of an  
205 improvement of mood or anxiety scores.

206 Path analyses were conducted using PROCESS statistics for SPSS v3.5, to assess the direct  
207 impact of MBCT on the improvement of the TFEQ score and the mediating effect of Stroop  
208 performance.

209

210

### 211 3. RESULTS

212 After MBCT, four out of the five facets of the FFMQ showed statistically significant  
213 improvements: Observing ( $t=2.34$ ,  $p=.01$ ), Describing ( $t=1.71$ ,  $p=.05$ ), Non-judging of inner  
214 experience ( $t=1.63$ ,  $p=.05$ ), and Non-reactivity to inner experience ( $t=1.77$ ,  $p=.04$ ). The only facet  
215 not to improve significantly was Acting with awareness ( $t=1.39$ ,  $p=0.08$ ). The effect sizes were  
216 small to moderate (Table 1).

217 We observed a significant improvement in TFEQ results during MBCT, with a moderate total  
218 effect size (Table 1). The level of depressive mood and the trait condition of anxiety also  
219 significantly improved after MBCT and not so following inscription on the WL (Table 1).  
220 Furthermore, when assessing the efficacy of MBCT on TFEQ score, we observed no impact of the  
221 sessions ( $F=.259$ ,  $p=.933$ ), gender ( $t=1.196$ ,  $p=.119$ ), diagnoses ( $F=.231$ ,  $p=.633$ ), age ( $r=.01$ ,  
222  $p=.969$ ), or baseline BMI ( $r=-.075$ ,  $p=.603$ ).

223 The logistic regression analysis showed that only TFEQ improvement was significant (Wald  
224  $\chi^2=4.65$ ,  $df=1$ ,  $p=.03$ ) following MBCT, while BDI (Wald  $\chi^2=2.93$ ,  $df=1$ ,  $p=.09$ ) and state anxiety  
225 (Wald  $\chi^2=.253$ ,  $df=1$ ,  $p=.62$ ) were not.

226 In the Stroop task, reaction times for ED-related words were shortened ( $t=2.24$ ,  $p=.01$ ,  $d=.52$ )  
227 by MBCT, whereas those for neutral ( $t=.349$ ,  $p=.36$ ,  $d=.08$ ) and mood ( $t=.015$ ,  $p=.49$ ,  $d<.01$ ) words  
228 were not (Table 1).

229 The path analysis on the effect of being tested twice, before and after the WL (control  
230 intervention, Figure 1), showed no direct effect neither on TFEQ score ( $t=-.804$ ,  $p=.42$ ) nor on  
231 reaction times in the Stroop task for ED-related words ( $t=-.600$ ,  $p=.56$ ). TFEQ score was  
232 significantly predicted by reaction times ( $t=5.545$ ,  $p<.001$ ). The bootstrapping indirect effect of WL  
233 on TFEQ score improvement through Stroop performance was not significant (CI 95%  $[-5.481 -$   
234  $(+2.074)]$ ).

235 A similar path analysis performed before and after MBCT (studied intervention, Figure 2)  
236 showed no residual direct effect of MBCT on TFEQ score ( $t=-.449$ ,  $p=.65$ ) but a strong effect on  
237 reaction times in the Stroop task for ED-related words ( $t=4.231$ ,  $p=.009$ ). TFEQ score improvement  
238 was significantly mediated by the improvement of reaction times ( $F=10.227$ ,  $p<.001$ ). The  
239 bootstrapping indirect effect of MBCT on TFEQ score improvement through Stroop performance  
240 was significant (CI 95%  $[-6.811 - (-0.566)]$ ).

241 None of the preceding results were changed when the five patients with a BMI below 18.5  
242 were excluded (data not shown).

243

244

#### 245 **4. DISCUSSION**

246 The impact of MBCT was assessed on patients with either BN or BED. We found that MBCT  
247 significantly improved mindfulness, TFEQ scores and reaction times in the Stroop task. It also had  
248 a significant positive impact on depression and trait anxiety. The improvement of the three factors  
249 of ED tested by the TFEQ (dietary restriction, disinhibition, and hunger) was mediated by the  
250 reduction of reaction times in the Stroop task for words related to food, weight and shape. These  
251 results support the idea that MBCT could induce positive changes in disordered eating, such as  
252 improving eating behaviours and, in parallel and independently, the anxiety and depressive  
253 symptoms tested herein.

254 Our study confirms the few results published in literature regarding the impact of MBCT for  
255 patients with BN or BED. Previous reviews have suggested that mindfulness-based interventions  
256 are effective in reducing symptoms of ED [7,38,39] and could reduce binge episodes and  
257 dichotomous thinking, body image concern and emotional eating [7,21]. Similarly, our results  
258 concerning improvement in mindfulness, anxiety and external-based eating are consistent with  
259 those of Daubenmier et al. [40]. However, the sample tested herein is larger than the subject  
260 populations comprised in most of these studies.

261 In the original version of the Stroop task [28], subjects are asked to name the colour of colour  
262 names written in congruent or incongruent colours. This version of the task measures the ability to  
263 refrain from reading the colour name and to name the colour of the ink. In the modified version that  
264 we used [27], the difficulty does not arise from congruent or incongruent colours, but depends on  
265 the salience of the words [30]. Indeed, words related to eating disorder have an increased cognitive  
266 load, which interferes with the ability to complete the task [29]. Cooper and Todd, whose version of  
267 the Stroop test we used, reported that patients with ED took longer to colour name words related to  
268 their concerns with eating, weight and body shape than neutral words [27]. In the present study, we  
269 found that patients were faster to colour name ED-related words post-MBCT than pre-MBCT. This  
270 suggests that MBCT efficiently decreased their concerns/biases with food, weight and body shape  
271 and, by doing so, reduced the salience and the resulting cognitive load of ED-related words.

272 Impulsivity promotes binge-eating behaviours in both BN [41] and BED [42]. Mindfulness  
273 and impulsivity are generally negatively correlated; indeed, Urgency (one of the facets of  
274 impulsivity) was reported to be negatively and strongly associated with Acting with Awareness,  
275 Non-reactivity and Non-judgment [43]. MBCT could therefore reduce binge-eating behaviours by  
276 improving mindfulness and consequently decrease impulsiveness. An alternative explanation could  
277 rather propose that MBCT targets executive control and/or emotion regulation. In a study devoted  
278 to bereavement and depression, MBCT facilitated the executive control function by alleviating the  
279 emotional interferences over the cognitive functions, suggesting that the MBCT intervention

280 significantly improved both executive control and emotion regulation [44]. In the present study,  
281 however, the co-occurring improvement of mood was not involved in the improvement of eating  
282 behaviours, while we observed a significant role of the reduction of the cognitive load of ED-related  
283 words. This suggests that cognitions (inhibitory control) rather than emotions are the leverage of  
284 MBCT efficacy in ED.

285 As mindfulness-based interventions primarily aim to facilitate self-acceptance, improve the  
286 ability to cope with emotions and decrease levels of negative affect [7–10,16–19], it is not  
287 surprising that MBCT was associated with a reduction of anxiety and depressive symptoms. This  
288 constitutes another significant advantage of using MBCT as a complementary therapy in patients  
289 with ED who often suffer from depression and anxiety [45,46].

290 Our findings are in accordance with the strength model of self-regulation [47–49]. This model  
291 posits that individuals have a limited capacity to regulate certain states (e.g. affect and hunger), and  
292 can benefit from mindfulness interventions to continue to increase their capacity for self-regulation,  
293 affective stability & flexibility, coping skills and reduced reactivity toward stress-induced bulimic  
294 compulsions.

295 Four limitations should be considered in the present study.

296 First, the fact that just 54% of patients completed the WL phase prior to MBCT reduced the  
297 statistical power to detect an effect in this specific group and in the global sample. The inclusion of  
298 patients in the WL was stopped at least four weeks before the first MBCT group started, in order to  
299 ensure a sufficiently long waiting time, i.e. at least one month. This strategy was decided to reduce  
300 the negative consequences of the protocol in the treatment proposed in our centre, and reduce the  
301 risk of biases associated with the inclusion of just volunteers. Our WL multiple baseline therefore  
302 cannot be considered as random, but probably facilitated the low attrition rate (22%) that we  
303 obtained.

304 Second, WL conditions may act as a nocebo in psychotherapy trials [50], and this might be  
305 amplified by our multiple baseline. The suspicion that this might lead to different effect size

306 estimates did not form part of this study. Future research should address this weakness, notably by  
307 preplanning sensitivity analyses and performing post-hoc analyses on findings of significant  
308 differences in order to adjust for potential publication bias.

309 Third, our tests lacked an evaluation of general psychopathology. Regarding the  
310 neuropsychological assessment, we only included in our study the Stroop test, but additional  
311 measures regarding memory and executive functions would have been useful. The Stroop task has  
312 some well-known limitations, such as variable scoring methods [51], a contaminating role of  
313 optometric [52], presence of dyslexia [53] or depressive disorder [54], honesty of responses [55] or  
314 even gum-chewing [56]. Furthermore, the Stroop task probably tested variable dimensions of  
315 cognitive control [57]. Knowing that pupil size increases as task demand rises, the observation of a  
316 steep increase of pupil size when reading incongruent distractors is reassuring [58]. Likewise,  
317 finding in our sample that mood and anxiety improved independently from reaction times is also  
318 reassuring. Associating different neurocognitive tests with the Stroop task would help define the  
319 neurocognitive aspects which could explain the positive effect of MBCT in ED.

320 Fourth, path analyses attribute the impact of an intervention on one intermediate factor to  
321 explain a global effect on another. While detecting that Stroop performance mediates the  
322 improvement of the TFEQ score is interesting, these analyses do not take into account that such  
323 effect probably differs from one patient to another. In other words, MBCT probably has more  
324 obvious efficacy in specific patient subgroups, and our sample was too small to be able to define  
325 them. In the same line, the instruments used in the present protocol only reflect some aspects of

326 eating, mood and anxiety disorders, and cannot be considered representative of the large  
327 heterogeneity of patients having these disorders.

328 In conclusion, whilst the current study presents interesting findings on the role of group  
329 MBCT and its relationship with eating behaviours, future research will be important to include  
330 biological parameters and other tests of cognitive flexibility and functioning.

331

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335 **Conflicts of Interest:** The authors declare that they have no competing interests.

336 **Data availability statement:** The data that support the findings of this study are not available.

337

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**Table 1: Comparison of mindfulness capacities (FFMQ), eating behaviour (TFEQ), depressive symptoms (BDI), trait and state anxiety (STAI), and emotional reactivity (modified Stroop test for ED) in 61 patients treated for an ED following inscription on a waiting list (WL) and before & after eight weeks of group MBCT.**

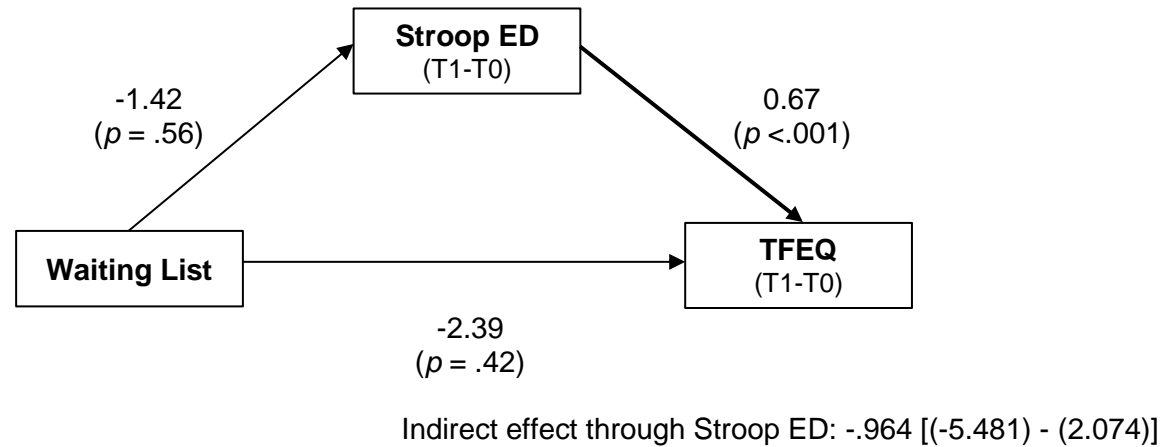
Parameters	Baseline values at study enrolment		WL		MBCT		Difference from 0 of $(T_2-T_1)-(T_1-T_0)$				
	(T <sub>0</sub> )		(T <sub>1</sub> -T <sub>0</sub> ) (N=33)		(T <sub>2</sub> -T <sub>1</sub> ) (N=52)		<i>t</i>	df	<i>p</i> -value	Cohen's d	
	Mean	SD	Mean	SD	Mean	SD					
<b>FFMQ</b>	<i>Observing</i>	22.2	6.58	-0.58	3.40	1.71	4.88	2.34	82	0.01*	0.53
	<i>Describing</i>	21.4	6.86	-0.03	3.38	1.59	4.71	1.71	82	0.05*	0.39
	<i>Awareness</i> <sup>†</sup>	22.1	6.49	-0.76	5.68	1.04	5.86	1.39	82	0.08	0.31
	<i>Non-judging</i> <sup>‡</sup>	21.3	5.88	0.00	5.23	2.27	6.79	1.63	82	0.05	0.37
	<i>Non-reactivity</i> <sup>§</sup>	12.4	3.14	0.51	2.25	1.86	4.67	1.77	82	0.04*	0.35
<b>TFEQ</b>	<i>Cognitive restraint</i>	12.1	4.66	-0.19	2.28	-1.30	2.76	1.90	82	0.06	-0.43
	<i>Disinhibition</i>	11.1	3.71	0.09	1.51	-1.00	2.76	2.31	82	0.02*	-0.46
	<i>Hunger</i>	7.2	4.27	0.56	2.44	-0.64	2.44	2.18	82	0.03*	-0.50
	<i>Total</i>	30.3	7.02	0.47	4.70	-2.92	6.02	2.72	82	0.01**	-0.61
<b>BDI</b>		11.3	4.81	-0.03	4.93	-2.50	4.92	2.55	82	0.01**	-0.51
<b>STAI-State</b>		63.2	10.90	-0.51	11.90	-3.69	12.40	1.18	82	0.18	-0.26
<b>STAI-Trait</b>		64.7	9.07	-0.39	7.11	-4.52	9.02	2.35	82	0.01*	-0.49

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<b>Stroop words</b>	<i>Congruent colours</i>	15.4	3.84	-2.48	3.71	-1.17	3.62	1.60	82	0.06	0.36
	<i>Incongruent colours</i>	25.2	10.20	-2.58	7.54	-3.66	5.08	0.72	82	0.24	-0.18
	<i>Transport</i>	18.0	5.23	-1.48	2.36	-0.74	1.98	1.50	82	0.07	0.35
	<i>Objects</i>	16.7	3.88	0.17	2.09	-1.22	2.85	2.59	82	0.01**	-0.53
	<i>Nature</i>	18.1	4.19	-0.80	2.37	-0.93	2.61	0.24	82	0.41	-0.05
	<i>Communication</i>	16.1	5.52	0.41	2.39	-0.81	2.80	2.14	82	0.02*	-0.46
	<b>All neutral words</b>	84.3	19.00	-4.18	6.91	-4.87	7.41	0.44	82	0.33	-0.10
	<i>Food</i>	17.8	3.13	-0.19	3.25	-1.50	3.04	1.86	82	0.03*	-0.43
	<i>Weight</i>	20	6.09	-1.01	3.62	-1.78	2.66	1.05	82	0.15	-0.26
	<i>Shape</i>	18.5	4.48	-0.87	2.25	-1.83	2.40	1.87	82	.03*	-0.41
	<b>All ED words</b>	56.2	13.00	-2.06	5.83	-5.11	5.84	2.35	82	.01*	-0.53
	<i>Depression-related words</i>	18.5	4.95	-0.95	2.50	-0.94	3.57	0.02	82	0.49	<0.01

Abbreviations: BMI, body-mass index; BDI, Beck depression inventory; FFMQ, five facets mindfulness questionnaire; MBCT, mindfulness-based cognitive therapy; STAI, state-trait anxiety inventory; TFEQ, three-factor eating questionnaire; WL, waiting list. \* p significant  $\leq .05$ ; \*\* p significant  $\leq .01$ ; † Acting with awareness; ‡ Non-judging of inner experience; § Non-reactivity to inner experience

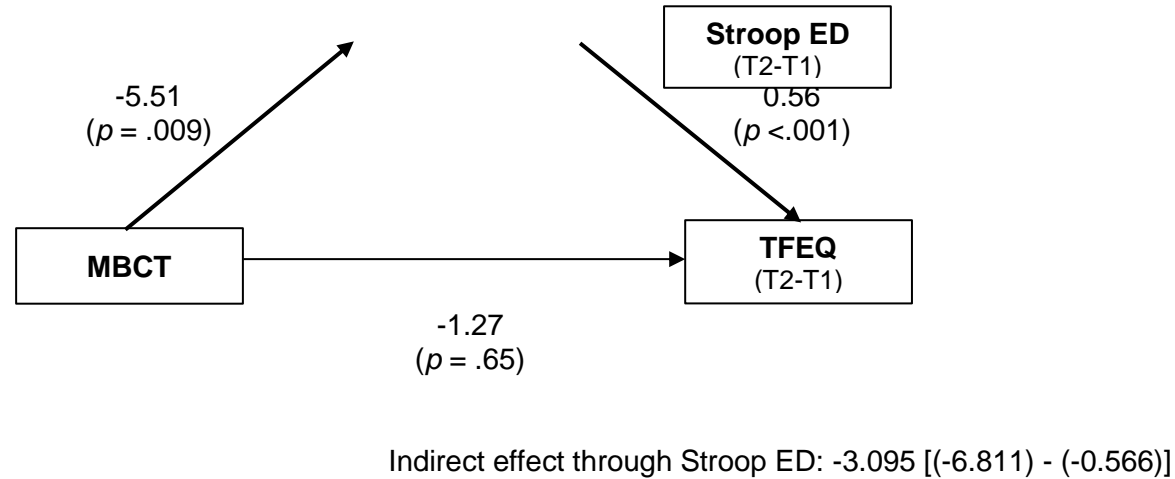
500 **Figure 1 – Path analysis of the impact of the “waiting list” on “TFEQ” score, directly, and through its impact on the “Stroop ED” test (for**  
 501 **words related to eating disorders).**



517 *Legend: Changes for both TFEQ score and performance in the emotional Stroop task associated with the waiting list correspond to the difference*  
 518 *between timepoints T0 and T1. Bold arrows indicate significant paths (p<.05). There was no direct effect of the waiting list neither on the TFEQ*  
 519 *score nor on emotional Stroop performance for ED-related words. ED symptoms improvement was significantly predicted by emotional Stroop*  
 520 *performance.*

521  
 522

Figure 2 – Path analysis of the impact of the mindfulness-based cognitive therapy (“MBCT”) on “TFEQ” score, directly, and through its impact on the “Stroop ED” test (for words related to eating disorders).



Legend: Changes for both TFEQ score and performance in the emotional Stroop task associated with MBCT correspond to the difference between timepoints T1 and T2. Bold arrows indicate significant paths ( $p < .05$ ). There was no direct effect of MBCT on the TFEQ score but a strong effect on emotional Stroop performance for ED-related words. ED symptoms improvement was significantly predicted by emotional Stroop performance.