

1 **A Serial Mediation Model of the Relationship between Alexithymia and BMI: The Role**
2 **of Negative Affect, Negative Urgency and Emotional Eating**

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26 Abstract

27 Difficulty identifying and describing emotions (alexithymia) has been related to
28 impulsiveness and negative affect, emotional eating and obesity. However, previous research
29 findings concerning the relationship between alexithymia and obesity have been mixed and
30 inconsistent, raising the possibility that the relationship is indirect and mediated by multiple
31 unknown factors. The aim of the study was to comprehensively explore the potential
32 pathways between alexithymia and obesity via a novel theoretical model, and for the first
33 time, incorporate negative affect, impulsiveness and emotional eating as potential mediating
34 factors. Two questionnaire-based studies were conducted; the first as an exploratory analysis
35 within a student sample ($N=125$), and the second as a self-replication within a more
36 representative general population sample ($N=342$). Study One revealed that difficulty
37 identifying feelings predicted Body Mass Index (BMI) both directly ($B = .1694$, $CI = .0194-$
38 $.3194$) and indirectly via impulsiveness and emotional eating ($B = .0074$, $CI = .0001-.0315$).
39 In contrast, Study Two revealed that alexithymia predicted BMI indirectly via negative affect
40 (when depression was included in the model; $B = .0335$, $CI = .0019-.0660$) or impulsiveness
41 (when anxiety was included in the model; $B = .0021$, $CI = .0001-.0066$). Our findings provide
42 partial support for the hypothesised model and offer original insight into the relationship
43 between alexithymia and obesity. Additionally, our findings highlight important
44 methodological considerations for future research and suggest that ways to address an
45 individual's ability to identify, describe and regulate emotions should be considered when
46 designing interventions to assist weight loss and management.

47

48 Keywords: Alexithymia, Emotional Dysregulation, Negative Urgency, Affect, Emotional
49 Eating, BMI

50

51 Emotional eating is commonly defined as the overconsumption of food in response to
52 negative emotions (Pinaquy, Chabrol, Simon, Louvet, & Barbe, 2003; Macht & Simons,
53 2000). Generally, individuals who self-report as emotional eaters using validated measures,
54 have been found to be at risk of weight gain from overconsumption, and in turn, increased
55 body mass index (BMI) and obesity in the long term (Finch & Tomiyama, 2015; Keonders &
56 van Strien, 2011; Kaplan & Kaplan, 1957; Sung, Lee & Song, 2009; van Strien, Herman &
57 Verheijden, 2012). However, at an individual level, the relationship may vary depending on
58 how individuals manage their eating behaviours and weight (e.g. Geliebter & Aversa, 2003).
59 Numerous theories of emotional eating have been proposed, including escaping from
60 negative affect (Heatherton & Baumeister, 1991), alleviating negative emotions (Lehman &
61 Rodin, 1989), and as a distraction mechanism (Polivy & Herman, 1999). These theories all
62 involve a maladaptive response to negative affect, and therefore, difficulties processing
63 emotions could influence the behaviour.

64 One way in which the mechanisms underpinning emotional eating can be explored is
65 through the examination of emotional dysregulation. Emotional dysregulation involves the
66 combination of emotional vulnerability and the inability to modulate emotional responses
67 (Gunderson & Zanarini, 1989; Lineham, 1993; Lineham, 1995), and is thought to encompass
68 three elements: difficulty identifying and describing emotions; the regulation of emotions,
69 and the consequent behaviours (such as emotional eating; Spence & Courbasson, 2012).
70 Despite receiving little attention in the research literature, initial evidence suggests that
71 emotional dysregulation may play an important role in eating disorders. Holliday, Uher,
72 Landau, Collier and Treasure (2006) found higher levels of emotional dysregulation in
73 women with anorexia nervosa compared to age-matched healthy controls, with similar
74 findings reported in a sample of individuals with co-morbid eating and substance misuse
75 disorders (Spence & Courbasson, 2012). Given this, it seems plausible to suggest that

76 emotional dysregulation may also play a role more broadly in eating behaviours, and
77 specifically, emotional eating. However, this has yet to be comprehensively examined or
78 explored in non-clinical samples.

79 Of particular relevance to emotional dysregulation is alexithymia, a personality trait
80 characterised by difficulty identifying feelings and distinguishing them from the somatic
81 sensations accompanying emotion (DIF), difficulty describing feelings to other people
82 (DDF), constricted imaginal processes, and a stimulus-bound, externally oriented thinking
83 style (EOT; Sifneos, 1973; Taylor, Bagby, & Parker, 1997). Alexithymia has been shown to
84 be highly prevalent in a number of medical and clinical conditions, particularly those
85 characterised by poor affect regulation and the use of maladaptive coping strategies (e.g.
86 Kang, Namkoong, Yoo, Jhung, & Kim, 2012; Shishido, Gaher, & Simons, 2013). For this
87 reason, alexithymia may also be associated with emotional eating.

88 Consistent with this, Spence and Courbasson (2012) found that difficulty identifying
89 and describing emotion was related to poor coping expectancies, which in turn, predicted
90 emotional eating. In a sample of individuals with obesity, Larsen and colleagues (2006) also
91 found higher levels of emotional eating to be associated with higher levels of alexithymia.
92 Greater levels of alexithymia have also been found in individuals with obesity and binge
93 eating disorder compared to those without, and alexithymia scores were also found to predict
94 17% of the variance in emotional eating scores, with DIF being the strongest significant
95 unique predictor (Pinaquy et al., 2003). The relationship has also been tested experimentally,
96 with higher levels of alexithymia associated with greater consumption of food following a
97 distress induction task in healthy females (van Strien & Ouwens, 2007).

98 In contrast, Noli and colleagues (2010) previously found a similar frequency of
99 emotional eating in samples of severely obese individuals with and without alexithymia.
100 However, they also found elevated levels of cognitive restraint, disinhibition and hunger in

101 those with alexithymia, suggesting the presence of some degree of disordered eating
102 behaviour in that group. It is possible that the use of an invalidated measure of emotional
103 eating and the highly specific and complex sample studied, accounts, at least in part, for these
104 mixed findings. Even so, Żak-Golab et al. (2013) also found no significant alexithymia
105 differences between participants with obesity, with or without binge eating disorder, and a
106 recent meta-analysis found increased DIF and EOT scores, but not DDF, in people with
107 obesity compared with control groups (Fernandes et al., 2018). Therefore, whilst there
108 appears to be some empirical evidence for a role of alexithymia in emotional eating and
109 obesity, findings are mixed and inconsistent across similar samples, potentially raising the
110 possibility that the relationships are mediated by multiple unknown factors which have yet to
111 be considered.

112 In light of this, our aim is to comprehensively explore the mechanisms underpinning
113 the relationship between alexithymia and emotional eating, expanding this further to explain
114 variance in BMI. Based on available evidence, we propose a novel theoretical model that
115 incorporates both negative affect and impulsivity as theoretically driven, mediating factors.
116 Firstly, emotional eating is grounded in the idea that the consumption of food follows an
117 emotional experience (van Strien, Frijters, & Bergers, 1986). Therefore, it seems logical that
118 an individual's level of general negative affect may play a role. Alexithymia has also been
119 associated with increased levels of depression and anxiety (Berardis et al., 2008), and
120 depression has been shown to be related to emotional eating in both clinical and general
121 populations (e.g. Larsen, van Strien, Eisinga, & Engels, 2006, Konttinen, Männistö, Sarlio-
122 Lähteenkorva, Silventoinen, & Haukkala, 2010). In addition, a study conducted in two
123 European countries found that emotional eating mediated the relationship between depression
124 and BMI (van Strien, Konttinen, Homberg, Engels, & Winkens, 2016). It could therefore be

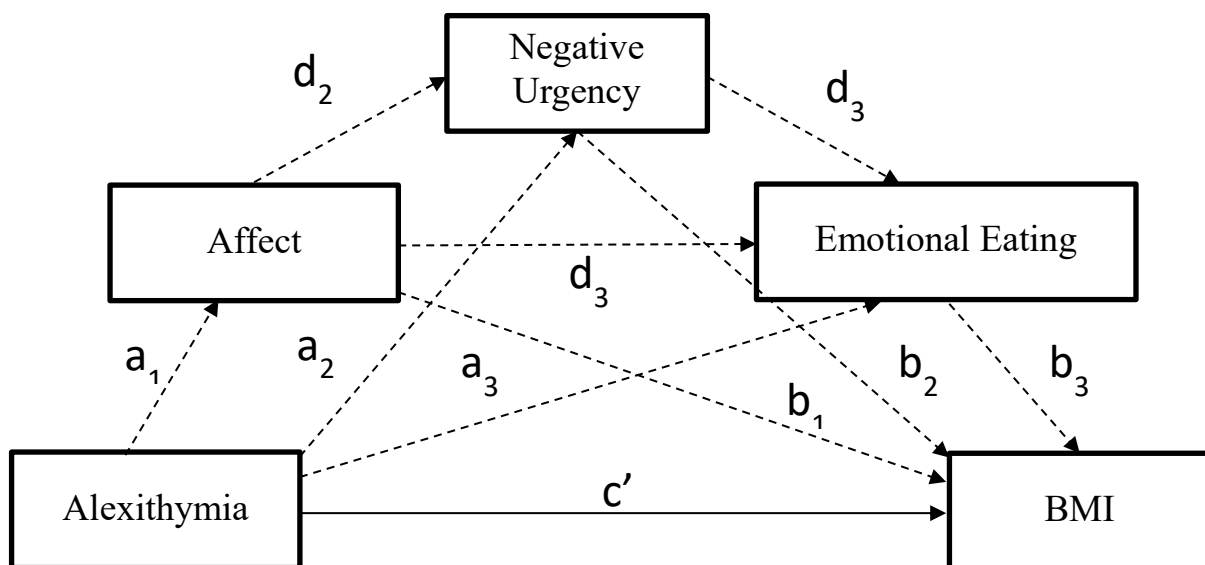
125 theorised that individuals with poor emotional regulation may be at increased risk of negative
126 affect, which in turn, may exacerbate their emotional eating.

127 Secondly, impulsive tendencies have been associated with emotional eating (Jansinka
128 et al., 2012), and specifically, negative urgency which is defined as acting rashly in response
129 to negative affect (as measured by the UPPS-P; Cyders, Smith, Spillane, Fischer, Annus, &
130 Peterson, 2007; Pike, 2013). In a sample of female twins, Racine et al. (2013) found a
131 moderate significant correlation between negative urgency and emotional eating, even after
132 controlling for the effects of negative affect. Etiological and twin model results also revealed
133 that genetic and, to a lesser extent, non-shared environmental factors accounted for this
134 relationship. Further, the genetic factors influencing negative urgency and dysregulated
135 eating were highly correlated; leading to the conclusion that negative urgency likely increases
136 the risk of developing binge and emotional eating through primarily genetic mechanisms.
137 Such findings suggest that individuals may be most at risk of engaging in emotional eating if
138 they experience elevated levels of affect and make rash decisions in response. In addition,
139 Pike (2013) reported a significant positive relationship between alexithymia and negative
140 urgency in a sample of undergraduate students, finding that both factors positively correlated
141 with emotional eating. However, negative urgency did not significantly predict emotional
142 eating or moderate its relationship with alexithymia, suggesting that the relationship is
143 complex and that other factors likely play a role.

144 To date, only one study has attempted to explore the relationship between depression
145 and emotional eating including impulsivity and the DIF facet of alexithymia as possible
146 indirect pathways (Ouwens, van Strien, & van Leeuwe, 2009). Ouwens and colleagues (2009)
147 found that DIF, impulsivity and depression were all significantly correlated with emotional
148 eating, and that depression was directly and indirectly (through DIF and impulsivity) related
149 to emotional eating. In contrast, in our model we seek to explore negative urgency as a more

150 specific facet of impulsivity, to examine negative affect in terms of both depression and
151 anxiety, and to explore the alexithymia construct as a whole, as well as its three core features.

152 In summary, we sought to conduct the first comprehensive examination of the
153 potential mediating pathways between alexithymia and BMI via a novel theoretical model.
154 Potential mediators considered were negative affect, impulsiveness and emotional eating (see
155 Figure 1). To address this in a robust manner, we conducted an exploratory analysis in a
156 student sample (Study One) and a self-replication to test the applicability of the model in a
157 more representative general population sample (Study Two). Our model (see Figure 1)
158 theorises that alexithymia is indirectly predictive of BMI. We propose that individuals who
159 have difficulty understanding their emotions (alexithymia) are vulnerable to experiencing
160 increased levels of anxiety and depression (negative affect), which may cause them to act
161 rashly in response (negative urgency) and engage in emotional eating, leading to a negative
162 impact on BMI.



169 *Figure 1.* Theoretical model of emotional eating inclusive of alexithymia, affect and
170 impulsivity.

171

172 **Study One**

173 Here we explore the model in a student sample as part of an exploratory analysis.

174 **Method**

175 **Participants**

176 The sample consisted of students drawn from Swansea University who participated
177 for course credit or volunteered in response to study adverts. Participants had to be between
178 18-65 years of age and report no history of eating, mood, addictive or substance use
179 disorders, with eligibility determined as part of the consent process. 130 participants initially
180 met these criteria. However, five participants were subsequently removed owing to a reported
181 history of eating disorders (disclosed after completion) or missing height and weight data
182 which meant BMI could not be calculated.

183 Of the remaining 125 participants, 107 (85.60%) were female and the mean
184 age of the sample was 20.85 years of age (*SD* = 3.06, range = 18.27 – 36.87 years). 115
185 (92.00%) participants were single, with the remaining 10 (8.00%) co-habiting. Participants
186 had spent an average of 14.30 years in education (*SD* = .92, range 12 - 18 years) and 90.40%
187 (*n* = 113) reported their ethnic background as White. Remaining participants reported their
188 ethnic backgrounds as Asian (*n* = 3, 2.4%), Black (*n* = 2, 1.6%), Mixed (*n* = 6, 4.8%) and
189 other (*n* = 1, 0.8%). Mean BMI was 23.99 (*SD* = 4.34) with values ranging from 16.84 to
190 41.21 kg/m².

191

192 **Measures**

193 **Demographics.** Participants provided their date of birth, sex, marital/relationship
194 status, ethnicity and years spent in education.

195 **Toronto Alexithymia Scale** (TAS-20; Bagby, Parker, & Taylor, 1994; Bagby, Taylor,
196 & Parker, 1994): Regarded as the gold-standard method of assessing alexithymia, the TAS-20
197 consists of 20 items measuring three facets of alexithymia: difficulty identifying feelings
198 (DIF; e.g. “*I am often confused about what emotion I am feeling*”), difficulty describing
199 feelings (DDF; e.g. “*It is difficult for me to find the right words for my feelings*”), and
200 externally-oriented thinking (EOT; e.g. “*Being in touch with emotions is essential*”).
201 Participants indicate their responses by selecting the answer that best describes them on a 5-
202 point scale (*1* = strongly disagree to *5* = strongly agree). The three subscales (DIF, DDF,
203 EOT) are combined to generate a total TAS-20 alexithymia score which can be used to
204 determine the presence or absence of alexithymia. Scores ≥ 61 indicate the presence of
205 alexithymia, scores of 52-60 indicate ‘possible’ alexithymia and scores ≤ 51 indicate the
206 absence of alexithymia (Taylor, Bagby, & Parker, 1992). The TAS-20 has good levels of
207 validity (Bagby, Taylor, et al., 1994) and in line with previous research (Bagby, Parker, et al.,
208 1994; Pinaquy et al., 2003), internal consistency was found to be high in the current study (α
209 = .84). High levels of internal consistency were also found for the DIF ($\alpha = .83$) and DDF (α
210 = .80) subscales. Consistent with previously reported levels (Larsen et al., 2006; Pike, 2013;
211 Pinaquy et al., 2003), internal consistency of the EOT subscale was much lower ($\alpha = .55$).

212 **UPPS-P Impulsivity Behaviour Scale** (UPPS-P; Cyders et al., 2007; Whiteside &
213 Lynam, 2001): The (negative) urgency, (lack of) premeditation, (lack of) perseverance,
214 sensation seeking and positive urgency measure of impulsivity. However, the current study
215 only reports data from the negative urgency subscale (NU, 12 items; e.g. “*When I feel bad, I*
216 *will often do things I later regret in order to make myself feel better now*”). Participants
217 respond on a four-point Likert type scale (*1* = agree strong to *4* = disagree strongly), with

218 higher scores indicating greater impulsive tendencies. The Cronbach's alpha for the NU
219 subscale was $\alpha = .87$, and whilst other measures of impulsivity are available, the UPPS-P was
220 chosen as it has a specific measure of NU.

221 ***Beck Depression Inventory – II*** (BDI; Beck, Ward, Mendelson, Mock, & Erruagh,
222 1961; Beck, Steer, & Carbin, 1988; Beck, Steer, & Brown, 1996): The BDI is the most
223 commonly used measure of depression, consisting of 21 items that assess the severity of
224 depressive symptoms experienced in the last two weeks. Respondents choose an answer that
225 best describes them on a four-point Likert-type scale (0 = not at all, no change to 3 =
226 increase/decrease in symptom) with statements referring to “*sadness*,” “*pessimism*,” and
227 “*past failure*,” as examples. The maximum score on the BDI is 63, with scores between 0-13
228 indicating the presence of minimal depression, 14-19 mild depression, 20-28 moderate
229 depression, and 29-63 severe depression (Wood, Williams, & Lewis, 2010). Internal
230 consistency was found to be high ($\alpha = .90$) within the current study.

231 ***Beck Anxiety Inventory*** (BAI; Beck, Epstein, Brown, & Steer, 1988): Consisting of
232 21-items, the BAI asks participants to rate how much they have been bothered by emotional,
233 physiological, and cognitive symptoms of anxiety in the last week. Participants respond by
234 selecting the answer that best describes them on a four-point Likert-type scale (0 = not at all
235 to 3 = severely). Total scores range between 0-63, with scores between 0-9 indicating the
236 absence of anxiety, 10-18 mild to moderate anxiety; 19-29 moderate to severe anxiety, and
237 30-63 severe anxiety (Beck, & Steer, 1990). The BAI was specifically chosen over other
238 measures as it has excellent psychometric properties and is widely used in both research and
239 clinical practice (Beck, Epstein et al., 1988). In line with previous research (Beck, Epstein, et
240 al., 1998), internal consistency was high ($\alpha = .91$).

241 **Three Factor Eating Questionnaire Revised - 18** (TFEQ-R18; Karlsson, Persson,
242 Sjöström, & Sullivan, 2000): The TFEQ is a revised shortened revision of the TFEQ
243 (Stunkard & Messick, 1985). Previous dichotomous responses were replaced with Likert type
244 scales as the former were found to be restricting. Participants respond by selecting the answer
245 that best describes them on a 4-point Likert type scale (1 = definitely true to 4 = definitely
246 false). The TFEQ-R18 consists of three subscales: cognitive restraint (e.g. “*I do not eat some*
247 *foods because they make me fat*”); uncontrolled eating (e.g. “*I get so hungry that my stomach*
248 *often seems like a bottomless pit*”), and emotional eating (e.g. “*When I feel anxious, I find*
249 *myself eating*”). 13 items are reversed scored and higher total scores are indicative of greater
250 levels of cognitive restraint, uncontrollable eating and emotional eating. Although developed
251 in an obese population, the TFEQ-R18 has been found to valid within general population
252 samples and to have satisfactory levels of internal consistency (de Lauzon, et al., 2004). In
253 the current study, the following Cronbach’s alphas were found: cognitive restraint ($\alpha = .86$),
254 uncontrollable eating ($\alpha = .88$), and emotional eating ($\alpha = .85$). The TFEQ was selected to
255 allow the inclusion of cognitive restraint and uncontrolled eating scores as control variables
256 in the serial multivariate mediation analyses.

257 **Emotional Eating Scale** (EES; Arnow, Kernady, & Agras, 1995): The EES is a 25 self-report
258 measure to explore the urge to eat in response to a number of emotions (e.g. “*Lonely*” and
259 “*Angry*”). Participants respond by selecting the answer that best describes them on a five-
260 point scale (1 = no desire to eat, to 5 = an overwhelming urge to eat). In addition to an EES
261 total score, subscale scores can be calculated for anger/frustration, anxiety, and depression.
262 The EES demonstrated adequate to excellent levels of internal consistency (range $\alpha = .75$ -
263 $.93$), and although initially created within a clinical population, it has been used extensively
264 in general population samples (e.g. Price, Higgs, & Lee, 2015; Moon & Berenbaum, 2009).
265 The EES was favoured over alternative measures of emotional eating (i.e., Dutch Eating

266 Behaviour Questionnaire; van Strien et al., 1986) as it captures eating in response to a wide
267 range of negative emotions.

268 **Body Mass Index** (BMI); obtained by taking a measurement of height using a
269 stadiometer in metres and three readings of weight to gain an average using WW digital
270 scales in kilograms. The BMI value was calculated using the following equation in excel
271 ($\text{weight (kg)} / (\text{height (m)}^2)$).

272 **Procedure**

273 Ethical approval was obtained from the Department of Psychology Research Ethics
274 Committee, College of Human and Health Sciences, Swansea University. Participants were
275 presented with a detailed information sheet before providing written informed consent to
276 partake. All participants also completed a delayed discounting task which was part of a larger
277 study, although data from this task is not reported here. Participants were then instructed to
278 work through the self-reported questionnaires presented to them via Survey Monkey (Palo
279 Alto, California, USA). Upon completion, weight and height measurements were taken so
280 BMI could be calculated. The study lasted for approximately 30 minutes and participants
281 were thanked for their time upon completion.

282 **Data Analysis**

283 All statistical analyses were carried out using IBM SPSS Statistics 22.0 and
284 PROCESS 2.16.3 (Hayes, 2013). Preliminary analysis examined the presence of outliers and
285 the assumptions of normality were met. In terms of statistical analyses employed, Pearson
286 correlations were used to investigate the associations between measures and PROCESS was
287 used to test our theorised models. PROCESS was used as significant associations between

288 variables are not needed and bootstrapping reduces type 1 error. Finally, all variables
289 (including TAS-20, BDI and BAI) were treated as continuous variables.

290 *Serial multivariate mediation analyses.*

291 A series of exploratory serial multiple mediation models (Hayes, 2013) were
292 conducted. 16 models were analysis for direct and specific indirect effects (see Table 1). A
293 direct effect (c') is the relationship between X and Y controlling for all mediators, and a
294 specific indirect effect (e.g. a_1b_1 , $a_1d_{21}b_2$) is the relationship between X and Y via a particular
295 mediator or mediators. Using Model 1 (see Table 1) and Figure 1, the direct and indirect
296 effects analysed can be demonstrated. Total alexithymia scores were entered as the predictor
297 variable (X) and BMI scores as the outcome variable (Y). Multiple mediators were then
298 entered in the following order; negative affect, impulsivity (negative urgency) and emotional
299 eating, e.g. Model 1; $BDI \rightarrow NU \rightarrow TFEQ-EE$. This created and tested the following indirect
300 pathways; via BDI alone (a_1b_1), via BDI and NU ($a_1d_{21}b_2$), via NU only (a_2b_2), via NU and
301 TFEQ-EE ($a_2d_{32}b_3$), via BDI and TFEQ-EE ($a_1d_{31}b_3$), via TFEQ-EE only (a_3b_3) and finally
302 via BDI, NU and TFEQ-EE ($a_1d_{21}d_{32}b_3$). The remaining models followed this structure
303 substituting the TAS-20 subscales for X , BAI for affect at M_1 and emotional eating as
304 measured by EES at M_3 . Mediating variables are also controlled for in indirect effects. 95%
305 bias-corrected confidence intervals based on 10,000 bootstrap samples were calculated.
306 Finally, as age, gender, uncontrolled eating and cognitive restraint have all been correlated
307 with emotional eating and BMI (e.g. Koenders & van Strien, 2011; Larsen et al., 2006; Lluch,
308 Herbeth, Méjean & Siest, 2000); these variables were controlled for in all models (e.g.
309 younger participants may have a lower BMI compared to older subjects simply because not
310 enough time has passed since the onset of emotional eating behaviours, rather than reflecting
311 the influence of predictor variables).

312 Table 1. The serial multivariate mediation pathways tested.

Model	Pathway tested
1	TAS-20→BDI→NU →TFEQ-EE →BMI
2	DIF→BDI→NU→TFEQ-EE →BMI
3	DDF→BDI→NU→ TFEQ-EE →BMI
4	EOT→BDI→NU →TFEQ-EE →BMI
5	TAS-20→BDI→NU →EES→BMI
6	DIF→BDI→NU →EES→BMI
7	DDF→BDI→NU →EES→BMI
8	EOT→BDI→NU →EES→BMI
9	TAS-20→BAI→NU →TFEQ-EE →BMI
10	DIF→BAI→NU →TFEQ-EE →BMI
11	DDF→BAI→NU →TFEQ-EE →BMI
12	EOT→BAI→NU →TFEQ-EE →BMI
13	TAS-20→BAI→NU →EES→BMI
14	DIF→BAI→NU →EES→BMI
15	DDF→BAI→NU →EES→BMI
16	EOT→BAI→NU →EES→BMI

313 BMI = body mass index, DIF = difficulty identifying feelings, DDF = difficulty describing
 314 feelings, EOT = externally oriented thinking, TAS-20 = total alexithymia scores, NU =
 315 negative urgency, BDI = Beck depression inventory, BAI = Beck anxiety inventory, EES =
 316 total emotional eating scale, TFEQ-EE = emotional eating subscale from the TFEQ.
 317

318 Results

319 Descriptives

320 Mean total scores were as follows: TAS-20: $M = 45.51$, $SD = 11.33$; NU: $M = 28.26$;
 321 $SD = 7.01$; EES: $M = 48.60$, $SD = 16.41$; TFEQ: $M = 42.58$, $SD = 29.15$; BDI: $M = 10.14$, SD
 322 $= 8.08$, and BAI: $M = 10.10$; $SD = 9.49$). In addition, levels of alexithymia were consistent
 323 with previously reported (Bagby, Parker et al., 1994; Salminen, Saarijärvi, Äärelä, Toikka, &
 324 Kauhanen, 1999) rates in general population samples (Alexithymia: $n = 13$, 10.4%; possible

alexithymia: $n = 23$, 18.4%; no alexithymia: $n = 89$, 71.2%), and the majority of the sample reported minimal levels of depression (minimal/no depression: $n = 91$, 72.8%; mild: $n = 18$, 14.4%; moderate: $n = 10$, 8.0%; severe: $n = 6$, 4.8%) and anxiety (minimal/no anxiety: $n = 78$, 62.4%; mild: $n = 26$, 20.8%; moderate: $n = 14$, 11.2%; severe: $n = 7$, 5.6%).

Correlation Analysis

Pearson’s correlations were conducted to initially explore the relationships between alexithymia, negative urgency, negative affect, emotional eating and BMI. Significant positive correlations were found between EES total scores and TAS-20 total scores ($r = .176$, $p = .049$) and DIF subscale scores ($r = .203$, $p = .024$; see Table 2). The negative urgency facet was also significantly positively correlated with EES total scores ($r = .385$, $p \leq .001$), and similar results were found for the emotional eating subscale of the TFEQ ($r = .380$, $p \leq .001$). Significant positive correlations were also found between BDI, BAI and emotional eating scores as measured by the EES and TFEQ-EE (see Table 2). There was no significant correlation between BMI and any of the other variables. When applying Bonferroni’s correction ($p < .0011$) several relationships between emotional eating, alexithymia, negative urgency and negative affect remained significant (see Table 2).

Table 2. Pearson’s correlations of all study variables for the Study One.

	1.	2.	3.	4.	5.	6.	7.	8.	9.
1. DIF	-								
2. DDF	.638***	-							
3. EOT	.270**	.331***	-						
4. TAS Total	.853***	.849***	.631***	-					

5. NU	.422***	.234**	.102	.341**	-				
				*					
6. BDI Total	.529***	.397***	.037	.438**	.379**	-			
				*	*				
7. BAI Total	.437***	.308***	.116	.384**	.304**	.639**	-		
				*	*	*			
8. EES Total	.203*	.085	.115	.176*	.385**	.265**	.271**	-	
					*				
9. TFEQ -EE	.074	.018	.090	.076	.328**	.069	-.037	.588***	-
					*				
10. BMI	.151	.078	-	.083	.077	.065	.144	.150	.138
			.067						

342

343 DIF = difficulty identifying feelings, DDF = difficulty describing feelings, EOT = externally
344 oriented thinking, TAS-20 = total alexithymia scores, NU = negative urgency, BDI
345 = Beck depression inventory, BAI = Beck anxiety inventory, EES = total emotional eating
346 scale, TFEQ-EE = emotional eating subscale from the TFEQ, BMI = body mass index.
347 *= $p < .05$, ** = $p < .01$, *** = $p \leq .001$

348

349 Serial Mediation Models

350 **Depression.** The PROCESS macro was used to analyse the models presented in Table

351 1. Model 1 revealed no significant direct effect between alexithymia and BMI, but a
352 significant specific indirect effect approached significance, via BDI, NU, and TFEQ-EE
353 ($a_1d_{21}d_{32}b_3$), $B = .0009$, $CI = .0000-.0059$. Hayes (2013) states that confidence intervals must
354 not contain 0 for an effect to be significant. Running the model with emotional eating, as
355 measured by EES at M_3 , revealed a similar pattern of results (Model 5). Model 2, DIF entered
356 as X, showed a significant direct effect (c'), $B = .1694$, $CI = .0194-.3194$ and one significant
357 specific indirect effect via NU and TFEQ-EE ($a_2d_{31}b_3$), $B = .0074$, $CI = .0001-.0315$. A
358 second effect, via BDI, NU and TFEQ-EE ($a_1d_{21}d_{32}b_3$), $B = .0021$, $CI = .0000-.0129$,
359 approached significance. When entering EES at M_3 , Model 6 revealed a significant direct
360 effect (c'), $B = .1608$, $CI = .0107-.3109$ and a specific indirect effect via BDI, NU and EES
361 ($a_1d_{21}d_{32}b_3$), $B = .0016$, $CI = .0000-.0103$ approached significance. There were no significant
362 direct or indirect effects for models 3, 4, 7 and 8.

363 *Anxiety*. Analysis of model 9, entering BAI at M_1 , found no significant direct effect
364 between TAS-20 total scores and BMI. However, a significant specific indirect effect was
365 found, via NU and TFEQ-EE ($a_2d_{31}b_3$), $B = .0034$, $CI = .0002-.013$. A second indirect effect
366 approached significance, via BAI, NU and TFEQ-EE ($a_1d_{21}d_{32}b_3$), $B = .0008$, $CI = .0000-$
367 $.0051$. Model 10, with DIF entered as X , revealed one significant indirect effect via NU and
368 TFEQ-EE ($a_2d_{32}b_3$), $B = .0102$, $CI = .0009-.0353$. Model 11, including DDF as X , had no
369 significant direct effect but three significant specific indirect effects. The first via BAI (a_1b_1),
370 $B = .0427$, $CI = .0014-.1162$, the second via BAI, NU, and TFEQ-EE ($a_1d_{21}d_{32}b_3$), $B = .0019$,
371 $CI = .0001-.0119$, and the third via NU and TFEQ-EE ($a_2d_{31}b_3$), $B = .0052$, $CI = .0001-.0243$.
372 Contrast analysis revealed the effects via BAI only was significantly stronger than via BAI,
373 NU and TFEQ-EE ($B = .0408$, $CI = .0003-.1118$), with no difference between the latter and
374 the effect via NU and TFEQ-EE. Models 12-16 did not reveal any significant direct or
375 indirect effects between total and subscale scores of the TAS-20 (X) and BMI (Y).

376

377

Discussion

378 In our exploratory analysis of a student sample we found a significant direct effect of
379 the difficulty identifying feelings subscale on BMI. Furthermore, a specific indirect effect
380 suggests that difficulty identifying feelings can lead to an increased tendency to react rashly
381 to negative affect (negative urgency), exacerbating emotional eating which could lead to an
382 increased BMI.

383 When anxiety scores were included in the model, an indirect effect via negative
384 urgency and emotional eating was found for total alexithymia scores and the difficulty
385 identifying subscale, but only for emotional eating as measured by the TFEQ. The role of
386 difficulty describing feelings appears to be stronger when anxiety is included in the model as

387 three indirect effects were found to be significant. These effects were through the following
388 pathways: via increased anxiety scores only; via increased negative urgency and emotional
389 eating, and via increased anxiety, negative urgency and emotional eating. Contrast analysis
390 revealed that the indirect pathway via increased anxiety scores was the strongest.

391 **Study Two**

392 Study Two sought to re-examine the relationships between alexithymia, negative
393 affect, negative urgency, emotional eating and BMI, and to test the applicability of the
394 significant models in Study One in a more representative general population sample. On the
395 basis of our previous findings, significant positive correlations were predicted between
396 alexithymia, negative affect, emotional eating and negative urgency. In addition, similar
397 indirect and direct effects between DIF and BMI were expected to emerge when depression
398 was included in the models. In contrast, we expected DDF to have a significant indirect effect
399 on BMI via multiple pathways (e.g. via anxiety alone; via negative urgency and emotional
400 eating) when anxiety was included in the models.

401

402 **Methods**

403 **Participants**

404 Invitations to take part in an online study were advertised on social media and via
405 Swansea University's online platforms. As with Study One, participants had to be between
406 18-65 years of age and report no history of eating, mood, addictive, or substance misuse
407 disorders, with eligibility determined as part of the consent process. 651 participants initially
408 accessed the survey, although data for 309 participants was subsequently removed because of
409 missing, inaccurate or incomplete data (e.g. non-completers), or because of failure to provide

410 full consent and/or meet eligibility criteria. Of the remaining 342 participants, mean age was
411 32.36 years old ($SD = 11.38$, range = 18.20-64.13). 279 (81.6%) were female and the
412 majority ($n = 315$, 92.1%) reported their ethnicity as white, with other ethnicities reported
413 being Asian ($n = 7$, 2%), Black ($n = 5$, .9%), Chinese ($n = 2$, .6%), Mixed ($n = 8$, 2.3%) and
414 other, or preferred not to say ($n = 7$, 2%). BMI ranged from 16.33-48.10 with an average of
415 25.94 ($SD = 5.51$).

416 **Measures**

417 The same measures as Study One were employed. However, as this was an online
418 study, BMI was calculated from self-reported height and weight.

419 **Procedure**

420 Ethical approval was obtained from the Department of Psychology Ethics Committee,
421 College of Human and Health Sciences, Swansea University. Participants completed the
422 study online via Survey Monkey (Palo Alto, California, USA) in their own time. Participants
423 were presented with an information page and upon providing full consent on screen, were
424 asked to answer standard demographic questions followed by the TAS-20, BDI, BAI, UPPS-
425 P, EES and TFEQ. Participants were also asked for their height and weight and were
426 provided with conversion details to report both in metric format. If participants wanted to
427 withdraw at any time they could do so by closing the web browser. Upon completion,
428 participants were presented with a debrief page and were thanked for their time.

429 **Data Analysis**

430 Statistical analysis was carried out using SPSS 22.0 and PROCESS 2.16.3 (Hayes,
431 2013). As all variables were normally distributed, Pearson's correlation analysis was
432 performed. Serial mediation analysis was conducted and as per Study One, age, gender,

433 uncontrolled eating and cognitive restraint scores were controlled for in all models. In
434 addition, all variables were included in the models as continuous variables.

435

436 **Results**

437 **Descriptives**

438 Mean total scores were as follows: TAS-20: $M = 46.84$, $SD = 13.33$; NU: $M = 9.42$;
439 $SD = 7.44$; EES: $M = 50.88$, $SD = 19.79$; TFEQ: $M = 57.76$, $SD = 22.31$; BDI: $M = 10.66$, SD
440 $= 9.77$, and BAI: $M = 10.66$; $SD = 9.49$). The majority of the sample reported an absence of
441 clinically relevant alexithymia (Alexithymia: $n = 61$, 17.8%; possible alexithymia: $n = 61$,
442 17.8%; no alexithymia: $n = 220$, 64.3%), and minimal levels of depression (minimal/no
443 depression: $n = 213$, 62.3%; mild: $n = 49$, 14.3%; moderate: $n = 49$, 14.3%; severe: $n = 31$,
444 9.1%) and anxiety (minimal/no anxiety: $n = 200$, 58.5%; mild: $n = 75$, 21.9%; moderate: $n =$
445 48, 14.0%; severe: $n = 19$, 5.6%).

446

447 **Correlation Analysis**

448 Pearson's correlations showed that TAS-20 total, DIF and DDF scores were
449 significantly positively correlated with emotional eating as measured by the EES and the
450 TFEQ (see Table 3). Negative urgency was positively and significantly correlated with
451 emotional eating; EES: $r = .350$, $p < .001$ and TFEQ: $r = .324$, $p < .001$. There was also a
452 positive significant relationship between BDI scores and emotional eating as measured by
453 both the EES and TFEQ (see Table 3). BAI scores were only significantly related to EES
454 total scores. BMI scores were not significantly related to alexithymia but were weakly
455 correlated with negative urgency ($r = .152$, $p = .005$) and emotional eating (EES: $r = .212$, $p <$

456 .001, TFEQ: $r = .2, p < .001$). Several relationships remained significant after applying a
 457 Bonferroni adjusted alpha of $p = .0011$ (See Table 3).

458

459 Table 3. Pearson's correlations of all study variables for the Study Two.

	1.	2.	3.	4.	5.	6.	7.	8.	9.
1. DIF	-								
2. DDF	.706* **	-							
3. EOT	.275* **	.453** *	-						
4. TAS-20 Total	.858* **	.887** *	.670** *	-					
5. NU	.524* **	.396** *	.214** *	.485** *	-				
6. BDI Total	.645* **	.516** *	.213** *	.589** *	.544** *	-			
7. BAI Total	.553* **	.396** *	.118* *	.464** *	.354** *	.699** *	-		
8. EES Total	.265* **	.174** *	.058 *	.217** *	.350** *	.317** *	.241** *	-	
9. TFEQ-EE	.180* **	.218* *	-.004 *	.135* *	.324** *	.219** *	.093 *	.608** *	-
10. BMI	.050	-.025	-.002	.016	.152**	.130*	-.016	.212** *	.200** *

460 DIF = difficulty identifying feelings, DDF = difficulty describing feelings, EOT = externally
 461 oriented thinking, TAS-20 = total alexithymia scores, NU = negative urgency, BDI = Beck
 462 depression inventory, BAI = Beck anxiety inventory, EES = total emotional eating scale,
 463 TFEQ-EE = emotional eating subscale from the TFEQ, BMI = body mass index.

464 * = $p < .05$, ** = $p < .01$, *** = $p \leq .001$

465

466 Serial Mediation Models

467 **Depression.** The models presented in Table 1 were also tested in Study Two. Model 1
 468 revealed no significant direct effects between total TAS-20 scores and BMI, but a significant
 469 specific indirect effect was found via BDI scores (a_1b_1), $B = .0335, CI = .0019-.0660$. Models
 470 2, 3 and 4 also showed the same specific indirect pathway via BDI (a_1b_1), model 2: $B =$

471 .0795, $CI = .0103-.1531$, model 3: $B = .0786$, $CI = .0097-.1518$, model 4: $B = .0214$, $CI =$
472 $.0008-.0609$. A similar pattern of results was found when emotional eating scores (EES) were
473 entered (models 5-7). A significant specific indirect effect was found via BDI scores (a_1b_1):
474 Model 5: $B = .0317$, $CI = .0011-.0649$; Model 6: $B = .0756$, $CI = .0093-.1481$, and Model 7:
475 $B = .0734$, $CI = .0062-.1472$). There were no significant direct or indirect pathways in model
476 8.

477 **Anxiety.** BAI scores were then entered as the measure of affect at M_1 for models 9-16.
478 Model 9 found no significant direct pathway but a significant specific indirect pathway via
479 BAI and NU, ($a_1d_2b_2$), $B = .0021$, $CI = .0001-.0066$. There was no significant direct or
480 indirect effect for Model 10. There were two significant specific indirect pathways for Model
481 11, via BAI and NU ($a_1d_2b_2$), $B = .0072$, $CI = .0008-.0189$, and via NU (a_2b_2), $B = .0341$, CI
482 $= .0019-.0787$. Contrast analysis revealed that the effect between these two indirect effects
483 was significant and the indirect effect via NU was the strongest, ($B = .0269$, $CI = -.0693- -$
484 $.0023$). Model 12 revealed a significant indirect effect via NU (a_2b_2), $B = .0007$, $CI = .0004-$
485 $.0446$ and a second approached significance, via BAI, NU and TFEQ-EE ($a_1d_2d_3b_3$), $B =$
486 $.0001$, $CI = .0000-.0012$. When entering EES at M_3 , a similar pattern of results to TFEQ-EE
487 were found.

488 **Discussion**

489 Our analysis revealed that when depression was included in the model, depression
490 significantly mediated the effect of alexithymia on BMI. This remained significant when the
491 DIF, DDF and EOT subscales of the TAS-20 were entered as the predictor variables. When
492 including anxiety scores in the model, the indirect effect via negative urgency was the
493 strongest mediating factor between alexithymia and BMI scores.

494 **General Discussion**

495 We aimed to further understand the role of alexithymia as an explanatory mechanism
496 in emotional eating, and in turn, BMI. Guided by previous literature, we put forward a novel
497 theoretical model suggesting that alexithymia is indirectly associated with BMI through
498 negative affect (anxiety and depression examined separately), impulsivity (negative urgency)
499 and emotional eating (see Figure 1). Specifically, we proposed that alexithymia would be
500 associated with greater levels of negative affect, leading individuals to act rashly in response
501 (negative urgency) to avoid the associated sensations and to engage in emotional eating,
502 leading to an increased BMI. Initially we tested our model in a student sample (Study One)
503 before completing a self-replication to test the applicability of the model in a more
504 representative general population sample (Study Two).

505 Within our student sample we identified several significant pathways between
506 alexithymia and BMI. For models defining negative affect as depression, there was a direct
507 effect between difficulty identifying feelings (DIF) and BMI, and an indirect effect through
508 increased levels of depression, negative urgency and emotional eating. For models defining
509 negative affect as anxiety, we found that difficulty describing feelings (DDF) indirectly
510 predicted BMI through anxiety alone, but also through anxiety, negative urgency and
511 emotional eating. In addition, indirect effects through negative urgency and emotional eating
512 were found for total alexithymia DIF and DDF scores. In contrast, two main pathways were
513 identified in our general population sample (Study Two). When negative affect was defined
514 as depression, it mediated the relationship between total and subscale scores of alexithymia
515 and BMI. In contrast, when negative affect was defined as anxiety, negative urgency
516 significantly mediated the pathway between DDF, externally oriented thinking (EOT) and
517 BMI.

518 First, it appears that the pathways between alexithymia and BMI seem to differ
519 depending on whether negative affect is represented by anxiety or depression. This is not

520 entirely surprising, as even though alexithymia is related to negative affect overall (Suslow &
521 Donges, 2017), its relationship with anxiety and depression is thought to differ (Hendryx,
522 Haviland, & Shaw, 1991; Marchesi, Brusamonti, & Maggini, 2000). For example, Eizaguirre
523 and colleagues (2004) found that depression was a significant predictor of alexithymia total
524 and subscale scores in individuals with eating disorders, whereas anxiety was only a predictor
525 of total alexithymia and DIF subscale scores when combined with depression. This indicates
526 that depression may have stronger associations with alexithymia, which is supported by our
527 findings and is consistent with the view that depression and alexithymia may be overlapping
528 constructs (Marchesi et al., 2000; Honkalampi, Hintikka, Laukkanen, & Viiamäki, 2001;
529 Corcos et al., 2000; Parker, Bagby, & Taylor, 1991). In support of this argument, Torres and
530 colleagues (2015) previously highlighted how both constructs share multiple characteristics,
531 including negative affect (Mattila et al., 2008), decreased ability to communicate affect to
532 other people (Saarijarvi et al., 2001), problems with interpersonal communication (Mattila et
533 al., 2008), and lack of emotional clarity (Rude & McCarthy, 2003). Our findings also
534 reinforce the view that depression and anxiety should always be considered as distinct
535 emotional states within eating behaviour research. For example, Goossens and colleagues
536 (2009) argued that eating in response to anxiety reduces hyper arousal, whereas eating in
537 response to depression increases positive mood. Studies have also suggested that emotional
538 or binge eating may serve to reduce anxiety but may increase depression (Haedt-Matt &
539 Keel, 2011; Rosenbaum & White, 2015), and Finch and Tomiyama (2015) found that
540 emotional eating acted as a buffer to daily life stresses in women, but only when they did not
541 have elevated depressive symptoms.

542 Second, we found that different facets of alexithymia produced different pathways.
543 The DIF subscale of the TAS-20 directly and indirectly predicted BMI in the majority of
544 models. Indeed, the only time that it did not play a role was when anxiety was included in the

545 models in the general population sample. Overall, these findings emphasise the
546 multidimensional nature of alexithymia (Taylor, Bagby, Luminet, 2000) and suggest that
547 difficulty identifying feelings may be a core driving feature of alexithymia relevant to
548 emotional eating, and in turn, BMI. In support of this, Pinaquy et al. (2003) previously found
549 that DIF was the strongest predictor of emotional eating, and Larsen and colleagues (2006)
550 also found that DIF significantly mediated the relationship between depression and emotional
551 eating alongside impulsivity.

552 Third, and as summarised above, we also found different pathways between
553 alexithymia and BMI in our student versus general population sample, a finding that does not
554 seem to be attributable to demographic differences across groups. For example, even though
555 age, as well as levels of cognitive restraint and uncontrolled eating differed across our two
556 samples, we controlled for these variables in our analyses. Although, it is possible that other
557 demographic differences may have existed between our samples that we failed to consider. It
558 seems likely that years spent in education and socioeconomic status would have differed
559 across our two samples; factors known to be associated with both alexithymia and the
560 adoption of emotional regulation strategies (Lane, Sechrest, & Riedel, 1998; Parker, Taylor,
561 & Bagby, 2001). Instead, the fact we found different pathways across our two samples
562 highlights an important methodological consideration in the development of models.
563 Behaviour research using human participants relies heavily on convenient student samples,
564 but results may only be applicable to other student samples and may not generalise to a
565 broader population. For this reason, completing a self-replication as we have done here,
566 should be seen as a pivotal step in similar research in the future. Therefore, although we
567 found contrasting results, it nevertheless highlights how important it is that initial models are
568 interpreted with caution until they undergo rigorous testing in broader samples.

569 Taken together, our results have potentially important clinical implications. Emotional
570 eating is one of many contributing factors to increased BMI and obesity, and if emotional
571 eating is a form of regulating emotions, then understanding the role of alexithymia and
572 emotional dysregulation more broadly, will help develop strategies designed to assist weight
573 loss and management. For example, Finch and Tomiyama (2015) previously found that
574 comfort eating buffered the association between adverse life events and perceived stress, but
575 only in individuals without elevated levels of depressive symptoms. This suggests that
576 comfort eating in response to naturally occurring stressors may serve as a protective
577 mechanism in some individuals. Therefore, whilst it is important to reduce emotional eating
578 due to its associated negative impact on health, a new strategy is needed to help such
579 individuals manage their response to stress and negative emotions. Weight management is
580 likely to differ if emotional eating is withdrawn as a coping strategy, as this would also
581 remove the use of food to self-soothe. Therefore, addressing an individual's ability to
582 identify, describe and regulate emotions should be considered when designing interventions
583 to manage weight.

584 However, our study is not without limitations. First, our samples were predominantly
585 female. This may influence results as males are reported to exhibit greater levels of
586 alexithymia than their female counterparts (Mattila, Salminen, Nummi & Joukamaa, 2006;
587 Honkalampi, Hintikka, Tanskanen, Lehtonen, & Viianamäki, 2000), as well as lower levels
588 of depression and emotional eating (e.g. Larsen et al., 2006). Therefore, it is possible that the
589 pathways between alexithymia and BMI may differ across genders and this should be
590 explored in future research. Second, even though we controlled for age in our analyses, we
591 did not control for the possible influence of age related factors, such as the use of more
592 adaptive and less impulsive coping strategies over the course of one's lifespan (Diehl, Coyle,
593 & Labouvie-Vief, 1996). Third, BMI was assessed differently across our two studies.

594 However, whilst some studies suggest that self-report methods can lead to an underestimation
595 and overestimation of weight and height, respectively (Spencer, Appleby, Davey and Key,
596 2001), self-reported body weight has been found to be an excellent approximation of actual
597 body weight across a broad range of populations (Jeffrey, 1996; Kuczmarski, Kuczmarski,
598 and Najjar, 2001). Fourth, even though our choice of mediating factors was guided by
599 previous literature, it is possible that other factors may also play a role. For instance, anxiety
600 sensitivity, the belief that sensations associated with anxiety have negative consequences, has
601 been associated with alexithymia (Devine, Stewart, & Watt, 1999; Wood, O'Hagan,
602 Williams, McCabe, & Chadwick, 2014). It may be that individuals who are uncomfortable
603 with the associated sensations of anxiety may be more inclined to try to remove them as
604 quickly as possible through maladaptive coping strategies, such as emotional eating (Reaves,
605 Christiansen, Boyland, Halford, Llewellyn, & Hardman, 2016). Interoceptive awareness,
606 defined as the ability to accurately detect and interpret bodily sensations and associated with
607 alexithymia, may also be an important mediating factor (Herbert, Herbert, & Pollatos, 2011).
608 Individuals who are have low interoceptive awareness may be vulnerable to engaging in
609 emotional eating due to misinterpretation of bodily sensations of arousal (e.g. butterflies in
610 the stomach associated with anxiety interpreted as pangs of hunger; Young, Williams, Pink,
611 Fregard, Owens, & Benton, 2017). Future research should explore whether these variables
612 further mediate the relationship alexithymia and BMI. Finally, and consistent with previous
613 research (Pinaquy et al. 2003; Pike 2013; Larsen et al., 2006), the internal consistency of the
614 EOT subscale of the TAS-20 was relatively low across both of our samples. Consequently,
615 conclusions drawn around this subscale should be interpreted with caution.

616 To conclude, our research offers novel insight into the relationship between alexithymia
617 and BMI and highlights important methodological considerations for future research. For the
618 first time, we incorporated multiple mediating factors (negative affect, negative urgency and

619 emotional eating) in one inclusive theoretical model, and outcomes were tested for robustness
620 through self-replication in a more representative general population sample. Overall, our
621 results provide some support for the hypothesised model. Exploratory analysis in a student
622 sample revealed that difficulty identifying feelings predicted BMI both directly and indirectly
623 via negative urgency and emotional eating. In contrast, results from our more representative
624 general population sample revealed that alexithymia predicted BMI indirectly via depression
625 or impulsiveness. Whilst the precise nature in which alexithymia drives emotional eating
626 remains unclear, these findings represent the first steps in developing one inclusive model
627 and add strength to the proposal that alexithymia is an important factor in understanding
628 emotional eating and BMI.

629

630

References

- 631 Arnow, B., Kenardy, J., & Agras, W. S. (1995). The Emotional Eating Scale: The
632 development of a measure to assess coping with negative affect by eating. *Int J Eat*
633 *Disord*, 18(1), 79-90. doi:10.1002/1098-108X(199507)18:1<79::AID-
634 EAT2260180109>3.0.CO;2-V
- 635 Bagby, R. M., Parker, J. D., & Taylor, G. J. (1994). The twenty-item Toronto Alexithymia
636 Scale—I. Item selection and cross-validation of the factor structure. *J Psychosom*
637 *Res*, 38(1), 23-32. doi:10.1016/0022-3999(94)90005-1
- 638 Bagby, R. M., Taylor, G. J., & Parker, J. D. (1994). The twenty-item Toronto Alexithymia
639 Scale—II. Convergent, discriminant, and concurrent validity. *J Psychosom Res*, 38(1),
640 33-40. doi:10.1016/0022-3999(94)90006-X
- 641 Beck, A. T., Epstein, N., Brown, G., & Steer, R. A. (1988a). An inventory for measuring
642 clinical anxiety: psychometric properties. *J Consul Clin Psychol*, 56(6), 893.
643 doi:10.1037/0022-006X.56.6.893
- 644 Beck, A. T., & Steer, R. A. (1990). *Manual for the Beck anxiety inventory*. San Antonio,
645 USA: The Psychological Corporation.
- 646 Beck, A. T., Steer, R. A., & Brown, G. K. (1996). *Beck depression inventory-II*. San
647 Antonio, USA: The Psychological Corporation
- 648 Beck, A. T., Steer, R. A., & Carbin, M. G. (1988). Psychometric properties of the Beck
649 Depression Inventory: Twenty-five years of evaluation. *Clin Psychol Rev*, 8(1), 77-100.
650 doi:10.1016/0272-7358(88)90050-5
- 651 Beck, A. T., Ward, C. H., Mendelson, M., Mock, J., & Erbaugh, J. (1961). An inventory for
652 measuring. *Arch Gen Psych*, 4, 561-571. doi:10.1001/archpsyc.1961.01710120031004

653 Berardis, D. D., Campanella, D., Nicola, S., Gianna, S., Alessandro, C., Chiara, C., ... &
654 Ferro, F. M. (2008). The impact of alexithymia on anxiety disorders: a review of the
655 literature. *Curr Psych Rev*, 4(2), 80-86. doi:10.2174/157340008784529287

656 Corcos, M., Guilbaud, O., Speranza, M., Paterniti, S., Loas, G., Stephan, P., & Jeammet, P.
657 (2000). Alexithymia and depression in eating disorders. *Psychiatry Res*, 93(3), 263-266.
658 doi:10.1016/S0165-1781(00)00109-8

659 Cyders, M. A., Smith, G. T., Spillane, N. S., Fischer, S., Annus, A. M., & Peterson, C.
660 (2007). Integration of impulsivity and positive mood to predict risky behavior:
661 Development and validation of a measure of positive urgency. *Psychol Assess*, 19(1),
662 107. doi:10.1037/1040-3590.19.1.107

663 De Lauzon, B., Romon, M., Deschamps, V., Lafay, L., Borys, J. M., Karlsson, J., ... &
664 Charles, M. A. (2004). The Three-Factor Eating Questionnaire-R18 is able to
665 distinguish among different eating patterns in a general population. *J Nutr*, 134(9),
666 2372-2380.

667 Devine, H., Stewart, S. H., & Watt, M. C. (1999). Relations between anxiety sensitivity and
668 dimensions of alexithymia in a young adult sample. *J Psychosom Res*, 47(2), 145-158.
669 doi:10.1016/S0022-3999(99)00033-1

670 Diehl, M., Coyle, N., & Labouvie-Vief, G. (1996). Age and sex differences in strategies of
671 coping and defense across the life span. *Psychol Aging*, 11(1), 127.

672 Eizaguirre, A. E., de Cabezon, A. O. S., de Alda, I. O., Olariaga, L. J., & Juaniz, M. (2004).
673 Alexithymia and its relationships with anxiety and depression in eating disorders. *Pers*
674 *Individ Diff*, 36(2), 321-331. doi:10.1016/S0191-8869(03)00099-0

675 Fernandes, J., Ferreira-Santos, F., Miller, K., & Torres, S. (2018). Emotional processing in
676 obesity: a systematic review and exploratory meta-analysis. *Obes Rev* 19(1), 111-120.
677 doi: 10.1111/obr.12607

678 Finch, L. E., & Tomiyama, A. J. (2015). Comfort eating, psychological stress, and depressive
679 symptoms in young adult women. *Appetite*, 95, 239-244.
680 doi:10.1016/j.appet.2015.07.017

681 Geliebter, A., & Aversa, A. (2003). Emotional eating in overweight, normal weight, and
682 underweight individuals. *Eat Beh*, 3(4), 341–347. doi:10.1016/S1471-0153(02)00100-9

683 Gunderson, J.G., & Zanarini, M. C. (1989): Pathogenesis in borderline personality. In A.
684 Tasman, R. E. Hales, & A. J. Frances (Eds.), *Review of Psychiatry, Vol. 8* (pp. 25-48).
685 Washington, USA: American Psychiatric Press.

686 Haedt-Matt, A. A., Keel, P. K., Racine, S. E., Burt, S. A., Hu, J. Y., Boker, S., ... & Klump,
687 K. L. (2014). Do emotional eating urges regulate affect? Concurrent and prospective
688 associations and implications for risk models of binge eating. *Int J Eat Disord*, 47(8),
689 874-877. doi:10.1002/eat.22247

690 Hayes, A. F. (2012). *Introduction to mediation, moderation, and conditional process*
691 *analysis: A regression-based approach*. New York, USA: Guilford Publications.

692 Heatherton, T. F., & Baumeister, R. F. (1991). Binge eating as escape from self-
693 awareness. *Psychol Bull*, 110(1), 86.

694 Hendryx, M. S., Haviland, M. G., & Shaw, D. G. (1991). Dimensions of alexithymia and
695 their relationships to anxiety and depression. *J Pers Assess*, 56(2), 227-237.
696 doi:10.1207/s15327752jpa5602_4

697 Herbert, B. M., Herbert, C., & Pollatos, O. (2011). On the relationship between interoceptive
698 awareness and alexithymia: is interoceptive awareness related to emotional
699 awareness? *J Pers*, *79*(5), 1149-1175. doi:10.1111/j.1467-494.2011.00717.x

700 Holliday, J., Uher, R., Landau, S., Collier, D., & Treasure, J. (2006). Personality pathology
701 among individuals with a lifetime history of anorexia nervosa. *J Pers Disord*, *20*(4),
702 417-430. doi:10.152/pedi.2006.20.4.417

703 Honkalampi, K., Hintikka, J., Tanskanen, A., Lehtonen, J., & Viinamäki, H. (2000).
704 Depression is strongly associated with alexithymia in the general population. *J*
705 *Psychosom Res*, *48*(1), 99-104. doi:10.1016/S0022-3999(99)00083-5

706 Honkalampi, K., Hintikka, J., Laukkanen, E., & Viinamäki, J. L. H. (2001). Alexithymia and
707 depression: a prospective study of patients with major depressive
708 disorder. *Psychosomatics*, *42*(3), 229-234. doi:10.1176/appi.psy.42.3.229

709 Jasinska, A. J., Yasuda, M., Burant, C. F., Gregor, N., Khatri, S., Sweet, M., & Falk, E. B.
710 (2012). Impulsivity and inhibitory control deficits are associated with unhealthy eating
711 in young adults. *Appetite*, *59*(3), 738-747. doi:10.1016/j.appet.2013.08.001

712 Jeffery, R. (1996). Bias in reported body weight as a function of education, occupation,
713 health and weight concern. (1996). *Add Beh*, *21*(2), 217-222. doi: 10.1016/0306-
714 4603(95)00050-X

715 Kang, J. I., Namkoong, K., Yoo, S. W., Jung, K., & Kim, S. J. (2012). Abnormalities of
716 emotional awareness and perception in patients with obsessive–compulsive disorder. *J*
717 *Affect Disord*, *141*(2), 286-293. doi:10.1016/j.jad.2012.04.001

- 718 Kaplan, H. I., & Kaplan, H. S. (1957). The psychosomatic concept of obesity. *J Nerv Ment*
719 *Dis, 125*, 181-201.
- 720 Karlsson, J., Persson, L. O., Sjöström, L., & Sullivan, M. (2000). Psychometric properties
721 and factor structure of the Three-Factor Eating Questionnaire (TFEQ) in obese men and
722 women. Results from the Swedish Obese Subjects (SOS) study. *Int J Obes, 24*(12),
723 1715. doi:10.1038/sj.ijo.0801442
- 724 Koenders, P. G., & van Strien, T. (2011). Emotional eating, rather than lifestyle behavior,
725 drives weight gain in a prospective study in 1562 employees. *J Occup Environ*
726 *Med, 53*(11), 1287-1293. doi:10.1097/JOM.0b013e31823078a2
- 727 Kontinen, H., Männistö, S., Sarlio-Lähteenkorva, S., Silventoinen, K., & Haukkala, A.
728 (2010). Emotional eating, depressive symptoms and self-reported food consumption. A
729 population-based study. *Appetite, 54*(3), 473-479. doi:10.1016/J.APPET.2010.01.014
- 730 Kuczmarski, M. F., Kuczmarski, R. J., & Najjar, M. (2001). Effects of age on validity of self-
731 reported height, weight, and body mass index: findings from the Third National Health
732 and Nutrition Examination Survey, 1988–1994. *J Am Diet AssOC, 101*(1), 28-34. doi:
733 10.1016/S0002-8223(01)00008-6
- 734 Lane, R. D., Sechrest, L., & Riedel, R. (1998). Sociodemographic correlates of
735 alexithymia. *Compr Psychiatry, 39*(6), 377-385.
- 736 Lane, R. D., Lee, S., Reidel, R., Weldon, V., Kaszniak, A., & Schwartz, G. E. (1996).
737 Impaired verbal and nonverbal emotion recognition in alexithymia. *Psychosom*
738 *Med, 58*(3), 203-210.

- 739 Larsen, J. K., van Strien, T., Eisinga, R., & Engels, R. C. (2006). Gender differences in the
740 association between alexithymia and emotional eating in obese individuals. *J*
741 *Psychosom Res*, 60(3), 237-243. doi:10.1016/J.JPSYCHORES.2.005.07.006
- 742 Lehman, A. K., & Rodin, J. (1989). Styles of self-nurturance and disordered eating. *J Consult*
743 *Clin Psychol*, 57(1), 117. doi:10.1037/0022-006X.57.1.117
- 744 Linehan, M. M. (1993). *Cognitive-Behavioral Treatment of Borderline Personality Disorder*.
745 New York, USA: The Guilford Press.
- 746 Linehan, M. M. (1995). *Understanding Borderline Personality Disorder*. New York, USA:
747 The Guilford Press.
- 748 Lluch, A., Herbeth, B., Méjean, L., & Siest, G. (2000). Dietary intakes, eating style and
749 overweight in the Stanislas Family Study. *Int J Obes*, 24(11), 1493–1499.
750 doi:10.1038/sj.ijo.0801425
- 751 Macht, M., & Simons, G. (2000). Emotions and eating in everyday life. *Appetite*, 35(1), 65-
752 71. doi:10.1006/appe.2000.0325
- 753 Marchesi, C., Brusamonti, E., & Maggini, C. (2000). Are alexithymia, depression, and
754 anxiety distinct constructs in affective disorders? *J Psychosom Res*, 49(1), 43-49.
755 doi:10.1016/S0022-3999(00)00084-2
- 756 Mattila, A. K., Poutanen, O., Koivisto A-M., Salokangas, R. K. R., & Joukamaa, M. (2008).
757 The performance of diagnostic measures of depression in alexithymic and
758 nonalexithymic subjects. *Gen Hos Psych*, 30 (1), 77-79

759 Mattila, A. K., Salminen, J. K., Nummi, T., & Joukamaa, M. (2006). Age is strongly
760 associated with alexithymia in the general population. *J Psychosom Res*, *61*(5), 629-
761 635. doi:10.1016/J.PSYCHORES.2.006.04.013

762 Moon, A., & Berenbaum, H. (2009). Emotional awareness and emotional eating. *Cogn*
763 *Emot* *23*(3), 417-429. doi:10.1080/02699930801961798

764 Noli, G., Cornicelli, M., Marinari, G. M., Carlini, F., Scopinaro, N., & Adami, G. F. (2010).
765 Alexithymia and eating behaviour in severely obese patients. *J Hum Nutr Diet*, *23*(6),
766 616-619. doi:10.1111/j.1365-277X.2010.01079.x

767 Ouwens, M. A., van Strien, T., & van Leeuwe, J. F. (2009). Possible pathways between
768 depression, emotional and external eating. A structural equation model. *Appetite*, *53*(2),
769 245-248. doi:10.1016/J.APPET.2009.06.001

770 Parker, J. D., Bagby, R. M., & Taylor, G. J. (1991). Alexithymia and depression: distinct or
771 overlapping constructs? *Compr Psychiatry*, *32*(5), 387-394. doi:10.1016/0010-
772 440X(91)90015-5

773 Parker, J. D., Taylor, G. J., & Bagby, R. M. (2001). The relationship between emotional
774 intelligence and alexithymia. *Pers Individ Diff*, *30*(1), 107-115. doi:10.1016/S0191-
775 8869(00)000014-3

776 Parker, J. D., Taylor, G. J., & Bagby, R. M. (2003). The 20-Item Toronto Alexithymia Scale:
777 III. Reliability and factorial validity in a community population. *J Psychosom*
778 *Res*, *55*(3), 269-275. doi:10.1016/S0022-3999(02)00578-0

779 Pike, C. (2013). *The Association between Alexithymia, Impulsivity and Negative Affect in*
780 *Emotional and External Eating*. (Master's thesis). Retrieved from
781 https://ir.canterbury.ac.nz/bitstream/handle/10092/8986/thesis_fulltext.pdf?sequence=1

782 Pinaquy, S., Chabrol, H., Simon, C., Louvet, J. P., & Barbe, P. (2003). Emotional Eating,
783 Alexithymia, and Binge-Eating Disorder in Obese Women. *Obes Res, 11*(2), 195-201.
784 doi:10.1038/oby.2003.31

785 Polivy, J., & Herman, C. P. (1999). Distress and eating: why do dieters overeat? *Int J Eat*
786 *Disord, 26*(2), 153-164. doi:10.1002/(SICI)1098-108X(199909026:2<153::AID-
787 EAT4>3.0.CO;2-R

788 Price, M., Higgs, S., & Lee, M. (2015). Self-reported eating traits: underlying components of
789 food responsiveness and dietary restriction are positively related to BMI. *Appetite, 95*,
790 203-210. doi:10.1016/J.APPET.2015.07.006

791 Racine, S. E., Keel, P. K., Burt, S. A., Sisk, C. L., Neale, M., Boker, S., & Klump, K. L.
792 (2013). Exploring the relationship between negative urgency and dysregulated eating:
793 Etiologic associations and the role of negative affect. *J Abnorm Psychol, 122*(2), 433.
794 doi:10.1037/a0031250

795 Reaves, D. L., Christiansen, P., Boyland, E., Halford, J. C. G., Llewellyn, C. H., & Hardman,
796 C. A. (2016). Cross-sectional associations between personality, eating to cope, and
797 consumption. *Appetite, (107)*, 689-690. doi:10.1016/j.appet.2016.08.076

798 Rosenbaum, D. L., & White, K. S. (2015). The relation of anxiety, depression, and stress to
799 binge eating behavior. *J Health Psychol, 20*(6), 887-898.
800 doi:10.1177/1359105315580212

- 801 Rude, S., & McCarthy, C. (2003). Emotional functioning in depressed and depression-
802 vulnerable college students. *Cog Emo*, 17(5), 799-806.
- 803 Saarijärvi, S., Salminen, J. K., & Toikka, T. B. (2001). Alexithymia and depression: a 1-
804 year follow-up study in outpatients with major depression. *J Psychosom Res*, 51(6),
805 729-733.
- 806 Salminen, J. J. K., Saarijärvi, S., Äärelä, E., Toikka, T., & Kauhanen, J. (1999). Prevalence of
807 alexithymia and its association with sociodemographic variables in the general
808 population of finland. *J Psychosom Res*, 46(1), 75–82. doi:10.1016/S0022-
809 3999(98)00053-1
- 810 Shishido, H., Gaher, R. M., & Simons, J. S. (2013). I don't know how I feel, therefore I act:
811 alexithymia, urgency, and alcohol problems. *Addict Behav*, 38(4), 2014-2017.
812 doi:10.1016/J.ADDBEH.2012.12.014
- 813 Sifneos, P. E. (1973). The prevalence of 'alexithymic' characteristics in psychosomatic
814 patients. *Psychother Psychosom*, 22(2-6), 255-262. doi:10.1159/000286529
- 815 Spence, S., & Courbasson, C. (2012). The role of emotional dysregulation in concurrent
816 eating disorders and substance use disorders. *Eat Behav*, 13(4), 382-385.
817 doi:10.1016/J.EATBEH.2012.05.006
- 818 Spencer, E. A., Appleby, P. N., Davey, G. K., & Key, T. J. (2002). Validity of self-reported
819 height and weight in 4808 EPIC-Oxford participants. *Pub Health Nut*, 5(4), 561-565.
820 doi: 10.1079/PHN2001322

821 Stunkard, A. J., & Messick, S. (1985). The three-factor eating questionnaire to measure
822 dietary restraint, disinhibition and hunger. *J Psychosom Res*, 29(1), 71-83.
823 doi:10.1016/0022-3999(85)90010-8

824 Sung, J., Lee, K., & Song, Y. M. (2009). Relationship of eating behavior to long-term weight
825 change and body mass index: The Healthy Twin study. *Eat Weight Disord-ST*, 14(2-3),
826 e98-e105. doi:10.1007/BF03327806

827 Suslow, T., & Donges, U. S. (2017). Alexithymia components are differentially related to
828 explicit negative affect but not associated with explicit positive affect or implicit
829 affectivity. *Front Psychol*, 8, 1758. doi:10.3389/fpsyg.2017.01758

830 Taylor, G. J., Bagby, R. M., & Luminet, O. (2000). Assessment of alexithymia: Self-report
831 and observer-rated measures. In R. Bar-on & J. D. A. Parker (Eds.), *The Handbook of*
832 *Emotional Intelligence* (pp. 301-319). San Francisco, USA: Jossey Bass.

833 Taylor, G. J., Bagby, R. M., & Parker, J. D. (1997). *Disorders of affect regulation:*
834 *Alexithymia in medical and psychiatric illness*. New York, USA: Cambridge University
835 Press.

836 Taylor GJ, Bagby RM, Parker JDA (2006). The 20-Item Toronto Alexithymia Scale Manual.
837 <http://www.gtaylorpsychiatry.org/tas.htm>

838

839 Torres, S., Guerra, M. P., Lencastre, L., Miller, K., Vieira, F. M., Roma-Torres, A., ... Costa,
840 P. (2015). Alexithymia in anorexia nervosa: The mediating role of depression. *Psych*
841 *Res*, 225(1), 99–107. doi:10.1016/j.psychres.2014.10.023

842 van Strien, T., Frijters, J. E., Bergers, G. P., & Defares, P. B. (1986). The Dutch Eating
843 Behavior Questionnaire (DEBQ) for assessment of restrained, emotional, and external
844 eating behavior. *Int J Eat Disord*, 5(2), 295-315. doi:10.1002/1098-
845 108X(198602)5:2<295::AID-EAT2260050209>3.0.CO;2-T

846 van Strien, T., Herman, C.P. and Verheijden, M.W., 2012. Eating style, overeating and
847 weight gain. A prospective 2-year follow-up study in a representative Dutch
848 sample. *Appetite*, 59(3), pp.782-789. doi:10.1016/J.APPET.2012.08.009

849 van Strien, T., Konttinen, H., Homberg, J. R., Engels, R. C., & Winkens, L. H. (2016).
850 Emotional eating as a mediator between depression and weight gain. *Appetite*, 100,
851 216-224. doi:10.1016/J.APPET.2016.02.034

852 van Strien, T., & Ouwens, M. A. (2007). Effects of distress, alexithymia and impulsivity on
853 eating. *Eat Behav*, 8(2), 251-257. doi:10.1016/J.EATBEH.2006.06.004

854 Whiteside, S. P., & Lynam, D. R. (2001). The five factor model and impulsivity: Using a
855 structural model of personality to understand impulsivity. *Pers Individ Diff*, 30(4), 669-
856 689. doi:10.1016/S0191-8869(00)00064-7

857 Wood, R. L., O'Hagan, G., Williams, C., McCabe, M., & Chadwick, N. (2014). Anxiety
858 Sensitivity and Alexithymia as Mediators of Postconcussion Syndrome Following Mild
859 Traumatic Brain Injury. *J Head Trauma Rehabil*, 29(1), E9–E17.
860 doi:10.1097/HTR.0b013e31827eabba

861 Wood, R. L., Williams, C., & Lewis, R. (2010). Role of alexithymia in suicide ideation after
862 traumatic brain injury. *J Int Neuropsychol Soc*, 16(6), 1108-1114.
863 doi:10.1017/S1355617710001013

864 Young, H. A., Williams, C., Pink, A. E., Freegard, G., Owens, A., & Benton, D. (2017).

865 Getting to the heart of the matter: Does aberrant interoceptive processing contribute

866 towards emotional eating? *PloS one*, 12(10), e0186312.

867 doi:10.1371/journal.pone.0186312

868 Żak-Golab, A., Tomalski, R., Bąk-Sosnowska, M., Holecki, M., Kocelak, P., Olszanecka-

869 Glinianowicz, M., Chudek, J., & Zahorska-Markiewicz, B. (2103). Alexithymia,

870 depression, anxiety and binge eating in obese women. *Eur J Psychiat*, 27(3), 149-159.

871 doi: 10.4321/S0213-61632013000300001

872