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2 Disorganized attachment predicts body mass index via uncontrolled eating

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Abstract

Background/Objectives: Previous research has demonstrated relationships between attachment orientations (expectations of ourselves and others in interpersonal relationships), eating behaviours and obesity. However, such research has been limited to investigations of 'organised' forms of attachment orientations (reflecting coherent and predictable patterns of behaviour). Theoretically, aberrant eating behaviours and body mass index, should also be related to 'disorganized attachment.'

Subjects: Here we test these relationships for the first time in a general population. Secondary data analyses of a pre-existing dataset were conducted (N = 537).

Methods used: Questionnaire measures of organised (avoidant and anxious) and disorganized attachment were included alongside eating behaviour measures (emotional eating, uncontrolled eating and cognitive restraint) and body mass index (BMI).

Results: Parallel multiple mediation analysis (PROCESS) showed that uncontrolled eating (but not emotional eating or cognitive restraint) significantly mediated a relationship between disorganized attachment and body mass index (significant indirect relationship; LLCI = .02 ULCI = .16) when both attachment anxiety and avoidance were included as covariates.

Conclusions: We suggest that the mechanism underpinning this indirect relationship is a form of maladaptive affect regulation, but that the behavioural motivators differ from those observed in anxiously attached individuals. Rather than eating being a premeditated strategy used by individuals high in disorganized attachment to manage emotion, opportunities to eat are simply taken as they present themselves. Professionals engaged in addressing eating problems and weight

51 management should consider attachment orientations in their patient assessments

52 and be mindful that attachment disorganized individuals are especially likely to

53 engage in uncontrolled eating behaviours that are associated with a higher BMI.

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55 **Key words**: disorganized attachment; attachment anxiety; uncontrolled eating;

56 emotional eating; cognitive restraint; body mass index

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59 **Introduction**

60 Recent estimates have suggested that overweight and obesity will affect 2.7 billion

61 people worldwide by 2025 [1]. Overweight and obesity are associated with an

62 increased risk of cardiovascular disease, type 2 diabetes and cancer amongst other

63 health issues [2]. As the upward trend in obesity continues [3], the need for effective

64 interventions is of high priority [4].

65 'Attachment orientation' is one psychological factor that has been shown to

66 relate to obesity and overweight in adults [5]. Attachment orientation is a term used to

67 describe the set of expectations that we all possess about how we and others

68 behave in inter-personal relationships. These mental models are thought to be

69 established early in life and reflect interactions with caregivers [6]. Adult attachment

70 orientations reflects the dynamics and feelings associated with our most important

71 long-term relationships in life, including those from early life [7].

72 Currently, adult attachment orientations tends to be conceptualised in terms of

73 two dimensions [7]. These are attachment *anxiety* which is characterised by a fear of

74 abandonment and attachment *avoidance* which is characterised by a fear of

75 intimacy. A low score on both of these dimensions indicates 'attachment security'.

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76   Whilst a high score on either or both of these dimensions indicates 'attachment

77   insecurity'.

78   A recent meta-analysis showed that, in a general population, higher

79   attachment insecurity was associated with more unhealthy eating behaviours (e.g.,

80   disinhibited eating, uncontrolled eating, emotional eating amongst others) [8]. The

81   strongest relationship was between attachment anxiety and unhealthy eating

82   behaviours, with effects tending to be of medium effect size. Importantly, disinhibited

83   eating (a general propensity to engage in periodic overeating [9]) and emotional eating

84   (episodic overeating in response to negative affect [10]) have been found to mediate a

85   relationship between attachment and BMI, [11, 12] respectively. This meta-analysis [8]

86   also showed that higher attachment avoidance related to more unhealthy eating

87   behaviours, however, the effect size for this relationship was small and the weakest

88   amongst those examined (attachment insecurity, anxiety, avoidance and

89   fearfulness).

90   The mechanism underpinning these associations is thought to be affect

91   regulation; anxiously attached individuals are relatively poor at managing their

92   emotions by comparison to their attachment secure counterparts. When upsetting

93   events take place, they may seek support, but the interaction is characterised by

94   mistrust and fear of rejection rather than reassurance. Moreover, the attachment

95   system is hyperactivated leading to a hyper-vigilance to potentially upsetting stimuli

96   [13, 14]. To 'break the cycle' of hyperactivation, highly anxiously attached individuals

97   rely on external sources of affect regulation such as food [15]. Indeed, in recent work, it

98   was shown that attachment anxiety was specifically related to an inability to both

99   disengage from the source of upset and engage in goal-oriented behaviour, which

100 was in turn related to eating in response to stress and body mass index [12]. By

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101   contrast, attachment avoidance is associated with deactivating strategies, that is, the

102   avoidance of emotions and suppression of stress and help-seeking (Mikulincer and

103   Orbach, 1995). It has been suggested that this maladaptive approach does not

104   actually eliminate stress and therefore remaining physiological stress markers and

105   negative affect precipitate a need to engage in external affect regulation (i.e., eating).

106   It should be noted that support for this theoretical explanation linking attachment

107   avoidance and eating behaviour is scant compared with the better understood

108   relationship between attachment anxiety and eating behaviour.

109   However, these findings focus only on 'organised' forms of attachment

110   orientations. That is, where mental models and strategies are 'coherent' and allow

111   individuals to select (which may be explicit or implicit) strategies to manage

112   situations that are adaptive and predictable based on their experience of inter-

113   personal relationships [16]. For example, it is logical and adaptive for the child of a

114   neglectful caregiver to deactivate their attachment system as in attachment

115   avoidance and seek to minimise intimacy. Even when individuals are high in both

116   attachment avoidance and anxiety, an orientation called fearful-avoidance, they will

117   use the hyperactivating and deactivating strategies intermittently. By contrast, adult

118   disorganized attachment is characterised by a general fear of romantic attachment

119   figures and refers to a lack of coherent and predictable strategies to manage the self

120   and others [16]. This leads to contradictory and confused behaviour in response to

121   distress; approach behaviours may be initiated but are left incomplete due to fear

122   and a simultaneous desire to distance themselves [17]. A recent development has

123   been the measurement of disorganisation as a construct that is separate and

124   additional to the organised dimensions of adult attachment [16].

125   While attachment avoidance reflects punitive or neglectful relationship

126   experiences and attachment anxiety reflects inconsistency in relational experiences,

127   disorganized attachment is related to child abuse, loss, trauma and otherwise

128   frightening interpersonal experiences. Research has shown that 80% of maltreated

129   children had a disorganized attachment pattern [18]. Such adverse childhood

130   experiences are also relevant to the understanding of obesity [19]. A systematic review

131   and meta-analysis [20] not only showed a clear relationship between childhood

132   experience of abuse and adult obesity but also severe abuse was significantly more

133   related to obesity than less severe abuse. Suggested mechanisms underpinning this

134   relationship included maladaptive coping responses, stress and emotional

135   perturbations.

136   Considering the shared aetiology of disorganized attachment and obesity,

137   with respect to the experience of abuse in childhood, we investigated whether a

138   relationship between disorganized attachment, eating behaviour and BMI existed.

139   Here, our approach was to focus on a general population and sub-clinical eating

140   behaviours, of the kind investigated previously in relation to attachment anxiety and

141   its relationship with BMI [12]. The ability to investigate this relationship in a large

142   general population has been facilitated by the recent development of the adult

143   disorganized attachment scale [16], which assesses the construct of disorganisation as

144   a continuous dimension. Importantly, for the assessment of disorganized attachment

145   in a general population, this approach can assess a range of levels, including

146   relatively low scores.

147   Therefore, we hypothesised that higher disorganized attachment scores

148   would relate to higher BMI and that this relationship would be mediated by measures

149   of disinhibited eating. Specifically, we expected this relationship to exist independent

150   of attachment anxiety (i.e., when attachment anxiety is controlled for). Following

151   previous research, we examined the construct of disinhibited eating with measures

152   of uncontrolled eating and emotional eating. Uncontrolled eating is a measure of

153   opportunistic eating in response to both internal (e.g., extreme hunger) and external

154   (e.g., the smell of a tempting food) cues to eat [10]. This is a separate construct to

155   eating as a response to negative emotion (emotional eating).

156   Given the contradictory nature of patterns of behaviour associated with

157   disorganized attachment, we also tentatively hypothesised that a relationship with

158   BMI might also be mediated by dietary restraint. Dietary restraint refers to the

159   cognitive control over intake in order to influence body weight or shape [10] and has

160   been conceptualised as antagonistic to disinhibited eating [21]. One possibility is that

161   the hypothesised use of eating to regulate affect by attachment disorganized

162   individuals might precipitate reactionary dietary restraint (which has been shown to

163   ironically lead to further disinhibited eating behaviours [31]).

164   In addition, using an exploratory approach based on the primary hypotheses

165   being supported, we produced a comprehensive model that incorporated both

166   disorganized attachment *and* attachment anxiety as predictors of body mass index

167   via disinhibited eating behaviours.

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170   **Methods**

171   This study is a secondary data analysis of an unpublished dataset collected for a

172   different purpose. A brief description of the primary study and its results can be

173   found in the supplementary information. The primary hypotheses were pre-registered

174   with the Open Science Framework (osf.io/2dr74) following data collection but before

175   the data analyses associated with this paper. The dataset has been deposited for

176   open access with the Open Science Framework

177   (https://osf.io/2dr74/?view_only=a7bfeea11614401ca9464545ab4f620c).

178

179   *Participants*

180   A total of 752 participants began the study but 163 participants failed to

181   complete all of the measures and were therefore excluded. We excluded a further 52

182   participants from our dataset because either they reported a height and weight that

183   yielded an ambiguous or spurious BMI value (e.g., unlikely to be possible) or a BMI

184   that was valid but considered to be below healthy-range (i.e., below 18) to minimise

185   risk of inadvertently including disordered individuals in our sample. This resulted in a

186   sample size of 537 (Male = 126, female = 404, other = 6, prefer not to say = 1; mean

187   age = 25.5 years old, *SD* = 9.9). This sample size met with our requirements for

188   adequately powering our analyses to detect effects; considering the novelty of our

189   hypotheses a prudent approach was to power for small effect sizes within our model.

190   Following Fritz and MacKinnon's [22] guidance for detecting mediated effects with

191   sample sizes providing .8 power using bias-corrected bootstrap approaches, we

192   required at least a sample size of at least 462. To be eligible for the study,

193   participants had to be over the age of 18 years old and have no current or previous

194   diagnosis of an eating disorder.

195   Participants were recruited in two cohorts. In the first cohort (*n* = 130

196   completers), a consortium-led approach (see Button *et al.* [23]) was taken by

197   university students based at the University of Sheffield (*n* = 63 completers) and

198   Swansea University (*n* = 67 completers). The cohort 1 sample consisted mainly of

199   university students and staff, as the study was advertised to potential participants

200 who could attend a session at the universities via campus posters and student-study

201 participation systems only. The second cohort (*n* = 459) provided only self-report

202 height and weight and therefore were able to complete the study entirely online.

203 They were recruited via social media, posters and student-study participation

204 systems.

205   For cohort 1, ethical approval was obtained from local human research ethics

206 committees at both sites. For cohort 2, an ethical amendment outlining a change to

207 an online only approach was approved by local human research ethics committees

208 at both sites. All participants provided informed consent.

209

210 *Measures*

211   *Disorganized attachment* The 9-item Disorganized Attachment scale [16] was

212 used. This consists of a single subscale and for the current study Cronbach's alpha

213 for this measure was .88. Participants rated their agreement to statements about

214 their general experience of relationships (as opposed to a specific current

215 relationship). For example, "I never know who I am with romantic partners".

216 Responses were provided on a 7-point Likert scale, from 1 (strongly disagree) to 7

217 (strongly agree).

218

219   *Attachment anxiety and avoidance*. The 12-item short-form Experiences in

220 Close Relationships questionnaire [24] was used to assess attachment anxiety (6

221 items) and attachment avoidance (6 items). For the current study, Cronbach's alpha

222 for the attachment anxiety subscale was .88 and for the attachment avoidance

223 subscale was .84. On a seven-point scale ranging from strongly disagree to strongly

224 agree, participants stated their level of agreement with statement referring to the

225 experiences of interpersonal relationships. For example, "I worry a fair amount about

226 losing my relationships" (attachment anxiety) and "I don't feel comfortable opening

227 up to others" (attachment avoidance).

228

229 *Eating style.* The 18-item short-form three factor eating questionnaire [10] was

230 used to assess three constructs, cognitive restraint, emotional eating and

231 uncontrolled eating. Participants responded with the extent to which statements

232 applied to them on a 4-point scale ranging from definitely true to definitely false or a

233 variant of this scale depending on the question. For the cognitive restraint scale (6

234 items; Cronbach's alpha for this study = .85), statements concerned the extent to

235 which they consciously apply restraint to their eating behaviour (*e.g.,* "I consciously

236 hold back at meals in order not to gain weight"). For the uncontrolled eating scale (9

237 items; Cronbach's alpha for this study = .86), statements concerned the extent to

238 which they lost control over their eating behaviour (e.g., "Sometimes when I start

239 eating, I just can't seem to stop"). For the emotional eating scale (3 items;

240 Cronbach's alpha for this study = .87), statements concerned eating in response to

241 emotional states (e.g., "When I feel lonely, I console myself with food").

242

243 *Anthropometric measures*: For cohort 1, participants attended a lab session

244 where their height and weight were measured by a researcher using a portable

245 stadiometer and non-medical grade weighing scales respectively. For cohort 2,

246 current height and weight were self-reported by participants using their preferred

247 units. These were converted to metric measures. Across both cohorts, height and

248 weight measures were used to calculate BMI (kg/m^2).

249

250 *Procedure*

251 The study was hosted on Qualtrics survey software (Qualtrics, Provo, UT, USA) and

252 participants had to click an anonymised link to access the study. They were asked to

253 read an information sheet and informed consent screen and to tick a box if they

254 consented. Following this they were asked to complete all measures (those outlined

255 here for the current study as well as those outlined in the supplementary information

256 for the full version of the study) as well as basic demographic questions. Upon

257 completion participants were either asked about their availability and contact

258 information for a follow-up session for the measurement of height and weight and

259 then debriefed (cohort 1) or asked to self-report their height and weight and then

260 debriefed.

261

262 *Data analysis*

263   Following Price *et al.* [25], we merged the BMI data from the two cohorts. This

264 decision was made on the basis that self-reported BMI and researcher-measured

265 BMI have been found to be highly-correlated for both younger [26] and older adults [27].

266 Nevertheless, height can be overestimated and weight can be underestimated,

267 therefore cohort (i.e., self-report vs. measured) was entered as a covariate into our

268 analyses, however, as it was not a significant covariate and made no difference to

269 the results of our analyses it was trimmed from our final models.

270   In order to examine our primary hypotheses, a parallel mediation model was

271 conducted. This approach was selected because it allows for the simultaneous entry

272 of multiple mediators within a single model, such that the independent contributions

273 of each mediator as part of an indirect pathway can be assessed. It also allowed for

274 covariates to be entered into the model.

275   Our model was conducted with disorganized attachment (predictor), BMI

276   (outcome) and parallel multiple mediators (cognitive restraint, emotional eating and

277   uncontrolled eating). In order to isolate an effect of disorganized attachment we

278   controlled for both attachment avoidance and anxiety. Also, following Wilkinson *et al.*

279   [11, 12], we controlled for gender and age. This model was conducted using PROCESS

280   v3.1 [28]. The covariates were controlled for at the level of both the mediator and the

281   outcome.

282   Following this, a comprehensive model was produced that incorporated both

283   findings associated with disorganized attachment (i.e., the results of the first

284   analysis) and a replication of the significant indirect relationship between attachment

285   anxiety, disinhibited eating measures and BMI reported in previous research [11, 12].

286   This approach allows, for the first time, for the indirect effect of attachment anxiety

287   on BMI to be tested whilst also controlling for disorganized attachment.

288   Therefore, path analysis was conducted using IBM SPSS AMOS. v.25.0. We

289   included disorganized attachment, attachment anxiety, attachment avoidance, age

290   and gender as exogenous variables, and uncontrolled eating, emotional eating and

291   BMI as endogenous variables. Cognitive restraint was not included, as our primary

292   analysis (above) failed to support a role for this factor. Covariance relationships were

293   specified between each of the exogenous variables and error terms were included

294   for each endogenous variable. Direct relationships were specified from each

295   exogenous variable to each endogenous variable; therefore both direct and indirect

296   relationships could be examined. Both of our model ran 5000 bootstrap samples and

297   95% confidence intervals are reported.

298   **Results**

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299 Means and standard deviations for each measure and correlations between them

300 can be found in Tables 1 and 2 respectively.

301

302 *Confirmatory analyses of primary pre-registered hypotheses: Disorganized*

303 *attachment, eating behaviours (cognitive restraint, emotional and uncontrolled*

304 *eating) and BMI*

305

306 Our parallel multiple mediation model (Fig 1) showed that there was no significant

307 direct relationship between disorganized attachment and BMI when no mediators

308 were included in the model (total effects) and this remained the case when mediators

309 were included (direct effects). However, a significant indirect effect that ran between

310 disorganized attachment and BMI via uncontrolled eating was identified. There were

311 no significant indirect effects associated with cognitive restraint or emotional eating.

312

313 *Path analysis testing a comprehensive model of the relationships between*

314 *attachment orientations, disinhibited eating behaviours and BMI*

315

316 Our path analysis revealed the significant indirect pathway between disorganized

317 attachment and BMI via uncontrolled eating that was observed within our primary

318 analysis. Also, a significant indirect pathway between attachment anxiety and BMI

319 via emotional eating was identified. No direct effects between attachment

320 orientations and BMI (without mediators included) were observed. Figure 2 provides

321 a visualisation of our model, however, for the sake of legibility we have only included

322 key relationships and statistics. Comprehensive information regarding direct

323   relationships relating to our specific hypotheses can be found in Tables 3 and 4 and

324   other direct relationships can be found in the supplementary information file.

325   Overall a good model fit was indicated with a chi square goodness of fit

326   statistic that was not significant (p = .672), a comparative fit index (CFI) of 1.00 and a

327   root mean square error of approximation (RMSEA) of .00.

328

329   **Discussion**

330   This study has identified disorganized attachment as a novel predictor of BMI in a

331   non-clinical population via the mechanism of uncontrolled eating. Our hypotheses

332   were partially confirmed. The relationship between disorganized attachment and BMI

333   was mediated by uncontrolled eating only (and not emotional eating or cognitive

334   restraint). This highlights the importance of accounting for uncontrolled eating in

335   individuals who present to health professionals with disorganized attachment and a

336   high BMI.

337   For the first time, we can provide evidence to support a comprehensive

338   theoretical model that incorporates both organised and disorganized attachment

339   orientations and their relationship to eating psychopathology and BMI (Fig 2).

340   Importantly, this speaks to a broader theoretical model that links attachment

341   orientations to health outcomes more generally [15], suggesting that an extension is

342   required, such that it goes beyond organised forms of attachment orientations to

343   include effects of disorganisation on health outcomes.

344   The most theoretically sound explanation for why disorganized attachment

345   relates to BMI via uncontrolled eating is that these behaviours serve affect regulatory

346   need. Specifically, whilst the motivator for eating might not be emotion, it is some

347   other eating-related cue, the incidental reward associated with such eating

behaviours may have the unintended consequence of regulating affect. This suggestion is consistent with Paetzold *et al.*'s [16] view of disorganized attachment in two ways; firstly, disorganized attachment is associated with problematic emotion regulation - anger and hostility. When these are experienced they are associated with impulsivity and general negative emotionality, which in turn may precipitate a need for affect regulation. However, due to their conflict around support seeking (a general fear of relationships "encourages simultaneous and confused approach and avoidance of the attachment figure for support and solace in times of need" [16]), highly disorganized individuals are likely to receive less support and perceive support as poorer than less disorganized individuals. External forms of affect regulation, such as disinhibition related to food consumption, may provide one of the few ways for disorganized individuals to manage their emotions.

Secondly, the characteristic incoherence of a disorganized attachment strategy is borne out here; specifically, it is likely that the affect regulatory effects of uncontrolled eating behaviours are reinforced but have failed to be translated into a coherent strategy such as 'emotional eating'. Future research is required to test these theoretical pathways; specifically, approaches to emotion regulation that might explain the relationship between disorganized attachment orientation and such eating behaviour. Moreover, the extent to which there is shared (or not) aetiology with attachment anxiety merits scrutiny.

For anxiously attached individuals, the indirect relationship between attachment anxiety and BMI via emotional eating is consistent with previous research[12]. However, it is notable, that it in our model it was necessary to specify a relationship running from emotional eating to uncontrolled eating (for improved model fit). This is consistent with the broader literature; recent commentary by Van

15

373   Strien [29] reports on the co-occurrence of such constructs (this paper refers to

374   external eating which is conceptually similar to uncontrolled eating) and explains it in

375   terms of the 'escape-of-self-awareness' theory [30], whereby emotional eaters narrow

376   their attention to their immediate environment. Indeed, previous work suggests that

377   attachment anxiety is associated with an inability to disengage with a source of upset

378   [12] and eating in this context allows for escape/ disengagement.

379   Contrary to one of our hypotheses, there was no significant relationship

380   between disorganized attachment and cognitive restraint. This work is inconsistent

381   with traditional 'restraint theory' [31], which suggests that disinhibited eating is a

382   response to restraint. Rather, relationships with disinhibited eating behaviours were

383   shown without respective relationships with cognitive restraint. This is more

384   consistent with psychosomatic theory, which suggests that personality traits and

385   psychopathology can cause disinhibited eating irrespective of restraint status [10]. One

386   speculation is that the interplay between restrained eating and disinhibited eating

387   described within traditional restraint theory actually represents a relatively coherent

388   strategy, whereby disinhibition is a predictable response to restraint and restraint is a

389   predictable response to disinhibition. Such a coherent pattern of behaviour is

390   uncharacteristic of attachment disorganized individuals. Given the novelty of this

391   finding and our limited understanding of disorganized attachment relative to

392   organised attachment orientations, future research should attempt to replicate this

393   finding.

394   Some of our findings here are also contrary to a recent meta-analysis [8] which

395   showed a significant relationship between attachment avoidance and emotional

396   eating. We failed to find a significant relationship of this kind despite our larger

397   sample size. A greater understanding of the role of attachment avoidance in models

398   of attachment orientations and eating behaviour is needed, especially given recent

399   results suggesting that attachment avoidance actually relates to restricted eating via

400   the mechanism of 'emotional cut-off' [32]. This latter finding and the failure to find a

401   significant relationship between attachment avoidance and emotional eating in the

402   current study are generally more consistent with our theoretical understanding of

403   attachment avoidance; attachment avoidant individuals engage in deactivating

404   strategies that actively minimise the experience of negative affect and cognitions [33],

405   therefore there is no requirement to affect regulate using food in the first place.

406   It is notable that our findings were evident even when the mean disorganized

407   attachment score for the overall sample was relatively low on the scale (2.82

408   arbitrary units; a.u.) and the maximum (6.67 a.u.) was just below the top of the scale

409   (7 a.u.). Stronger relationships may be evident in a more clinically-relevant sample,

410   for example bariatric-metabolic surgery patients. Previous research has shown that

411   attachment insecurity is more prevalent in bariatric-metabolic surgery patients than in

412   lean control populations [34, 35] and that there is a relationship between attachment

413   anxiety and binge eating mediated by emotion-regulation difficulties for surgery

414   candidates [36]. Future weight loss surgery research should consider a role for

415   disorganized attachment given that eating psychopathologies (including those

416   related to uncontrolled eating) initially decrease following surgery but then

417   significantly and problematically increase in follow ups beyond a year after surgery

418   [37, 38].

419   Previous research has shown that maternal attachment anxiety is associated

420   with the use of feeding practices that promote child emotional eating, amongst other

421   bidirectional effects [39]. Future research might consider exploring the effect of

422   parental disorganized attachment on child feeding practices. More generally it has

423 been found that parents with disorganized attachment behave in ways that may

424 engender disorganized attachment in a child [40]. Whether eating behaviours form

425 some part of this complex relationship remains to be explored.

426 More generally it should be noted that only a relatively small percentage of the

427 variance associated with BMI was explained by our models (16 -18%), which is in

428 line with previous studies [11, 12]. Furthermore, only correlational relationships were

429 examined here and therefore causal inferences cannot be made. One possibility is

430 reverse causality which would suggest that a higher BMI leads to disinhibited eating

431 behaviours and this affects attachment orientations. In all likelihood, a more complex

432 non-recursive relationship exists which future longitudinal work might consider. A

433 strength of our study is the inclusion of a sub-set of researcher measured height and

434 weight to derive the body mass index rather than just self-reported height and weight

435 alone.

436 This work represents a theoretical advancement of this area in line with the

437 general attachment literature which is growing with respect to our understanding of

438 adult disorganized attachment. Future work should build on the models presented

439 here to include additional demographic and individual difference level factors, for

440 example socio-economic status, which is associated with both attachment [41] and

441 BMI [42] and/ or neuroticism which is also associated with both eating behaviours [43]

442 and attachment orientations [44].

443 In addition, given that attachment orientations are fundamentally rooted in

444 experiences with close others, it is vital that future research consider roles for social

445 relationship level variables (e.g., relationship status and social network perceptions).

446 Of particular interest is that perceived social support has been shown to moderate

447 the relationship between attachment anxiety and health-related measures [45].

448 Specifically, future work could examine whether, like highly anxiously attached

449 individuals, highly attachment disorganized individuals' health is poorer despite a

450 high level of perceived social support compared to low attachment disorganized

451 individuals.

452 Moreover, this work should inform our broader understanding of the

453 association between attachment orientations and health outcomes [46], models *must*

454 consider the role of disorganized attachment over and above organised forms of

455 attachment. Clinicians engaged in addressing eating problems and weight

456 management should consider attachment orientations in their patient assessments

457 and be mindful that attachment disorganized individuals are especially likely to

458 engage in uncontrolled eating behaviours that are associated with a higher BMI.

459 Future work might also consider whether specific interventions are more or less

460 appropriate for use with individuals who have different attachment profiles.

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472 References:

473

474   1.   World Obesity Federation. Obesity infographics. World Obesity Federation

475   website 2017. https://www.obesityday.worldobesity.org/world-obesity-day-

476   2017

477

478   2.   World Health Organisation. Obesity and overweight, WHO website 2016.

479   https://www.who.int/en/news-room/fact-sheets/detail/obesity-and-overweight.

480

481   3.   NCD Risk Factor Collaboration. Trends in adult body-mass index in 200

482   countries from 1975 to 2014: a pooled analysis of 1698 population-based

483   measurement studies with 19· 2 million participants. *The Lancet* 2016;

484   **387**(10026)**:** 1377-1396.

485

486   4.   Ells LJ, Demaio A, Farpour-Lambert N. Diet, genes, and obesity. *BMJ: British*

487   *Medical Journal (Online)* 2018; **360**.

488

489   5.   Diener MJ, Geenen R, Koelen JA, Aarts F, Gerdes VEA, Brandjes DPM *et al.*

490   The Significance of Attachment Quality for Obesity: A Meta-Analytic Review.

491   *Canadian Journal of Behavioural Science-Revue Canadienne Des Sciences*

492   *Du Comportement* 2016; **48**(4)**:** 255-265.

493

494   6.   Bowlby J. *Attachment and Loss: Attachment; John Bowlby*, Basic Books,

495   1969.

496

497   7.   Brennan KA, Clark CL, Shaver PR. Self-report measurement of adult

498   attachment: An integrative overview. 1998.

499

500   8.   Faber A, Dubé L, Knäuper B. Attachment and eating: A meta-analytic review

501   of the relevance of attachment for unhealthy and healthy eating behaviors in

502   the general population. *Appetite* 2017.

503

504   9.   Westenhoefer J, Broeckmann P, Münch A-K, Pudel V. Cognitive control of

505   eating behavior and the disinhibition effect. *Appetite* 1994; **23**(1)**:** 27-41.

506

507   10.   Karlsson J, Persson L-O, Sjöström L, Sullivan M. Psychometric properties and

508   factor structure of the Three-Factor Eating Questionnaire (TFEQ) in obese

509   men and women. Results from the Swedish Obese Subjects (SOS) study.

510   *International Journal of Obesity & Related Metabolic Disorders* 2000; **24**(12).

511

512   11.   Wilkinson LL, Rowe AC, Bishop RJ, Brunstrom JM. Attachment anxiety,

513   disinhibited eating, and body mass index in adulthood. *International Journal of*

514   *Obesity* 2010; **34**(9)**:** 1442-1445.

515

516   12.   Wilkinson LL, Rowe AC, Robinson E, Hardman CA. Explaining the

517   relationship between attachment anxiety, eating behaviour and BMI. *Appetite*

518   2018; **127:** 214-222.

519

520   13.   Mikulincer M. Adult attachment style and affect regulation: strategic variations

521   in self-appraisals. *Journal of personality and social psychology* 1998; **75**(2)**:**

522   420.

523

524   14.   Mikulincer M, Florian V. The relationship between adult attachment styles and

525   emotional and cognitive reactions to stressful events. 1998.

526

527   15.   Maunder R, Hunter J. Attachment and psychosomatic medicine:

528   developmental contributions to stress and disease. *Psychosomatic medicine*

529   2001; **63**(4)**:** 556-567.

530

531   16.   Paetzold RL, Rholes WS, Kohn JL. Disorganized attachment in adulthood:

532   Theory, measurement, and implications for romantic relationships. *Review of*

533   *General Psychology* 2015; **19**(2)**:** 146.

534

535   17.   Main M, Solomon J. Procedures for identifying infants as

536   disorganized/disoriented during the Ainsworth Strange Situation. *Attachment*

537   *in the preschool years: Theory, research, and intervention* 1990; **1:** 121-160.

538

539   18.   Cicchetti D, Barnett D. Attachment organization in maltreated preschoolers.

540   *Development and psychopathology* 1991; **3**(4)**:** 397-411.

541

542   19.   Felitti VJ, Anda RF, Nordenberg D, Williamson DF, Spitz AM, Edwards V *et al.*

543   Relationship of childhood abuse and household dysfunction to many of the

544   leading causes of death in adults: The Adverse Childhood Experiences (ACE)

545   Study. *American journal of preventive medicine* 1998; **14**(4)**:** 245-258.

546

547   20.   Hemmingsson E, Johansson K, Reynisdottir S. Effects of childhood abuse on

548   adult obesity: a systematic review and meta-analysis. *Obesity Reviews* 2014;

549   **15**(11)**:** 882-893.

550

551   21.   Van Strien T, Cleven A, Schippers G. Restraint, tendency toward overeating

552   and ice cream consumption. *International Journal of Eating Disorders* 2000;

553   **28**(3)**:** 333-338.

554

555   22.   Fritz MS, MacKinnon DP. Required sample size to detect the mediated effect.

556   *Psychological science* 2007; **18**(3)**:** 233-239.

557

558   23.   Button K, Lawrence N, Chambers C, Munafò M. Instilling

559   scientific rigour at the grassroots. In: *The Psychologist*: British Psychological

560   Society, 2016. pp 158 -167.

561

562   24.   Lafontaine M-F, Brassard A, Lussier Y, Valois P, Shaver PR, Johnson SM.

563   Selecting the best items for a short-form of the Experiences in Close

564   Relationships questionnaire. *European Journal of Psychological Assessment*

565   2016; **32**(2)**:** 140.

566

567   25.   Price M, Higgs S, Lee M. Self-reported eating traits: underlying components of

568   food responsivity and dietary restriction are positively related to BMI. *Appetite*

569   2015; **95:** 203-210.

570

571   26.   Pursey K, Burrows TL, Stanwell P, Collins CE. How accurate is web-based

572   self-reported height, weight, and body mass index in young adults? *Journal of*

573   *medical Internet research* 2014; **16**(1).

574

575   27.   Ng SP, Korda R, Clements M, Latz I, Bauman A, Bambrick H *et al.* Validity of

576   self-reported height and weight and derived body mass index in middle-aged

577   and elderly individuals in Australia. *Australian and New Zealand journal of*

578   *public health* 2011; **35**(6)**:** 557-563.

579

580   28.   Hayes AF. *Introduction to mediation, moderation, and conditional process*

581   *analysis: A regression-based approach*, Guilford Press, 2013.

582

583   29.   van Strien T. Causes of emotional eating and matched treatment of obesity.

584   *Current diabetes reports* 2018; **18:** 1-8.

585

586   30.   Heatherton TF, Baumeister RF. Binge eating as escape from self-awareness.

587   *Psychological bulletin* 1991; **110**(1)**:** 86.

588

589   31.   Herman CP, Mack D. Restrained and unrestrained eating 1. *Journal of*

590   *personality* 1975; **43**(4)**:** 647-660.

591

592   32.   Han S, Kahn JH. Attachment, Emotion Regulation Difficulties, and Disordered

593   Eating Among College Women and Men. *The Counseling Psychologist* 2017;

594   **45**(8)**:** 1066-1090.

595

596   33.   Mikulincer M, Shaver PR, Pereg D. Attachment theory and affect regulation:

597   The dynamics, development, and cognitive consequences of attachment-

598   related strategies. *Motivation and emotion* 2003; **27**(2)**:** 77-102.

599

600   34.   Nancarrow A, Hollywood A, Ogden J, Hashemi M. The Role of Attachment in

601   Body Weight and Weight Loss in Bariatric Patients. *Obesity surgery* 2018;

602   **28**(2)**:** 410-414.

603

604   35.   Wilkinson L, Rowe A, Sheldon C, Johnson A, Brunstrom J. Disinhibited eating

605   mediates differences in attachment insecurity between bariatric surgery

606   candidates/recipients and lean controls. *International Journal of Obesity* 2017;

607   **41**(12)**:** 1831.

608

609   36.   Shakory S, Van Exan J, Mills JS, Sockalingam S, Keating L, Taube-Schiff M.

610   Binge eating in bariatric surgery candidates: The role of insecure attachment

611   and emotion regulation. *Appetite* 2015; **91:** 69-75.

612

613   37.   Devlin MJ, King WC, Kalarchian MA, Hinerman A, Marcus MD, Yanovski SZ

614   *et al.* Eating pathology and associations with long-term changes in weight and

615   quality of life in the longitudinal assessment of bariatric surgery study.

616   *International Journal of Eating Disorders* 2018.

617

618   38.   Nasirzadeh Y, Kantarovich K, Wnuk S, Okrainec A, Cassin SE, Hawa R *et al.*

619   Binge Eating, Loss of Control over Eating, Emotional Eating, and Night Eating

620   After Bariatric Surgery: Results from the Toronto Bari-PSYCH Cohort Study.

621   *Obesity surgery* 2018**:** 1-8.

622

623   39.   Hardman CA, Christiansen P, Wilkinson LL. Using food to soothe: Maternal

624   attachment anxiety is associated with child emotional eating. *Appetite* 2016;

625   **99:** 91-96.

626

627   40.   Madigan S, Bakermans-Kranenburg MJ, Van Ijzendoorn MH, Moran G,

628   Pederson DR, Benoit D. Unresolved states of mind, anomalous parental

629   behavior, and disorganized attachment: A review and meta-analysis of a

630   transmission gap. *Attachment & human development* 2006; **8**(2)**:** 89-111.

631

632   41.   Van IJzendoorn MH, Bakermans-Kranenburg MJ. Invariance of adult

633   attachment across gender, age, culture, and socioeconomic status? *Journal*

634   *of social and personal relationships* 2010; **27**(2)**:** 200-208.

635

636   42.   Spinosa J, Christiansen P, Dickson J, Lorenzetti V, Hardman C. From socio-

637   economic disadvantage to obesity: The mediating role of psychological

638   distress and emotional eating. *Obesity* in press.

639

640   43.   Ellickson-Larew S, Naragon-Gainey K, Watson D. Pathological eating

641   behaviors, BMI, and facet-level traits: the roles of conscientiousness,

642   neuroticism, and impulsivity. *Eating behaviors* 2013; **14**(4)**:** 428-431.

643

644　44.　Crawford TN, Shaver PR, Goldsmith HH. How affect regulation moderates the

645　　　　association between anxious attachment and neuroticism. *Attachment &*

646　　　　*Human Development* 2007; **9**(2)**:** 95-109.

647

648　45.　Stanton SC, Campbell L. Psychological and physiological predictors of health

649　　　　in romantic relationships: An attachment perspective. *Journal of personality*

650　　　　2014; **82**(6)**:** 528-538.

651

652　46.　Lewczuk K, Kobylińska D, Marchlewska M, Krysztofiak M, Glica A, Moiseeva

653　　　　V. Adult attachment and health symptoms: The mediating role of emotion

654　　　　regulation difficulties. *Current Psychology* 2018**:** 1-14.

655

656　Figure legends:

657

658　Figure 1. Unstandardised regression coefficients are shown with standard error in

659　brackets *B*(SE). Values in brackets are direct effects when controlling for indirect

660　effects. Significant indirect relationships between disorganized attachment and BMI

661　are denoted by an asterisk and were found via uncontrolled eating (*B* = .08, (*SE* =

662　.04), *LLCI* = .02 , *ULCI* = .16) but not via cognitive restraint (*B* = -.0004, (*SE* = .01),

663　*LLCI* = -.02 , *ULCI* = .02) or emotional eating (*B* = .006, (*SE* = .04), *LLCI* = -.08, *ULCI*

664　= .1). The overall R^2 for the model was .18.

665

666　Figure 2. An updated theoretical model of the relationship between attachment

667　orientations and BMI via eating behaviour is presented that for the first time includes

668　disorganized attachment. Unstandardised regression coefficients are shown with

669 standard error in brackets B(SE). Significant indirect relationships are denoted by an

670 asterisk and were found for disorganized attachment and BMI via uncontrolled eating

671 (B = .08, $LLCI$ = .02, $ULCI$ = .17, p = .002) and attachment anxiety and BMI via

672 emotional eating (B = .19, $LLCI$ = .09, $ULCI$ = .32, p<.001).
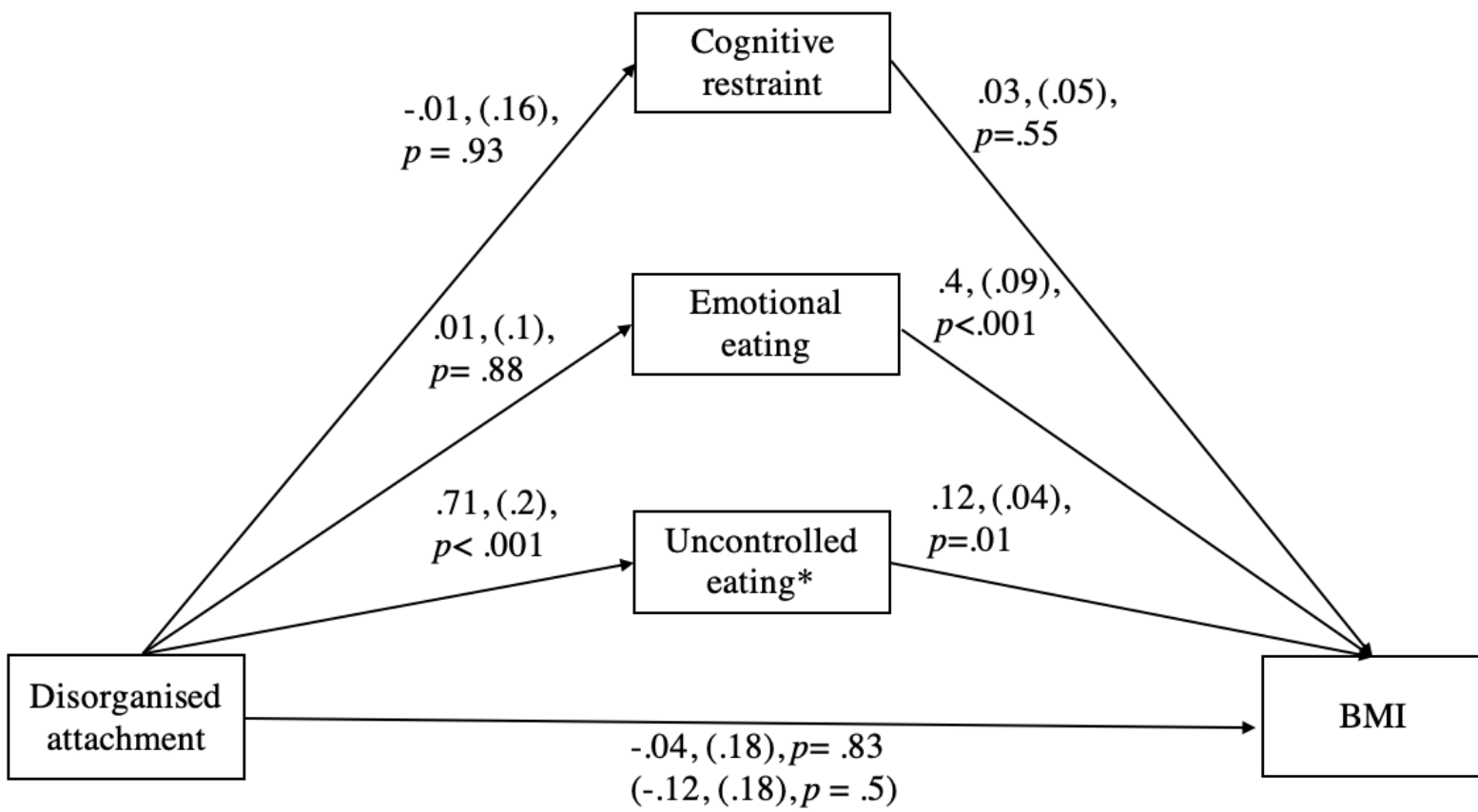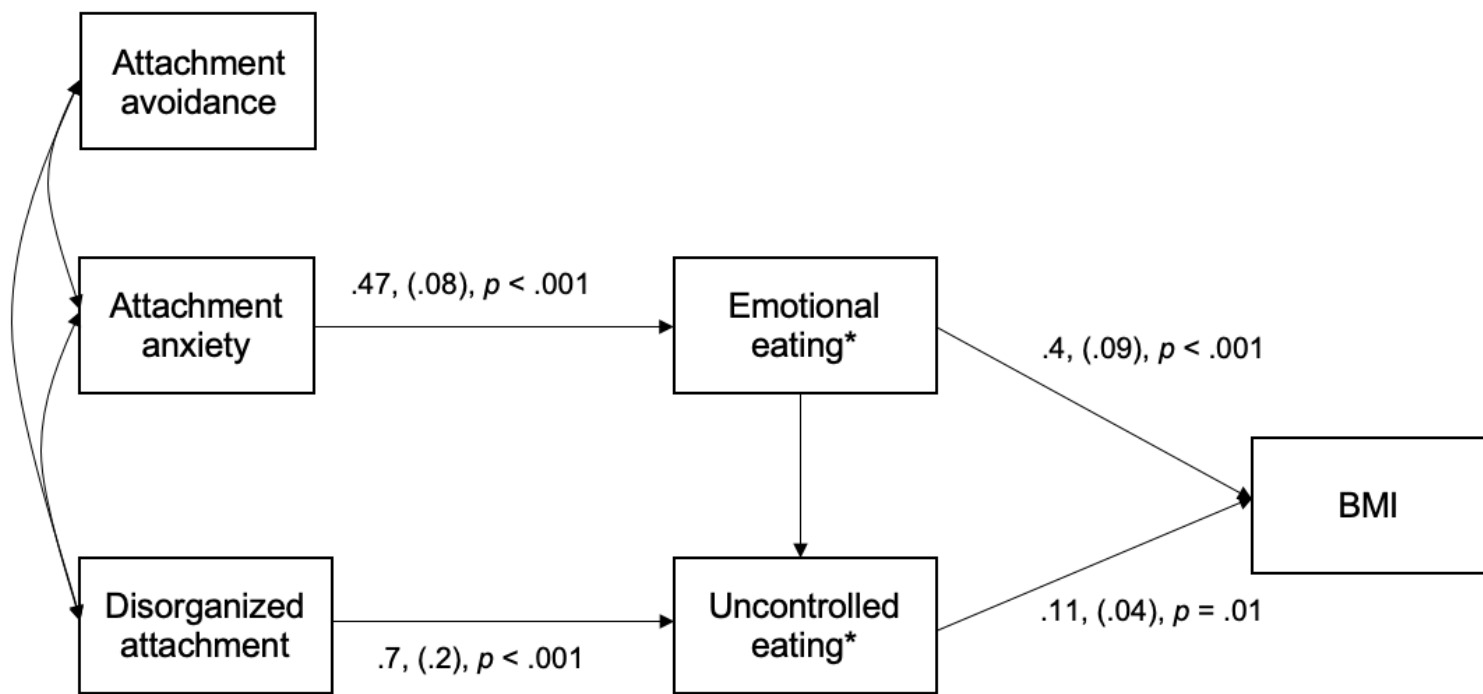
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Figure 1.

Figure 2.

Table 1: For each measure, mean scores, standard deviation (SD) and score range are shown. Units are shown including indication when scores are arbitrary units (a.u.)

	Mean scores	*SD*	Score range
Disorganised attachment (a.u.)	2.8	1.2	1 - 7
Attachment anxiety (a.u.)	4.3	1.4	1 - 7
Attachment avoidance (a.u.)	3.5	1.2	1 - 7
Uncontrolled eating (a.u.)	20.2	4.9	9 - 36
Emotional eating (a.u.)	7.1	2.4	3 - 12
Cognitive restraint (a.u.)	12	3.8	6 - 24
BMI (kg/m2)	23.7	4.3	18.04 - 47.5

Table 2 Pearson's correlations between each measure are shown
(* p < .05 ** p < .001)

	Emotional eating	Cognitive restraint	Attachment anxiety	Attachment avoidance	Disorganised attachment
Uncontrolled eating	.53**	0.06	.24**	0.03	.23**
Emotional eating		.13**	.32**	0.07	.14**
Cognitive restraint			.2**	0.07	0.08
Attachment anxiety				.095*	.36**
Attachment avoidance					.37**
Disorganised attachment					
BMI					
Age					

BMI	Age	Gender
.14**	-.24**	0.05
.204**	-.17**	.17**
0.05	0.02	.16**
-0.05	-.31**	.12**
-0.004	0.01	-.11**
-0.05	-.19**	0.003
	.31**	-0.03
		-.1*

Table 3. Unstandardized path coefficients, standard errors, and t-values for path analysis.

Path	Estimate	SE	t	p
Disorganised attachment to UE	0.7	0.18	3.9	<.001
Disorganised attachment to EE	0.02	0.1	0.15	0.88
Disorganised attachment to BMI	-0.15	0.16	-0.92	0.36
Attachment anxiety to UE	-0.01	0.15	-0.09	0.93
Attachment anxiety to EE	0.47	0.08	5.96	<.001
Attachment anxiety to BMI	-0.04	0.14	-0.31	0.76
UE to BMI	0.11	0.04	2.58	0.01
EE to BMI	0.4	0.09	4.5	<.001

*Additional information about other direct pathways can be found in the supplementary information file.

Table 4: Specific indirect effects and their respective confidence intervals and p-values for the path model

	Indirect effect	Bias-corrected 95% CI	p
Disorganised attachment to UE to BMI	0.08	.02, .17	0.002
Disorganised attachment to EE to BMI	0.01	-.08, .1	0.91
Attachment anxiety to UE to BMI	-0.001	-.04, .04	0.87
Attachment anxiety to EE to BMI	0.19	.09, .32	<.001