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The development and validation of a measure of eating disorder-specific interpersonal problems: The Interpersonal Relationships in Eating Disorders (IR-ED) scale

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24 **The development and validation of a measure of eating disorder-specific interpersonal**
25 **problems: The Interpersonal Relationships in Eating Disorders (IR-ED) scale**

26
27 **Abstract**

28 Clinical reports suggest that interpersonal problems are associated with the onset and
29 maintenance of eating pathology, but existing measures of such problems have limited links to
30 eating pathology. Therefore, the aim of this study was to develop an eating-specific measure of
31 interpersonal problems. The new measure, the Interpersonal Relationships in Eating Disorders
32 scale (IR-ED), was administered to a large community sample, a non-clinical replication
33 sample, and a clinical group of eating disorder patients. In Study 1, the psychometric properties
34 of the IR-ED were established, and they were tested using confirmatory analyses in Study 2.
35 Study 3 determined the validity of the test score interpretations in a clinical sample. The final
36 15-item version of the IR-ED demonstrated three distinct factors with reliability of test scores
37 - Food-Related Isolation; Avoidance of Body Evaluation; and Food-Related Interpersonal
38 Tension. Study 2 demonstrated that the IR-ED comprises a common Interpersonal Problems
39 factor and a specific group factor - Avoidance of Body Evaluation. Study 3 showed that the
40 clinical group had higher IR-ED scores than a non-clinical group. Across the studies, Avoidance
41 of Body Evaluation was the strongest correlate of eating pathology in this group. The IR-ED
42 has strong psychometric properties and its test scores appear to be more valid than those of a
43 generic measure of interpersonal problems. Avoidance of Body Evaluation is the strongest facet
44 of such interpersonal problems, and has meaningful links to models of eating psychopathology.

45
46 **Key words:** eating; interpersonal problems; validation; measurement; assessment;
47 psychometrics; eating disorders

49 **Public Significance Statement**

50 Interpersonal problems are commonly reported by individuals with eating disorders, but
51 clinicians have not previously had an evidence-based way of formulating or measuring such
52 problems. This study provides a validated measure of interpersonal problems that clinicians can
53 use to formulate eating problems and plan treatment for eating-disordered patients.

54

55 **The development and validation of a measure of eating disorder-specific interpersonal**
56 **problems: The Interpersonal Relationships in Eating Disorders (IR-ED) scale**

57 Interpersonal problems are difficulties in how people relate to, compare themselves to,
58 or interact with others, and have been linked to many psychological difficulties (e.g., Barrett,
59 & Barber, 2007; Eng, & Heimberg, 2006; Grisham, Steketee, & Frost, 2008; Kleiner, &
60 Marshall, 1987; Lazarus, Cheavens, Festa, & Rosenthal, 2014). Clinical accounts and research
61 suggest that interpersonal problems can influence and maintain non-clinical and clinical eating
62 concerns and behaviours (e.g., Abraham, & Beumont, 1982; Broberg, Hjalms, & Novenen,
63 2001; Lampard, Byrne, & McLean, 2011; Lieberman, Gauvin, Bukowski, & White, 2001;
64 Murphy, Straebl, Basden, Cooper, & Fairburn, 2012; Rieger et al., 2010; Schmidt, &
65 Treasure, 2006; Steiger et al., 1999; Tanofsky-Kraff, Wilfrey, & Spurrell, 2000). However, it
66 is not clear whether interpersonal problems have any specificity to eating pathology or whether
67 they are relatively generic to all mental disorders. There might be specific interpersonal
68 difficulties linked to eating pathology that are not captured by generic measures of interpersonal
69 problems (e.g., concern about others' evaluation of one's body). Identifying eating-specific
70 interpersonal problems could be important in assessing, formulating, and treating eating
71 disorders. For example, both interpersonal psychotherapy and cognitive behavioural therapy
72 stress the need to address interpersonal issues where they maintain an eating disorder (e.g.,
73 Fairburn, Cooper, & Shafran, 2003; Wilfley et al., 2002).

74 If the link between eating pathology and interpersonal problems were non-specific, one
75 would expect a generic measure of interpersonal problems to account for a substantial amount
76 of variance in eating pathology. There are several such generic measures, such as the
77 Interpersonal Relationship Inventory (Tilden, Nelson, & May, 1990) and the Interpersonal
78 Relationship Scale (Guerney, 1977). However, most have not been considered for their utility
79 when understanding eating disorders. When McEvoy, Burgess, Page, Nathan and Fursland

80 (2013) used one of the most well-established non-specific measures (the Inventory of
81 Interpersonal Problems–32 [IIP-32] - Barkham, Hardy, & Startup, 1996), they found that it has
82 limited utility in detecting interpersonal problems in eating disorder patients. Five out of eight
83 IIP-32 subscales were not related to variance in eating pathology. Raykos, McEvoy and
84 Fursland (2017) have also demonstrated that generic socialising problems (as measured by the
85 IIP-32) do not have a direct relationship with eating disorder symptoms.

86 Therefore, it appears that generic interpersonal measures such as the IIP-32 do not
87 adequately address eating-specific interpersonal problems, such as avoidance of others’
88 judgements about one’s appearance. Hence, it is important to consider whether a more specific
89 measure of the interpersonal problems faced by people with eating disorders would have greater
90 utility in understanding eating pathology. As no such measure exists, the aims of the first study
91 are to detail the development and initial validation of a measure of interpersonal issues related
92 to eating disorders (IR-ED) and to determine whether it has greater utility than generic measures
93 of interpersonal problems. As detailed in Study 1, the IR-ED items were generated through
94 discussion and revision by the authors, based on substantial experience in working with eating
95 disorders. Inclusion of items was on the basis of clinical relevance, but avoiding redundant
96 items. To demonstrate psychometric and clinical utility, the measure should: have a clear factor
97 structure with adequate internal consistency of the resulting scales; show strong reliability of
98 test-retest scores; be as strongly associated with non-eating pathology (anxiety, depression,
99 social anxiety) as a generic measure of interpersonal problems; and be more strongly associated
100 with eating pathology than a generic measure.

101 Study 1 aimed to develop the IR-ED measure based on factor analysis with a
102 homogenous non-clinical female sample, and then to determine its initial utility with males and
103 individuals with self-reported eating disorders. Further studies then aimed to replicate the
104 measure’s psychometric properties (Study 2) and to validate its scores with a clinical sample

105 (Study 3). The first hypothesis was that the IR-ED will have a clear and meaningful factor
106 structure, which can be assessed for clinical utility and which can be compared and contrasted
107 with a generic measure of interpersonal problems. The second hypothesis was that the IR-ED's
108 psychometric properties will be replicable. The final hypothesis was that the IR-ED will show
109 clinical utility among patients with eating disorders.

110 **STUDY 1 – DEVELOPMENT AND INITIAL VALIDATION OF THE MEASURE**

111 **Method**

112 **Participants**

113 Participants were recruited using online survey methods, including university staff and
114 student email lists and advertisements on Facebook and Twitter. They were not compensated
115 in any form. Individuals who reported an eating disorder were not included, in order to ensure
116 that any association with eating disorders in subsequent studies and analyses were not a product
117 of bias introduced by such individuals in the development of the IR-ED. Five hundred and
118 eighty-nine people logged onto the study. Fifty-eight (9.8%) dropped out before completing all
119 measures, leaving 531 completers (393 female, 136 male, 2 no gender specified). A total of 261
120 completers consented to be contacted for a follow-up, with 142 participants completing the re-
121 test stage (54.4%). Exploratory analyses showed that there were no differences in stage 1
122 measures between those who did or did not agree to or actually undertake the second stage (p
123 $< .05$ in all cases).

124 Overall, 31 participants (5.83%; 29 females) reported a current or past eating disorder
125 diagnosis. Most women did not report having an eating disorder diagnosis ($n = 364$; M age =
126 33.13, $SD = 11.38$; M body mass index (BMI) = 25.10, $SD = 6.49$), with the remainder self-
127 reporting an eating disorder diagnosis ($n = 29$; M age = 26.34, $SD = 8.05$; M BMI = 21.15, SD
128 = 1.16). Likewise, most men did not report having an eating disorder diagnosis ($n = 134$; M age
129 = 37.43, $SD = 13.57$; M BMI = 26.64, $SD = 4.66$), with the remainder self-reporting an eating

130 disorder diagnosis ($n = 2$; M age = 23.00, $SD = 7.07$; M BMI = 31.50, $SD = 9.73$). Most of the
131 sample was UK-based (91%), with the next largest contributor being the USA (2.64%).

132 **Measures**

133 Following completion of demographic information (e.g., nationality, age, self-reported
134 weight and height, history of diagnosis of an eating disorder), each participant completed the
135 following six measures within the online survey (completed on Qualtrics).

136 **Interpersonal Relationships in Eating Disorders scale (IR-ED)**. The IR-ED was
137 developed for the purposes of this study. The measure asked participants to rate the extent of
138 various interpersonal issues related to eating pathology, using a five-point Likert scale ranging
139 from 1 (“Not at all”) to 5 (“All the time”). A detailed description of the IR-ED’s development
140 is detailed in the Procedure.

141 **Inventory of Interpersonal Problems (IIP-32, Barkham et al., 1996)**. The IIP-32 is a
142 32-item questionnaire that addresses interpersonal problems across eight domains. The global
143 scale has acceptable reliability ($\alpha = 0.87$) and test-retest reliability ($r = 0.70$; Barkham et al.,
144 1996). Internal consistency for the global scale was high ($\alpha = 0.93$) in the present study.

145 **Eating Disorder Examination Questionnaire, version 6.0 (EDE-Q, Fairburn, 2008)**.
146 The EDE-Q is a widely used measure of eating pathology. It has four attitudinal subscales:
147 Restraint, Weight Concern, Shape Concern and Eating Concern. It has acceptable psychometric
148 and clinical validity (e.g., Luce, & Crowther, 1999), particularly at the global score level. High
149 internal consistency of the global EDE-Q was observed in the present sample ($\alpha = 0.94$), and
150 their mean score was 2.00 ($SD = 1.31$).

151 **Brief Fear of Negative Evaluation Scale – Straightforwardly Worded (BFNE-S,
152 Rodebaugh, Woods, Thissen, Heimberg, Chambless, & Rapee, 2004)**. The BFNE-S is an
153 eight-item self-report measure of fear about being negatively evaluated. It contains
154 straightforwardly worded items from the BFNE scale (Leary, 1983). The eight items are

155 summed to create a total score with higher scores indicating a higher fear of negative evaluation.
156 The BFNE-S has excellent internal consistency ($\alpha = .92$) and strong construct validity in clinical
157 samples (Weeks et al., 2005). The BFNE-S has demonstrated predictive utility for social anxiety
158 symptoms as measured by the Liebowitz Social Anxiety Scale (Weeks et al., 2005). High
159 internal consistency was observed in the present sample ($\alpha = 0.95$), and their mean score was
160 23.0 (SD = 8.99).

161 **Patient-Reported Outcomes Measurement Information System – Depression and**
162 **Anxiety** (PROMIS-D and PROMIS-A, Pilinkos et al., 2011). The PROMIS-D is an eight-item
163 questionnaire measuring depression. It has high internal consistency ($\alpha = 0.95$) and convergent
164 validity ($r = 0.83$). The PROMIS-A is a seven-item questionnaire measuring anxiety (Pilinkos
165 et al., 2011), with high internal consistency ($\alpha = 0.93$) and convergent validity ($r = 0.80$). High
166 internal consistency was observed in the present study for PROMIS-D ($\alpha = 0.94$) and PROMIS-
167 A ($\alpha = .94$). Their mean scores were 2.14 (SD = 0.92) and 2.27 (SD = 0.86), respectively.

168 **Procedure**

169 The IR-ED was developed through several iterations by the research team. An initial
170 pool of 28 items was developed by SJ and GW based upon clinical experience and a prior
171 literature search of interpersonal problems in eating disorders. The pool was shared with
172 research colleagues in Australia (BR, AF, SB, PM), who revised and added items based upon
173 their own clinical experience. The resultant pool consisted of 49 items, which were reviewed
174 iteratively by the research teams, leading to similar items being omitted or merged. This
175 iterative process led to a final pool of 26 items, which the research team as a whole reviewed
176 and agreed on in terms of face validity. Each item is rated on a five-point Likert scale, where
177 higher scores indicate a greater presence of the specific interpersonal issue over the past 28
178 days. After reading the information sheet and providing consent, participants completed all
179 measures (Time 1). The IR-ED was completed again by a subset of participants two weeks later,

180 to determine test-retest reliability (Time 2). Ethical approval for this study was provided by the
181 relevant Ethical Review Committee.

182 **Data analysis**

183 Initially, exploratory factor analysis (SPSS principal analysis factoring) was used to
184 determine whether the IR-ED had a meaningful factor structure. To protect against
185 heterogeneity influencing this analysis, only female participants were used for this analysis, and
186 those with an eating disorder diagnosis were excluded, resulting in $N = 364$. This number of
187 participants was well above the recommended guideline of five to 10 participants per
188 questionnaire item (Gorsuch, 1983). Specific factors were not hypothesised a priori. Nor was it
189 hypothesised that the resulting factors would be correlated. However, as that was a possible
190 outcome, different rotations were compared (Varimax and Direct Oblimin), and the most
191 appropriate model was used based on the coherence of the factors that emerged (i.e., the items
192 could be conceptually grouped into meaningful scales). Factors were retained if they had an
193 eigenvalue of >1.0 (Dancey & Reidy, 2004) and following visual inspection of scree plots and
194 other characteristics (see below for further detail). Tang et al. (1998) recommend that individual
195 items should be retained only if they load onto a specific factor by at least 0.4. For this study, a
196 more stringent cut-off of 0.5 was used to ensure a more robust measure. Individual items were
197 excluded if substantial cross-loading was detected (i.e., the difference in loadings between
198 factors was less than 0.2), to ensure that the factors were as distinct as possible. **Parallel analysis**
199 **was conducted to exclude the possibility of inclusion of inappropriately weak factors, using the**
200 **online engine (<https://analytics.gonzaga.edu/parallelengine/>) developed by Patil, Singh,**
201 **Mishra, & Donovan (2008). The criteria set were 26 variables, 380 participants, 100 random**
202 **correlation matrices, 95% percentile of eigenvalues, and 1000 seeds.** Cronbach's alpha was
203 used to determine the internal consistency of the emergent factors within the IR-ED.

204 The test-retest reliability of the IR-ED scores was analysed using intraclass correlations

205 and paired t-tests, based on the 35 male and 107 female participants who completed the study
206 at Time 1 and Time 2 but who did not report any history of an eating disorder (thus excluding
207 12 participants for this analysis). Pearson's correlations were also used to determine the
208 association of scores on the IR-ED and the IIP-32, based on the participants who completed
209 both measures and who did not report any eating disorder history (n = 500). For those
210 correlations, Bonferroni's correction was used to correct for multiple tests (n = 24), resulting in
211 an acceptable alpha of .002.

212 Multiple regression analyses were used to determine the relative utility of the IR-ED
213 and IIP-32 to explain variance in eating pathology (EDE-Q global score). This analysis was
214 repeated to determine which of the IR-ED and IIP-32 scales predicted general psychopathology
215 (anxiety, depression and fear of negative social evaluation). These analyses included all male
216 (n = 134) and female (n = 364) participants who did not report an eating disorder diagnosis.
217 Partial correlations were used to determine whether levels of anxiety, depression and fear of
218 negative social evaluation were uniquely associated with IR-ED subscales, to exclude the
219 possibility that apparent links between IIP-32 and IR-ED scores with eating pathology were
220 indirect, and were actually due to associations of interpersonal problems with mood and anxiety
221 symptoms. Again, Bonferroni's correction was used to correct for multiple correlations (n =
222 24), resulting in an acceptable alpha of .002.

223 Results

224 Factor structure of the IR-ED

225 Table 1 shows the results of the factor analysis. A Varimax rotation provided the best
226 solution (with strong, psychologically meaningful factors). It revealed three factors, based on
227 15 of the 26 original IR-ED items. The remaining items were excluded due to loading below
228 0.5 on all scales. No other items were excluded due to cross-loading, as none had loadings
229 within 0.2 of the strongest factor loading. Three factors were chosen because they met all the

230 following criteria - eigenvalue > 1.0 (this applied to five factors that came before the scree point
231 (four met this criterion, as eigenvalues for the first four factors were 4.341, 4.237, 3.069, 2.203
232 and 2.011, levelling off after that); accounted for a substantial additional cumulative amount of
233 variance (three factors met this criterion, as the variance accounted for was 16.7%, 16.3%,
234 11.8%, 8.47% and 7.61%); and contained items that loaded most strongly on the relevant factor
235 (this applied to three factors, as no items loaded most strongly on the final two of the five
236 strongest factors). Parallel analysis was also conducted on the data set, and suggested that all
237 of the five factors could have been included, but this was not done, given the lack of items
238 loading on any factor after the third. However, this analysis did offer reassurance that the use
239 of three factors was not excessive.

240 The first of the three factors was labelled Food-Related Isolation. It consisted of items
241 3, 5, 15, 18 and 22, and accounted for 16.70% of the variance in scores. The second factor was
242 Avoidance of Body Evaluation, which contained items 1, 6, 9, 11, 21 and 24, and accounted for
243 16.30% of the variance in scores. The third factor was Food-Related Interpersonal Tension,
244 which consisted of items 8, 12, 14 and 16, and accounted for 11.80% of variance in scores. All
245 IR-ED scales had acceptable internal consistency (Table 1). IR-ED scales were all significantly
246 correlated for this non-clinical group, in the moderate to strong range: Food-Related Isolation
247 with Avoidance of Body Evaluation – $r = .65$, $p < .001$; Food-Related Isolation with Food-
248 Related Interpersonal Tension – $r = .55$, $p < .001$; Avoidance of Body Evaluation with Food-
249 Related Interpersonal Tension – $r = .43$, $p < .001$).

250 Finally, item mean scores on the three IR-ED scales were calculated (sum of the relevant
251 items/number of items), and are reported in Table 1. A global score on the IR-ED was calculated
252 from the mean of the three subscales – $M = 1.50$; $SD = 0.62$; range = 1.00-3.83. The final, 15-
253 item version of the IR-ED and scoring key are presented in Appendix 1.

254 **Test-retest reliability of the IR-ED**

255 All IR-ED factors demonstrated significant ($P < .001$, in all cases) and strong intraclass
256 correlations (ICCs) between time 1 and time 2 for males and females, as follows – Food-Related
257 Isolation (males = .89; females = .90); Avoidance of Body Evaluation (males = .83; females =
258 .90); and Food-Related Interpersonal Tension (males = .77; females = .87). There were no
259 significant differences across time on the IR-ED subscales for either gender (Bonferroni
260 corrected $p > .05$ in all cases), apart from the scores for females on the Avoidance of Body
261 Evaluation scale, where there was a small but statistically significant rise in scores across the
262 two weeks ($M = 1.77$, $SD = 1.00$ vs $M = 1.88$, $SD = 1.07$; $t = 2.72$; $p = .008$). Therefore, the IR-
263 ED scores demonstrated broadly acceptable test-retest reliability.

264 **Association between generic and eating-specific measures of interpersonal problems**

265 Table 2 presents individual correlation coefficients between the subscales of the IR-ED
266 and the IIP-32. As stated above, an acceptable alpha value of .002 was used to reduce the risk
267 of Type 1 errors. Most IR-ED subscales were significantly associated with the IIP-32 subscales.
268 However, the correlations were weak to moderate, suggesting that the IR-ED and IIP-32 were
269 measuring relatively distinct constructs.

270 **Association of interpersonal problems with general and eating psychopathology**

271 Correlations between measures of psychopathology and the IR-ED are presented in
272 Table 3 for females and males separately. For the EDE-Q, partial correlations were conducted
273 controlling for anxiety, depression and fear of negative evaluation (PROMIS-A, PROMIS-D,
274 and BFNE-S scores), in order to understand the specific link between interpersonal problems
275 and eating pathology. As stated above, the alpha value was set at .002 to reduce the risk of Type
276 1 errors. Most of the IR-ED subscales were significantly associated with the PROMIS-A,
277 PROMIS-D, and BFNE-S. The IR-ED scales were also correlated with Global EDE-Q scores
278 when anxiety, depression and fear of negative evaluation were controlled for. Correlations were
279 mostly weak to moderate in strength.

280 To determine which aspects of interpersonal problems were associated most strongly
281 with eating pathology, multiple regression analyses were used (for females and males
282 separately). The individual scale scores of the IIP-32 and the IR-ED were entered
283 simultaneously as predictors of the global EDE-Q score (see Table 4). For females, the three
284 IR-ED scales were the strongest predictors of eating pathology, with only the IIP-32 Too
285 Dependent scale contributing significantly from the more generic elements of interpersonal
286 problems. IR-ED Avoidance of Body Evaluation was the strongest individual factor. For males,
287 only Avoidance of Body Evaluation was associated with eating pathology. Thus, one
288 interpersonal factor was the dominant concern relating to eating pathology – avoidance of
289 people and situations due to body concerns.

290 Similar analyses were conducted for the three broader measures of psychopathology in
291 the whole of this sample (full analyses available on request from the corresponding author). All
292 three regression analyses showed a significant overall effect of the IR-ED and IIP-32 on the
293 dependent variables ($F > 15.0$; $p < .001$; Adjusted $R^2 > 0.5$ in all cases). In the case of depression
294 (PROMIS-D), the IR-ED was the better predictor, with IR-ED Negative Body Evaluation ($t =$
295 3.45 ; $\beta = .314$; $p < .001$) contributing most strongly to poorer mood. In contrast, for anxiety
296 (PROMIS-A), the IIP-32 was the stronger predictor, with the IIP-32 Dependent scale being the
297 most powerful correlated of anxiety ($t = 3.30$; $\beta = .275$; $p < .001$). The same pattern was
298 found for fear of negative evaluation (FNEB), where the IIP-32 Dependent scale was again the
299 most powerful ($t = 5.34$; $\beta = .432$; $p < .001$).

300 Discussion

301 Using a non-clinical sample, the IR-ED demonstrated an acceptable three-factor
302 solution which consisted of Food-Related Isolation, Avoidance of Body Evaluation and Food-
303 Related Interpersonal Tension. The IR-ED was associated with a generic measure of
304 interpersonal problems (IIP-32) and showed equivalence to the IIP-32 in relation to other areas

305 of psychopathology (anxiety, depression and social anxiety). Importantly, the IR-ED predicted
306 more variance in eating pathology compared to the generic measure of interpersonal problems.
307 Future research using a larger sample of men is needed to demonstrate whether the same factor
308 structure holds among males as well as females.

309 **STUDY 2 – CONFIRMATORY ANALYSIS OF THE IR-ED’S STRUCTURE**

310 The first aim of study two was to cross-validate the IR-ED scores in an independent
311 undergraduate sample using confirmatory factor analyses comparing unitary, uncorrelated
312 three-factor, correlated three-factor, and bifactor models. The three-factor models assume the
313 factors represent theoretically distinct constructs beyond the total scale, and therefore imply
314 that the calculation of subscale scores will result in a more meaningful interpretation. However,
315 it may be premature to interpret subscale scores as representing a meaningful construct distinct
316 from a general interpersonal difficulty factor (Rodriguez, Reise, & Haviland, 2016).
317 Interpersonal problems in response to disordered eating are diverse and, although the data-
318 driven exploratory factor analysis in Study 1 statistically distinguished between three
319 components of interpersonal problems, the majority of variance across these three factors may
320 still be common (i.e., someone experiencing one type of interpersonal problem is likely to
321 experience others). Such a pattern of findings would suggest that the boundaries between the
322 problems assessed by the three factors in the IR-ED provide little independent or incremental
323 utility compared to a total score. For instance, if the shared variance amongst the subscales
324 explains most of the variance in subscale scores, then each subscale mostly reflects a single
325 underlying ‘interpersonal problems’ construct. In this case, specifying distinct latent variables
326 in models using the IR-ED may result in redundancy and multicollinearity problems.
327 Conceptually, identifying a predominant underlying general interpersonal problems factor
328 would be more parsimonious and may help to simplify case formulation and treatment planning.
329 Alternatively, if each subscale assesses substantive unique group factors that are separate to the

330 general factor and have unique predictive utility, this may assist the development of more
331 targeted interventions.

332 Adopting a bifactor modelling approach is one way to inform researchers and clinicians
333 on the most appropriate psychometric structure of the IR-ED, including whether total and/or
334 subscale scores should be used when interpreting the measure (Reise, Moore, & Haviland 2010;
335 Rodriguez et al., 2016). The bifactor measurement model stipulates that the variance in item
336 responses can be accounted for by a general factor representing shared variance amongst all the
337 items in addition to a set of group factors that explain variance beyond that explained by the
338 general factor (Reise et al., 2010; Rodriguez et al., 2016). Therefore, the general factor reflects
339 the broad construct a scale is attempting to measure, whilst the group factors reflect more
340 specific subdomains. For the present study, bifactor modelling will assist in determining
341 whether interpersonal problems in eating disorders are best conceptualised as unidimensional
342 or multidimensional.

343 The second aim was to investigate whether the IR-ED can predict eating disorder
344 symptoms, namely dietary restraint, shape concern, weight concern, and eating concern in a
345 non-clinical sample, after controlling for more generic measures of interpersonal functioning.
346 To determine whether the interpersonal problems measured by the IR-ED are specific to eating
347 disorder symptoms, it was also important to control for co-morbid psychopathology, such as
348 depression and anxiety, given that previous research has demonstrated these factors to be
349 associated with interpersonal problems in eating disorders (Arcelus et al., 2013).

350 The first hypothesis was that a bifactor model would provide the best fit relative to the
351 three-factor uncorrelated (orthogonal) model from study one, a three-factor correlated model
352 (factors were free to correlate), and a unidimensional model. The rationale for this hypothesis
353 was that interpersonal problems resulting from disordered eating are expected to co-occur and
354 interact with each other, such that a substantial proportion of variance across the factors is

355 shared. A bifactor model also enables the separability of specific interpersonal problems to be
356 modelled, and it is plausible that the three factors will also explain a substantive proportion of
357 unique reliable variance in subscale scores. The second hypothesis was that the IR-ED would
358 uniquely predict eating disorder psychopathology (dietary restraint, shape concerns, weight
359 concerns, eating concerns) after controlling for general interpersonal measures, depression, and
360 anxiety in a non-clinical sample.

361 **Participants**

362 Participants were recruited through convenience sampling through the School of
363 Psychology and Speech Pathology's participant pool. They were not compensated for
364 participation. MacCallum, Browne, and Sugawara's (1996) recommendations suggest that a
365 minimum sample size of 200 should be adequate to test models with the degrees of freedom in
366 the proposed models, although a larger sample will enable greater precision of parameter
367 estimates. The final sample comprised 396 cases (306 females, 86 males, and 4 identifying as
368 "other") with ages ranging from 17-69 years ($M = 21.76$, $SD = 6.13$).

369 **Measures and Procedure**

370 The same measures as Study 1 were administered in Study 2. This study was granted
371 ethics approval from the relevant University Ethics Committee (RDHS-58-16). The
372 questionnaires were administered online using Qualtrics. Participants were first required to read
373 and indicate their agreement to an information sheet and consent form about the study. After
374 completing the survey (time 1), participants were presented with a debriefing document that
375 detailed the aims of the study, and were provided with the contact details of counselling
376 services. Participants were asked to complete the IR-ED again after two-weeks (time 2).
377 Participants received course credit for their participation.

378 **Data Analysis**

379 Preliminary data screening to assess normality, univariate and multivariate outliers,

380 multicollinearity and the normality, linearity, and homoscedasticity of residuals was performed
381 in SPSS 23.0. As for study 1, the test-retest reliability of the IR-ED scores was analysed using
382 intraclass correlations and paired t-tests. Confirmatory factor analysis (CFA) using maximum
383 likelihood estimation was conducted in Mplus 8.0 (Muthén & Muthén, 1998-2017) to compare
384 the relative fit of each competing IR-ED measurement model. The IR-ED bifactor model was
385 compared to unidimensional, three-factor correlated, and three-factor uncorrelated models. A
386 number of fit indices were used to evaluate the competing IR-ED models including the chi-
387 square goodness of fit statistic (χ^2), comparative fit index (CFI), the Tucker-Lewis index (TLI),
388 and the root mean square error of approximation (RMSEA) with 90% confidence intervals
389 (CIs). Values greater than .90 and .95 for the CFI and TLI are indicative of a good and excellent
390 fit, respectively (Hu & Bentler, 1999; Tabachnick & Fidell, 2013). For the RMSEA, values of
391 .06 or less indicate a good-fitting model, with lower values corresponding with a closer fit, and
392 the upper CI limit should not exceed .10 (Tabachnick & Fidell, 2013). Model comparisons were
393 evaluated using chi-square difference tests.

394 Several statistical indices were calculated to assess the degree to which the variance in
395 the total and subscale scores could be attributed to variance associated with a single latent
396 variable (Rodriguez et al., 2016). The coefficient omega (ω) represents the proportion of total
397 score variance that is attributable to all common factors (i.e. both the general and group factors).
398 Alternatively, coefficient omega hierarchal (ω_H) represents the percentage of variance in IR-
399 ED total scores that is attributable to a single general factor. Explained common variance (ECV)
400 reflects the percentage of common variance that can be explained by the general factor with
401 higher values (greater than .70 or .80) suggesting the presence of a strong general factor in
402 addition to providing support for the unidimensionality of the scale's items (Rodriguez et al.,
403 2016). Item explained common variance (I-ECV) reflects the percentage of variance in each
404 IR-ED item that is attributable to the general factor (Rodriguez et al., 2016). The percent

405 uncontaminated correlations (PUC) can be used in conjunction with the ECV to determine the
406 dimensionality of the model (Reise et al., 2010). PUC represents the proportion of IR-ED item
407 covariance's that can be accounted for by the variance that is attributable to the general factor
408 and group factors (Rodriguez et al., 2016). Reise and colleagues (2010) suggest that when PUC
409 values are less than .80, ECV values are greater than .60, and ω_H is greater than .70 then the
410 multidimensionality within the data does not have enough impact to prohibit the interpretation
411 of the model as unidimensional.

412 A structural equation model was used to assess if the group factors and general
413 interpersonal problem factor accounted for unique variance in eating disorder symptoms (as
414 indicated by the dietary restraint, weight concern, shape concern, and eating concerns subscale
415 scores from the EDE-Q) beyond the variance accounted for by more generic measures of
416 interpersonal problems (BFNE-S and IIP-32). The model was run again controlling for
417 depression and anxiety. Confidence intervals (95%) were calculated around the parameter
418 estimates of the final model using 1000 bootstrapping resamples.

419 Results

420 Preliminary Analyses

421 No data were missing on key outcome variables (IR-ED, EDEQ). Missing data at Time
422 1 were observed for 12 cases (22 missing values in total) on depression and anxiety measures.
423 Little's Missing Completely At Random (MCAR) test was not significant, $\chi^2(125) = 127.63$, p
424 $= .42$, so missing data were imputed using expectation-maximization in SPSS. Histograms of
425 model variables were inspected for normality. All measures demonstrated acceptable skewness
426 (< 2) and kurtosis (< 7), thereby satisfying the assumption of normality (Tabachnick & Fidell,
427 2013). Inspection of box plots and Mahalanobis Distance revealed no problematic univariate or
428 multivariate outliers. The assumptions of linearity and homoscedasticity of residuals were met.
429 In addition to descriptive statistics, Table 5 shows that, in the current sample, scores on all

430 measures demonstrated excellent internal consistency, and the measures were moderately and
 431 positively correlated with each other.

432 **Test-retest reliability of the IR-ED**

433 A total of 304 participants (242 females, 59 males, 3 no gender given) provided re-test
 434 data for the IR-ED at time 2. Participants who did versus did not provide time 2 data did not
 435 significantly differ on age, gender, or any measure (all p s > .29). All IR-ED factors
 436 demonstrated significant and strong ICCs between time 1 and time 2 for males and females, as
 437 follows – Total score (males - $r = .80$, females - $r = .90$, Food-Related Isolation (males - $r = .67$;
 438 females - $r = .89$); Avoidance of Body Evaluation (males - $r = .84$; females - $r = .89$); and Food-
 439 Related Interpersonal Tension (males - $r = .81$; females - $r = .87$). For females, there was a
 440 significant but small reduction in Avoidance of Body Evaluation ($M = 2.22$, $SD = 1.00$ vs $M =$
 441 2.13 , $SD = .99$, $p = .02$), but changes were small and non-significant for the other subscales and
 442 total score (mean changes = $-.02$ to $.72$, p s = $.06$ to $.63$). For males, changes on total and subscale
 443 scores were very small (mean change ranged from $-.003$ to $.025$) and non-significant (p s = $.68$ -
 444 $.96$). Therefore, scores on the IR-ED demonstrated broadly acceptable test-retest reliability and
 445 stability.

446 **IR-ED Measurement Models**

447 The unidimensional, $\chi^2(90) = 555.25$, CFI = .782, TLI = .746, RMSEA = .114 (90% CI
 448 = .105-.123), and uncorrelated three-factor, $\chi^2(90) = 476.83$, CFI = .819, TLI = .789, RMSEA
 449 = .104 (90% CI = .095-.113), models provided a poor fit to the data. The correlated three-factor
 450 model, $\chi^2(87) = 175.97$, CFI = .958, TLI = .950, RMSEA = .051 (90% CI = .040-.061), and
 451 the bifactor model, $\chi^2(75) = 129.06$, CFI = .975, TLI = .965, RMSEA = .042 (90% CI = .030-
 452 $.055$), provided an excellent fit to the data. A significant chi-square difference test indicated
 453 that the bifactor model fit the data significantly better than the correlated three-factor model,
 454 $\Delta\chi^2(12) = 46.91$, $p < .001$. The standardized factor loadings for the one-factor, three-factor

455 uncorrelated, three-factor correlated, and bifactor models are presented in Table 6.

456 A majority of the IR-ED items had stronger loadings on the general factor than on the
 457 group factors with the exception of three items from group factor two (1, 6, and 7). Loadings
 458 were greater than .50 on the general factor, indicating that the items mostly represent the general
 459 interpersonal problems factor and support computation of a total score (Reise et al., 2010). The
 460 omega (ω) coefficients for the general IR-ED factor and group factors were high, ranging from
 461 .85 to .95. Omega hierarchical (ω_H) suggested that 82.3% of variance in IR-ED total scores can
 462 be accounted for by individual differences on the general factor. Group factor one (Food
 463 Related Isolation) explained very little variance (5.6%) in the subscale scores independent from
 464 the general IR-ED factor. Evidence of some multidimensionality was found as group factor two
 465 (Avoidance of Body Evaluation) and group factor three (Food-related Interpersonal Tension)
 466 accounted for a moderate proportion of subscale score variance (48.0% and 32.6%,
 467 respectively). The general factor accounted for 68.7% of the common variance whilst 31.3% of
 468 the common variance was attributable to the three group factors. The ECV value provided
 469 support for a robust general factor, though failed to reach the benchmark ($>.70$) needed to
 470 unambiguously indicate unidimensionality. A majority (66.7%) of the IR-ED items had I-ECV
 471 values less than .80, signifying they are poorer indicators of the general IR-ED factor and
 472 contribute more to the variance in their respective group factors. The PUC demonstrated that
 473 the general factor accounted for 70.5% of the item correlations in the IR-ED. Furthermore, the
 474 average relative parameter bias across the IR-ED items was acceptable (11.6%).

475 **Structural Equation Models**

476 Due to the inability to rule out multidimensionality from the CFAs, the bifactor model
 477 was employed in all structural models. An initial measurement model with the IR-ED bifactor
 478 model plus the eating disorder symptoms measurement model, but without any freed
 479 covariances between latent variables, provided a poor fit to the data, $\chi^2(137) = 465.745$, $p <$

480 .001, CFI = .908, TLI = .885, RMSEA = .078 (90% CI = .070-.086). The initial structural model
481 with the general factor and three group factors predicting eating disorder symptoms did not
482 converge. Given that group factor 1 explained a very small proportion of unique variance in the
483 bifactor measurement model, it was removed as a predictor of eating disorder symptoms. This
484 time the model converged, providing an excellent fit, $\chi^2(134) = 275.252$, $p < .001$, CFI = .960,
485 TLI = .949, RMSEA = .048 (90% CI = .043-.060). However, factor 3 of the IR-ED was a non-
486 significant predictor of eating disorder symptoms so this pathway was removed and the model
487 rerun. This final model also provided an excellent fit to the data, $\chi^2(135) = 275.660$, $p < .001$,
488 CFI = .961, TLI = .950, RMSEA = .048 (90% CI = .043-.060). The model accounted for 55.9%
489 (R^2) of the variance in eating disorder symptoms.

490 To examine the independent contribution of the IR-ED beyond the BFNE-S and IIP-32,
491 these measures were entered in the model as unique predictors of global EDE-Q. First, we tested
492 a measurement model with the IR-ED bifactor model, EDE-Q, BFNE-S, and IIP-32
493 measurement models without the structural pathways, which provided a poor fit to the data,
494 $\chi^2(545) = 1932.514$, $p < .001$, CFI = .826, TLI = .810, RMSEA = .080 (90% CI = .076-.084).
495 The structural pathways were then freed, and the general factor and second group factor of the
496 IR-ED were freed to correlate with BFNE-S and IIP-32. This model provided an adequate fit
497 to the data, $\chi^2(536) = 1300.67$, $p < .001$, CFI = .904, TLI = .894, RMSEA = .060 (90% CI =
498 .056-.064). The modification indices were observed to identify sources of model strain and the
499 largest modification index (118) was between items 5 and 6 of the BFNE-S. Both of these items
500 begin with the same sentence structure "I'm afraid that..." which is indicative of common
501 method variance. The residual variances of these two items were freed to correlate and the
502 model was rerun. No further modifications were deemed theoretically defensible. Results
503 revealed an acceptable fit, $\chi^2(535) = 1189.31$, $p < .001$, CFI = .918, TLI = .909, RMSEA = .056
504 (90% CI = .051-.060) and demonstrated the IR-ED general factor ($b = .50$, 95% CI = .35-.64),

505 IR-ED group factor two ($b = .47$, 95% CI = .32-.61), BFNE-S ($b = .34$, 95% CI = .22-.46), and
506 IIP-32 ($b = -.21$, 95% CI = -.37- -.06) all uniquely predicted global EDE (see Figure 1). The
507 model explained 61% (R^2) of the variance in eating disorder symptoms. Finally, the model was
508 rerun controlling for depression and anxiety symptoms. The relationships between the IR-ED,
509 IR-ED group factor two, BFNE-S, IIP-32 and eating disorder symptoms remained significant
510 after controlling for depression and anxiety. Depression and anxiety were not significantly
511 associated with eating disorder symptoms in this model, so the penultimate model was
512 preferred.

513 Discussion

514 Confirmatory Factor Analysis using an independent non-clinical sample suggested that
515 the IR-ED contains a strong general interpersonal problems factor, which can be assessed using
516 a total IR-ED score, and that is related to eating pathology. Variance in the Food-Related
517 Interpersonal Tension and Food-Related Isolation subscales is mostly accounted for by the
518 general factor, so these subscales cannot be meaningfully differentiated from the total score and
519 therefore should not be calculated. In contrast, Avoidance of Body Evaluation appears to be a
520 distinct factor and therefore could be considered separately from the total score to inform
521 formulation and subsequent intervention.

522 STUDY 3 – CLINICAL VALIDATION OF THE IR-ED

523 Using a clinical sample with diagnosed eating disorders, the aims of Study 3 were to:
524 (a) report descriptive statistics for the IR-ED, relative to the scores of non-clinical individuals;
525 (b) report bivariate correlations between the IR-ED and clinical characteristics (fear of negative
526 evaluation, anxiety, depression, generic interpersonal problems, and eating disorder
527 symptoms); and (c) demonstrate unique variance between the IR-ED subscales and eating
528 disorder symptoms. Although findings from Study 2 using an undergraduate sample suggested
529 that a total score should be used, in Study 3 we examined the IR-ED total and subscale scores

530 within a clinical sample as future psychometric investigations with larger clinical samples
531 might reveal greater differentiation between the subscales than was found in the non-clinical
532 sample.

533 **Participants**

534 The clinical sample comprised 107 patients (96% female; 71% Anglo-Australian
535 ethnicity; 55% employed) who were consecutively referred to a public mental health service
536 with a dedicated outpatient eating disorders service. All patients had a confirmed DSM-5 eating
537 disorder diagnosis (32% anorexia nervosa, 37% bulimia nervosa, 25% other specified feeding
538 or eating disorder, 6% unspecified feeding or eating disorder). Patients ranged in age from 16
539 to 63 years ($M = 24.3$ years, $SD = 9.5$ years) and illness duration ranged from 4 months to 51
540 years ($M = 5.9$ years; $SD = 8.1$ years). Exclusion criteria included current psychosis,
541 schizophrenia, or schizoaffective disorder, significant alcohol or substance abuse/dependence,
542 medical instability, or BMI below 14 kg/m². This study received approval from the Institution's
543 Human Research Ethics Committee (Approval Number QI 2014/39) and all patients provided
544 written informed consent for their data to be included. No patients were compensated for taking
545 part.

546 **Method**

547 **Procedure**

548 As part of routine clinical practice, patients attended an assessment at the clinic, which
549 included completion of self-report measures and administration of the Eating Disorder
550 Examination interview (EDE Version 12; Fairburn & Cooper, 1993). The EDE was
551 administered by clinical psychologists trained in its administration and specialising in eating
552 disorder treatment. The EDE scores have good convergent and concurrent validity, have good
553 inter-rater reliability, and discriminate well between groups with and without an eating disorder
554 (Berg et al., 2012; Fairburn & Cooper, 1993).

555 **Measures**

556 The measures from Study 2 were administered in Study 3.

557 **Data Analysis**

558 Mean IR-ED total and subscale scores were compared between the undergraduate
559 sample in Study 2 and the clinical sample in Study 3 using a MANOVA (to correct for any
560 potential intercorrelations of the IR-ED scales). Pearson's bivariate correlation coefficients
561 were also calculated between the IR-ED and BFNE-S, PROMIS anxiety and depression scales,
562 IIP-32, and EDE-Q global scores. An initial multiple regression analysis was then conducted to
563 examine the proportion of variance in EDE-Q Global scores that could be explained by the IR-
564 ED subscales, and the unique predictive utility of each subscale. BFNE, PROMIS anxiety and
565 depression, and IIP-32 total scale scores were then added to the model to investigate whether
566 IR-ED subscales continued to explain unique variance in EDE-Q Global scores.

567 **Results**

The means (SDs) for IR-ED Total score, Food-Related Isolation, Avoidance of Body Evaluation, and Food-Related Interpersonal Tension scales were 3.12 (0.93), 3.05 (0.98), 3.13 (0.98), and 3.15 (1.15), respectively. The MANOVA used to compare the student sample (from Study 2) with the clinical sample (this study) showed a significant overall effect ($F(3,499) = 84.5; p < .001; \text{partial } \eta^2 = 0.337$). Correcting for any intercorrelations, the clinical group had significantly higher mean scores on: Food-Related Isolation ($F(1,156.6) = 248.6; p < .001; \text{partial } \eta^2 = 0.337$); Avoidance of Body Evaluation ($F(1,100.0) = 113.1; p < .001; \text{partial } \eta^2 = 0.184$); and Food-Related Interpersonal Tension ($F(1,151.4) = 175.5, p < .001; \text{partial } \eta^2 = 0.259$). All effect sizes were very large. Table 7 shows that the IR-ED subscales were significantly and positively correlated with the BFNE-S, PROMIS anxiety and depression scales, IIP-32 subscales and EDE-Q global.

Multiple regression analysis was used to test if the three IR-ED scales significantly

predicted EDE-Q Global scores. Together, the three predictors explained 46.0% of the variance in EDE-Q Global (adjusted $R^2 = .46$), $F(3,102) = 30.77$, $p < .001$. However, the only significant individual predictor variable was IR-ED Avoidance of Body Evaluation subscale score ($B = .75$, 95% CI = .43-1.07, SE B = .16, $\beta = .57$, $p < .001$). IR-ED Food-related isolation ($B = .21$, 95% CI = -.19 - .60, SE B = .30, $\beta = .21$, $p = .31$) and Food-related interpersonal tension ($B = -.01$, 95% CI = -.26 - .24, SE B = .13, $\beta = .01$, $p = .92$) did not contribute significantly to the prediction of EDE-Q Global. When BFNE-S, IIP-32 Total, PROMIS anxiety and depression scores were included in the regression analysis, the predictor variables together explained 59% of the variance in EDE-Q Global (adjusted $R^2 = .59$), $F(7,98) = 22.23$, $p < .001$. IR-ED Avoidance of Body Evaluation ($B = .71$, 95% CI = .41 - 1.00, SE B = .15, $\beta = .53$, $p < .001$), BFNE-S ($B = .03$, 95% CI = .01 - .06, SE B = .01, $\beta = .22$, $p = .009$), IIP-32 Total ($B = -.54$, 95% CI = -.97 - -.11, SE B = .22, $\beta = .27$, $p = .01$), and anxiety ($B = .03$, 95% CI = .003 - .06, SE B = .01, $\beta = .22$, $p = .029$) emerged as significant individual predictors. IR-ED Food-related isolation ($B = .08$, 95% CI = -.28 - .44, SE B = .18, $\beta = .06$, $p = .439$) and IR-ED Food-related interpersonal tension ($B = .02$, 95% CI = -.21 - .24, SE B = .11, $\beta = .01$, $p = .140$) did not contribute significantly to the prediction of EDE-Q Global.¹

¹ Exploratory regression analyses were conducted separately in patients with primary AN and primary BN with the IR-ED subscales predicting EDE-Q Global scores. For patients with primary AN, the three IR-ED subscales explained 67% of the variance in EDE-Q Global (adjusted $R^2 = .67$), $F(3,31) = 21.61$, $p < .001$. As for the full sample, Avoidance of Body Evaluation subscale score was a significant individual predictor ($B = 1.30$, 95% CI = .69-1.91, SE B = .30, $\beta = .97$, $p < .001$), but Food-related isolation ($B = -.03$, 95% CI = -.76 - .71, SE B = .36, $\beta = -.02$, $p = .94$) and Food-related interpersonal tension ($B = -.21$, 95% CI = -.63 - .21, SE B = .21, $\beta = -.18$, $p = .31$) were not. For patients with primary BN, the three IR-ED subscales explained 37% of the variance in EDE-Q Global (adjusted $R^2 = .37$), $F(3,35) = 21.61$, $p < .001$. Avoidance of Body Evaluation subscale ($B = .33$, 95% CI = -.08 - .75, SE B

Discussion

A sample of individuals diagnosed with an eating disorder scored significantly higher on all IR-ED subscales compared to the non-clinical sample from study two. The IR-ED was also able to predict a large amount of variance in eating pathology beyond generic interpersonal problems, fear of negative evaluation, anxiety and depression, which was accounted for by the Avoidance of Body Evaluation subscale. This study suggests that the IR-ED has a unique and positive association with eating pathology in a clinical sample.

GENERAL DISCUSSION

568 Various models of eating disorders stress the importance of understanding interpersonal
 569 problems in assessing, formulating, and treating eating disorders (e.g., Fairburn et al., 2003;
 570 Lampard et al., 2011; Murphy et al., 2012; Rieger et al., 2010; Steiger et al., 1999). However,
 571 existing generic measures of interpersonal problems are only weakly associated with eating
 572 disorder pathology (e.g., McEvoy et al., 2013; Raykos et al., 2017). This series of studies aimed
 573 to develop a measure of interpersonal problems that is specific to eating pathology, and to
 574 determine whether this focus resulted in greater utility. The resulting measure – the IR-ED –
 575 demonstrates strong psychometric properties (factor structure, internal consistency, test-retest
 576 reliability), is moderately associated with a generic measure of interpersonal problems (the IIP-
 577 32), and has comparable associations to the IIP-32 with other pathologies (e.g., anxiety).
 578 However, the IR-ED scores have much greater clinical validity for use in eating disorders than

= .20, $\beta = .30$, $p = .11$), Food-related isolation ($B = .45$, 95% CI = -.04 - .94, SE $B = .24$, $\beta = .43$, $p = .07$), and Food-related interpersonal tension ($B = -.05$, 95% CI = -.40 - .30, SE $B = .17$, $\beta = -.06$, $p = .77$) were not statistically significant predictors. These post-hoc exploratory analyses within the AN and BN subsamples must be interpreted cautiously due to low power, and they must be replicated in larger samples.

579 the IIP-32, with stronger associations with eating attitudes and self-reported diagnoses in a non-
580 clinical sample, and with confirmed eating disorder diagnoses in a clinical sample. These
581 findings suggest that basing a measure of interpersonal problems on the specific disorder being
582 considered may be more effective than using a generic measure. However, whether this
583 improvement applies to other disorders is a matter for empirical investigation.

584 In Study 1, three correlated subscales emerged from the IR-ED - Food-Related Isolation,
585 Avoidance of Body Evaluation, and Food-Related Interpersonal Tension – reflecting different
586 domains of interpersonal problems relative to eating pathology. Food-Related Isolation
587 captures a theme of not wanting to eat in front of others and the secrecy that can surround eating
588 for people who experience eating pathology. Such concerns relate to the roles of shame and
589 self-criticism in the maintenance cycle of eating disorders (e.g., Danakalis et al., 2016),
590 impacting upon an individual’s likelihood to isolate themselves when eating and to disengage
591 from social activities where eating may be likely. Avoidance of Body Evaluation relates to
592 themes of social withdrawal from activities or scenarios where an individual’s body may be
593 viewed or evaluated by others, as shown to be relevant to the onset and maintenance of eating
594 pathology (e.g., Fairburn, 2008) via the impact of restriction and efforts to manage body size
595 and weight. Food-Related Interpersonal Tension relates to how an individual’s eating
596 behaviours influence the way other people interact with and behave towards them. For example,
597 people with eating disorders can isolate themselves and get involved in interpersonal role
598 disputes (e.g., Murphy et al., 2012).

599 Study 2 found evidence of a bifactor structure for the IR-ED, consisting of a general
600 interpersonal problem factor and one group factor (Avoidance of Body Evaluation). Avoidance
601 of Body Evaluation uniquely explained 48% of its respective subscale variance beyond that
602 explained by the general IR-ED factor, and contained three items that loaded higher onto the
603 group factor rather than the general factor. This group factor also demonstrated acceptable

604 reliability, suggesting it reflects a well-defined and stable subscale. These findings indicate that
605 Avoidance of Body Evaluation is a distinct construct from general interpersonal problems in
606 eating disorders, and should be considered as such when formulating a case and adapting
607 interventions for clients. In contrast, the Food-related Isolation and Food-related Interpersonal
608 Tension subscales appear to be ill-defined and unstable, suggesting that the items within these
609 subscales should be integrated within the total score but not be scored separately. During case
610 formulation, treatment planning and treatment outcome evaluation, clinicians may choose to
611 use a total score as a broad assessment of eating disorder related interpersonal problems, but
612 they also have the option to use the Avoidance of Body Evaluation subscale score to capture a
613 specific interpersonal problem that uniquely predicts eating disorder symptoms. It is important
614 to emphasise that the items measured by the other two IR-ED subscales still appear to assess
615 important components of interpersonal problems related to eating disorders, as evidenced by
616 their strong loading on the general IR-ED factor, but scoring them separately from the total
617 score is not meaningful.

618 Study three found evidence of discriminant validity of the IR-ED. Patients with a
619 confirmed eating disorder scored significantly higher overall and on all three IR-ED scales than
620 individuals in the community sample (Study 2). Consistent with findings from the two
621 community samples, Avoidance of Body Evaluation emerged as the strongest predictor of
622 eating pathology. These findings are consistent with the earlier conclusion that Avoidance of
623 Body Evaluation is a distinct construct from generic interpersonal problems that may be
624 important to consider in the assessment of patients with eating disorders. The specificity of this
625 interpersonal problem is highly amenable to case formulation (e.g., as a specific element within
626 the 'Life' element of Fairburn et al.'s [2003] transdiagnostic model, potentially explaining the
627 over-evaluation of shape) and treatment planning (e.g., exposure-based methods, behavioural
628 experiments, or imagery re-scripting interventions that directly address avoidance of body

629 evaluation may augment current evidence-supported protocols for eating disorders).

630 This series of studies has several strengths, including initial validation and cross-
631 validation in independent samples, and preliminary results within a clinical sample with
632 eating disorders. To summarise, convergent validity of the IR-ED scores is demonstrated by
633 their strong Cronbach's alphas ($\geq .8$ in all cases) and the associations of the scores with the
634 other inventories. Discriminant validity of the scores was shown by the size of the
635 correlations between the IR-ED scales ($r = .43-.63$), the differences between males and
636 females, and the differences between those with and without eating disorders. However, there
637 are several ways in which the research needs to be consolidated and extended. These will
638 include confirmation of the factor structure within a larger clinical sample, and determining
639 the utility of the measure among younger people, larger samples of males, and in different
640 cultures. Confirmation of the factor structure within a clinical sample is particularly critical
641 before findings using the three subscales in Study 3 can be considered reliable. For
642 completeness, and in case the three subscales are found to be more separable in future clinical
643 samples than they were in our undergraduate sample (Study 2), we investigated all three
644 subscales as predictors of eating disorder symptoms. However, if future studies find that the
645 IR-ED is best considered unidimensional in clinical samples then only a total score should be
646 used as a predictor.

647 There is also a need to investigate whether there are differences between different
648 diagnostic groups. Post-hoc exploratory analyses suggested that there may be differences
649 across individuals with principal AN versus BN diagnoses (footnote 1), although the small
650 sample sizes militate against strong conclusions being drawn from this study. Future research
651 with larger samples is required to examine differences.

652 It is important that future research evaluates measurement invariance of the IR-ED
653 across groups (e.g., clinical and non-clinical samples, different eating disorders, males and

654 females), to ensure that items are being interpreted in similar ways and that any identified
655 differences can be meaningfully interpreted. Finally, it should also be considered in future
656 research whether such a measure should be based on clinically-generated items that reflect
657 interpersonal problems found specifically in those with eating disorders, by adding items
658 generated by patients with eating disorders themselves.

659 The IR-ED has the potential to be a valuable tool across tasks and therapies. Initial
660 assessment of interpersonal problems specific to eating and body concerns might indicate ways
661 of understanding the origins and maintenance of eating disorders. However, the IR-ED might
662 also be used to identify central or supplementary targets for interventions (e.g., interpersonal
663 issues to address in interpersonal psychotherapy or in enhanced CBT), as well as potential
664 moderators (e.g., is there a need to individualise therapy to enhance its impact, as suggested
665 within existing protocols?). If this is the case, then the IR-ED might be used to evaluate progress
666 in treatment and prevention programmes (e.g., as an index of the outcome of stigma-reduction
667 programmes), as well as in initial identification of interpersonal problems.

668 **Conclusions**

669 This study showed evidence of construct and convergent validity, as well as internal
670 consistency and test-retest reliability, for a measure of eating-specific interpersonal problems –
671 the IR-ED. Compared to more generic measures of interpersonal problems, the IR-ED provides
672 greater insight into eating-specific interpersonal problems. Future research should aim to
673 confirm the structure in a clinical sample and investigate the roles of eating-specific
674 interpersonal problems in the onset, maintenance, and treatment of eating disorders.

675

676 **Conflict of Interest**

677 The authors have no conflict of interest to declare.

678

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Table 1

Principal Analysis Factoring (Varimax rotation) of the IR-ED measure for females who did not report an eating disorder diagnosis (n = 364), with item mean scores and internal consistency of resulting scales.

Items	Factor 1 Food-Related Isolation	Factor 2 Avoidance of Body Evaluation	Factor 3 Food-Related Interpersonal Tension
1 I find it hard to spend time with others because I worry what they think about my body	.408	.730	.109
2 I worry what others would think of my if they knew how I eat	.568	.478	.312
3 I avoid social situations where eating is involved	.729	.306	.161
4 My appearance allows me to stand out amongst my peers	.131	.189	.096
5 I avoid getting into conversations with others about food	.649	.266	.196
6 I avoid socialising with people who are likely to comment on my body or appearance	.353	.610	.168
7 Eating the way I do helps me to cope with my anxiety in social situations	.363	.366	.296
8 Other people try to pressure me into eating differently	.221	.174	.647
9 I avoid intimacy because I worry what others will think of my body	.168	.712	.121
10 Others admire my ability to control what I eat	.103	-.088	.067
11 I avoid certain activities that would mean other people might judge my body	.138	.746	.179
12 My pattern of eating often leads to disagreements or tension with others	.317	.123	.690
13 My appearance helps me feel that I fit in and am more accepted by others	-.033	-.053	.068
14 Other people try to pressure me into changing my appearance	-.011	.295	.551
15 My eating patterns make it hard for me to socialise as much as I would like to	.725	.286	.145
16 Other people worry about what I eat	.275	.049	.736

17	When I experience tension with others, I focus more on controlling my eating / weight	.292	.279	.304
18	I prefer to eat alone to avoid conflict with others about what I eat	.630	.269	.381
19	I worry that I spend too much time talking with other people about my appearance	.126	.397	.235
20	Controlling my weight helps me to feel more confident in social situations	.160	.318	.163
21	Worrying about my weight and appearance makes it difficult to feel really “connected” when I am with other people	.376	.656	.147
22	My eating patterns cause me to withdraw from others	.705	.262	.289
23	Eating the way I do makes it more likely that others will show concern for me	.369	-.111	.511
24	It is difficult to meet new people as I worry they are judging me or my appearance	.352	.697	.145
25	My eating patterns cause me to be secretive or deceptive with others	.583	.245	.407
26	Eating the way I do helps me to communicate my feelings and needs to others	.232	.117	.285
<hr/>				
	Eigenvalue	4.341	4.237	3.069
	Variance explained (Rotated)	16.70%	16.30%	11.80%
	Cronbach’s alpha	0.838	0.892	0.800
	Item mean	1.38	1.69	1.42
	(SD)	(0.71)	(0.89)	(0.62)

Note. Items where loadings are in bold were retained in that factor in the final version of the IR-ED.

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Table 2

Pearson's correlations (r) between the IR-ED and IIP-32, for all participants who did not report an eating disorder diagnosis (n=500)

IR-ED scale	IIP-32 scale								
	Hard to be sociable	Hard to be assertive	Too aggressive	Too open	Too caring	Hard to be supportive	Hard to be involved	Too dependent	
Food-Related Isolation	.53*	.31*	.22*	-.21*	.35*	.27*	.43*	.35*	
Avoidance of Body Evaluation	.56*	.36*	.30*	-.18*	.41*	.33*	.51*	.51*	
Food-Related Interpersonal Tension	.26*	.15*	.23*	.02	.23*	.19*	.18*	.30*	

Note. ^a IR-ED = Interpersonal Relationships in Eating Disorders; IIP-32 = Inventory of Interpersonal Problems. *p < .001

Table 3

Pearson's correlations (r) between the IR-ED and measures of fear of negative evaluation, depression, anxiety and eating disorder psychopathology

	Female (n = 364)			Male (n = 134)		
	Food-Related Isolation	Avoidance of Body Evaluation	Food-Related Interpersonal Tension	Food-Related Isolation	Avoidance of Body Evaluation	Food-Related Interpersonal Tension
BFNE-S	.45*	.56*	.30*	.31*	.54*	.17
PROMIS-anxiety	.40*	.50*	.28*	.23	.47*	.14
PROMIS-depression	.40*	.58*	.26*	.39*	.58*	.26*
EDE-Q Global	.40* ^a	.54* ^a	.34* ^a	.31* ^a	.34* ^a	.23 ^a

805 Note. ^a Partial Pearson's correlations controlling for PROMIS-A, PROMIS-D and BFNE-S. PROMIS-
806 D = Patient-Reported Outcomes Measurement Information System – Depression; PROMIS-A =
807 Patient-Reported Outcomes Measurement Information System – Anxiety; BFNE-S = Brief Fear of
808 Negative Evaluation-Straightforwardly worded scale; EDE-Q = Eating Disorders Examination
809 Questionnaire. * p < .001
810

811 Table 4
 812 Multiple regressions using Interpersonal Relationships in Eating Disorders scores (IR-ED) and
 813 Inventory of Interpersonal Problems scores (IIP-32) as predictors of Eating Disorder Examination
 814 Questionnaire global score (EDE-Q)

Independent variables	t	p	Beta
Females: N = 364, F(df = 11,363) = 39.8, P < .001, Adjusted R ² = .54			
IR-ED Food-Related Isolation	3.04	.003	.160
IR-ED Avoidance of Body Evaluation	9.66	.001	.537
IR-ED Food-Related Interpersonal Tension	2.34	.02	.100
IIP Hard to be Sociable	2.16	.04	-.122
IIP Hard to be Assertive	0.26	NS	-.013
IIP Too Aggressive	0.04	NS	-.002
IIP Too Open	0.79	NS	-.033
IIP Too Caring	2.41	.02	-.102
IIP Hard to be Supportive	0.30	NS	-.014
IIP Hard to be Involved	1.46	NS	-.074
IIP Too Dependent	3.37	.001	.174
Males: N = 134, F(df = 11,132) = 5.47, P < .001, Adjusted R ² = .27			
IR-ED Food-Related Isolation	1.80	NS	.224
IR-ED Avoidance of Body Evaluation	2.89	.005	.338
IR-ED Food-Related Interpersonal Tension	0.28	NS	.031
IIP Hard to be Sociable	1.42	.04	.162
IIP Hard to be Assertive	1.86	NS	-.191
IIP Too Aggressive	0.40	NS	.035
IIP Too Open	0.14	NS	.013
IIP Too Caring	1.49	.02	.135
IIP Hard to be Supportive	0.67	NS	-.078
IIP Hard to be Involved	1.18	NS	-.156
IIP Too Dependent	1.15	NS	.124

816 Table 5
 817 Descriptive Statistics, Bivariate Correlations, and Internal Consistencies in the
 818 undergraduate sample (Study 2)

	Mean	SD	1	2	3	4	5	6
1. IR-ED total	1.83	.77	.93					
2. EDE-Q Global	2.00	1.46	.66*	.96				
3. IIP-32	1.18	.65	.66*	.47*	.94			
4. BFNE-S	22.29	8.52	.57*	.59*	.62*	.95		
5. PROMIS-Dep	18.01	7.90	.56*	.51*	.58*	.59*	.95	
6. PROMIS-Anx	19.29	8.00	.54*	.49*	.58*	.57*	.82*	.95

819 Note. Internal consistencies are on the diagonals. SD = standard deviation; IR-ED =
 820 Interpersonal Relationships – Eating Disorders; EDE-Q Global = Eating Disorder
 821 Examination Global Score; IIP = Inventory of Interpersonal Problems; BFNE-S = Brief Fear
 822 of Negative Evaluation Straightforwardly Worded; PROMIS-Dep = Patient Reported
 823 Outcome Measurement Information System (PROMIS): Depression and Anxiety. * $p < .001$.

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Table 6.
Standardized Factor Loadings for the Measurement Models of the Interpersonal Relationships – Eating Disorders

Item	Uni- dimens ional	Three-factor Uncorrelated			Three-factor correlated			Bifactor model			
		F1	F2	F3	F1	F2	F3	General	F1	F2	F3
1. I find it hard to spend time with others because I worry what they think about my body	.67		.78			.78		.53		.57	
2. I avoid social situations where eating is involved	.670	.72			.72			.71	.12		
3. I avoid getting into conversations with others about food	.67	.71			.72			.71	.09		
4. I avoid socialising with people who are likely to comment on my body or appearance	.71		.74			.75		.61		.43	
5. Other people try to pressure me into eating differently	.64			.82			.81	.64			.50
6. I avoid intimacy because I worry what others will think of my body	.66		.79			.78		.52		.60	
7. I avoid certain activities that would mean other people might judge my body	.63		.77			.76		.48		.62	
8. My pattern of eating often leads to disagreements or tension with others	.67			.71			.77	.72			.26
9. Other people try to pressure me into changing my appearance	.53			.60			.59	.45			.41
10. My eating patterns make it hard for me to socialise as much as I would like to	.75	.80			.80			.76	.21		
11. Other people worry about what I eat	.61			.82			.79	.60			.58
12. I prefer to eat alone to avoid conflict with others about what I eat	.75	.76			.78			.80	.00		
13. Worrying about my weight and appearance makes it difficult to feel really “connected” when I am with other people	.75		.78			.79		.65		.45	

(Table continues)

Item	Uni- dimens ional	Three-factor Uncorrelated			Three-factor correlated			Bifactor model			
		F1	F2	F3	F1	F2	F3	General	F1	F2	F3
14. My eating patterns cause me to withdraw from others	.80	.88			.86			.81	.51		
15. It is difficult to meet new people as I worry they are judging me or my appearance	.72		.82			.82		.59		.57	
Coefficient omega								$\omega=.95$	$\omega_s=.90$	$\omega_s=.91$	$\omega_s=.85$
	ECV							.93	.29	.72	.52
	PUC							.71			

Note. N = 396. F1 = food-related isolation factor; F2 = avoidance of body evaluation factor; F3 = food related interpersonal tension factor,

ω = omega; ω_s = omega subscale; ω_H = omegaH; ECV = explained common variance; PUC = percent uncontaminated correlations.

Table 7

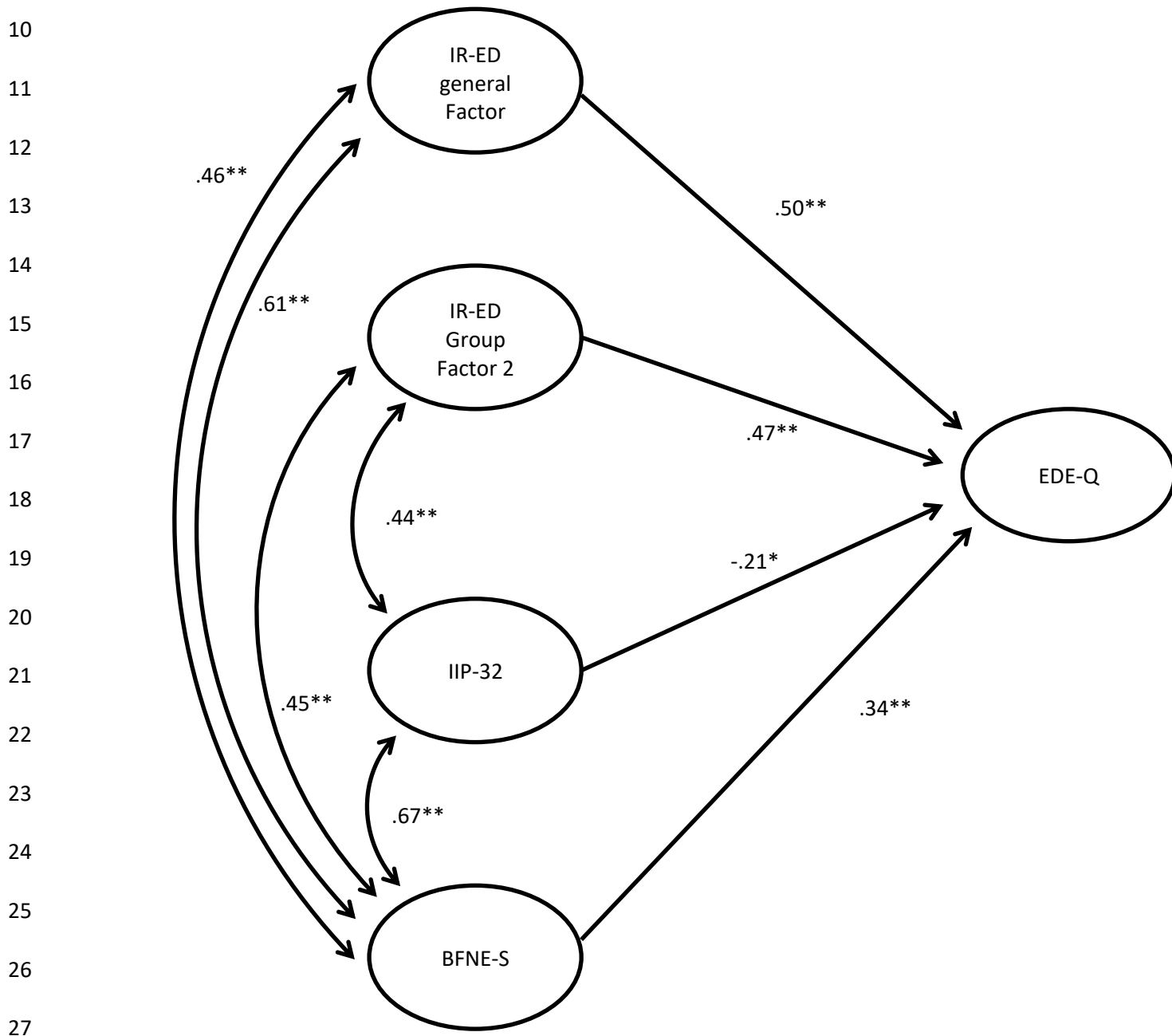
Spearman's rho correlations between the IR-ED and the BFNE-S, anxiety, depression, and IIP-32 in the clinical sample (N = 107)

	IR-ED Total	Food-related isolation	Avoidance of body evaluation	Food-related interpersonal tension
BFNE-S	.38***	.40***	.41***	.20*
PROMIS-anxiety	.39***	.40***	.38***	.30***
PROMIS-depression	.47***	.47***	.48***	.34**
EDE-Q Global	.67***	.60***	.68***	.43***
IIP-32				
Hard to be sociable	.55***	.56***	.57***	.34***
Hard to be assertive	.32**	.36***	.42***	.13
Too aggressive	.38***	.38***	.28**	.35***
Too open	-.26**	-.26**	-.29*	-.22
Too caring	.25*	.26*	.29**	.13
Hard to be supportive	.38***	.36***	.37***	.31**
Hard to be involved	.60***	.58***	.62***	.41***
Too dependent	.30**	.29**	.33**	.19 ^a

Note. BFNE = Brief Fear of Negative Evaluation scale, IR-ED = Interpersonal Relationships in Eating Disorders; IIP-32 = Inventory of Interpersonal Problems; EDE-Q = Eating Disorder Examination Questionnaire; PROMIS = Patient-Reported Outcomes Measurement

Information System – Depression and Anxiety scales. ^ap = .05 *p < .05 **p < .01 ***p < .001

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28 Figure 1. Final structural model with the IR-ED general factor and IR-ED group factor 2
 29 predicting EDE-Q, controlling for general IIP-32 and BFNE-S. IR-ED = Interpersonal
 30 Relationships in Eating Disorder (Group factor 2 = Avoidance of Body Evaluation), IIP =
 31 Inventory of Interpersonal Problems, BFNE = Brief Fear of Negative Evaluation Scale –
 32 straightforwardly worded items version, EDE-Q = Eating Disorders Examination
 33 Questionnaire. Parameters are standardised. Only significant pathways are included.

34 * $p < .01$, ** $p < .001$.

35 **Appendix 1: Interpersonal Relationships – Eating Disorders: 15-item version**

36 Instructions: Thinking about your experiences with others over the past 28 days, how much would you
 37 say that the following statements applied to you?

	Not at all	A little bit	Moderately	Quite a bit	All the time
1. I find it hard to spend time with others because I worry what they think about my body	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
2. I avoid social situations where eating is involved	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
3. I avoid getting into conversations with others about food	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
4. I avoid socialising with people who are likely to comment on my body or appearance	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
5. Other people try to pressure me into eating differently	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
6. I avoid intimacy because I worry what others will think of my body	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
7. I avoid certain activities that would mean other people might judge my body	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
8. My pattern of eating often leads to disagreements or tension with others	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
9. Other people try to pressure me into changing my eating	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
10. My eating patterns make it hard for me to socialise as much as I would like to	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
11. Other people worry about what I eat	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
12. I prefer to eat alone to avoid conflict with others about what I eat	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
13. Worrying about my weight and appearance makes it difficult to feel really “connected” when I am with other people	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
14. My eating patterns cause me to withdraw from others	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
15. It is difficult to meet new people as I worry they are judging me or my appearance	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

38
 39 **Scoring key (item means)**

- 40
 41 Food-Related Isolation scale: Total items 2, 3, 10, 12 and 14, and divide by 5
 42 Avoidance of Body Evaluation scale: Total items 1, 4, 6, 7, 13 and 15, and divide by 6
 43 Food-Related Interpersonal Tension scale: Total items 5, 8, 9 and 11, and divide by 4
 44