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Investigating the role of parent and child characteristics in healthy eating intervention outcomes

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5 **Investigating the role of parent and child characteristics in healthy eating intervention**

6 **outcomes**

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23 **Running head:** Investigating the role of parent and child characteristics

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25

26 **Abstract**

27

28 While numerous studies have investigated the efficacy of interventions at increasing

29 children's vegetable consumption, little research has examined the effect of individual

30 characteristics on intervention outcomes. In previous research, interventions consisting of

31 modelling and rewards have been shown to increase children's vegetable intake, but

32 differences were identified in terms of how much children respond to such interventions.

33 With this in mind, the current study investigated the role of parental feeding practices, child

34 temperament, and child eating behaviours as predictors of intervention success. Parents

35 (N=90) of children aged 2-4 years were recruited from toddler groups across Leicestershire,

36 UK. Parents completed measures of feeding practices, child eating behaviours and child

37 temperament, before participating in one of four conditions of a home-based, parent led 14

38 day intervention aimed at increasing their child's consumption of a disliked vegetable.

39 Correlations and logistic regressions were performed to investigate the role of these factors

40 in predicting intervention success. Parental feeding practices were not significantly

41 associated with intervention success. However, child sociability and food fussiness

42 significantly predicted intervention success, producing a regression model which could

43 predict intervention success in 61% of cases. These findings suggest that future

44 interventions could benefit from being tailored according to child temperament. Furthermore,

45 interventions for children high in food fussiness may be better targeted at reducing fussiness

46 in addition to increasing vegetable consumption.

47

48 **Key words:** Vegetable, intervention, temperament, eating behaviours, parent, feeding

49 practices, children

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52 **Investigating the role of parent and child characteristics in healthy eating intervention**
53 **outcomes**

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55 It is well known that vegetables are commonly disliked by children (e.g., Cooke & Wardle,
56 2005; Skinner, Carruth, Bounds, & Ziegler, 2002), as well as being under consumed (Public
57 Health England & Food Standards Agency, 2014). Given that food habits established in
58 childhood are known to track through to adulthood (e.g., Lytle, Seifert, Greenstein, &
59 McGovern, 2000; Mikkilä, Räsänen, Raitakari, Pietinen, & Viikari, 2007), interventions aimed
60 at increasing vegetable consumption in early childhood are vital. Both parent and child
61 factors (e.g., parents' feeding practices and child eating behaviours) have been linked to
62 children's intake of fruit and vegetables (e.g., Cooke et al., 2004; Galloway, Fiorito, Lee, &
63 Birch, 2005; Galloway, Lee, & Birch, 2003; Palfreyman, Haycraft, & Meyer, 2014). However,
64 it is not known whether individual differences in the ways that caregivers parent, or in
65 children's characteristics, influence the outcome of interventions aimed at increasing
66 children's acceptance of previously disliked vegetables. Indeed, Mitchell, Farrow, Haycraft,
67 and Meyer, (2013) suggest that although interventions aimed at increasing vegetable
68 consumption have shown promising results, their outcomes may well be influenced by the
69 ability of the parent, other actors, and/or the child to engage with the intervention.

70

71 A previous paper described the development of a home-based parent led intervention
72 comprised of a programme of 14 daily offerings of a vegetable which the child disliked
73 (Holley, Haycraft, & Farrow, 2014). It focused on comparing different elements of an
74 intervention to explore which behaviours are necessary alongside repeated exposure to
75 increase children's liking and consumption of a disliked vegetable. These elements were
76 rewards and modelling, with four different variants of this programme explored. It was found
77 that post-intervention consumption of the target vegetable was significantly higher for
78 children who had experienced either rewards and repeated exposure or the combination of
79 modelling, rewards and repeated exposure when compared to a no-offerings control group.
80 Nevertheless, significant increases in consumption across the intervention period were seen
81 in all intervention groups, with strong variability within each group. This suggests that rather
82 than one type of intervention being the most successful, individual differences in both parent
83 and child factors likely influence the success of such interventions. With this is mind,
84 research needs to explore the individual parent and child factors which might be related to
85 the success or failure of these interventions, in order to help modify and tailor the
86 development of future interventions in this area.

87

88   One characteristic that might alter the success of such interventions is the feeding practices
89   that children are exposed to from their parents. Feeding practices have previously been
90   shown to influence children's eating behaviours in both positive (such as promoting healthy
91   food choice and consumption) and negative (such as increasing unhealthy food choice and
92   food avoidance) ways (e.g., Blissett, Haycraft, & Farrow, 2010; Fisher, Mitchell, Smiciklas-
93   Wright, & Birch, 2002; Palfreyman et al., 2014; Pearson, Biddle, & Gorely, 2009). Several
94   feeding practices may be used in an effort to promote 'healthier' eating in children, with
95   parental modelling of fruit and vegetable intake suggested as a potentially successful
96   method for increasing child intake (e.g., Cullen, 2001; Gregory, Paxton, & Brozovic, 2011;
97   Palfreyman et al., 2014; Pearson et al., 2009; Tibbs et al., 2001). Research also supports
98   the use of a healthy home environment and encouraging balance and variety for increasing
99   vegetable consumption (Melbye, Øgaard, & Øverby, 2013), with school education
100   programmes suggesting utility in teaching children about nutrition (Auld, Romaniello,
101   Heimendinger, Hambidge, & Hambidge, 1999). With this in mind, it is possible that
102   interventions may be more successful for children whose parents adopt feeding practices
103   which promote healthy eating.

104

105   Parenting does not occur as a one-way process and characteristics of children, such as their
106   temperament, can influence parenting (e.g., Stright, Gallagher, & Kelley, 2008; Vereecken,
107   Legiest, De Bourdeaudhuij, & Maes, 2009) and quite probably the success of any parenting
108   based interventions. Low sociability could possibly inhibit a child's potential to learn eating
109   behaviours through others, particularly through methods such as modelling. In support of
110   this notion, children with inhibited approach (shyness/low sociability) have indeed shown
111   lower initial acceptance of novel foods (Moding, Birch, & Stifter, 2014). Another aspect of
112   child temperament that is linked to eating behaviour is emotionality. Children who display
113   higher levels of emotionality have been reported by parents to be more food avoidant
114   (Haycraft, Farrow, Meyer, Powell, & Blissett, 2011) and parental reports of their child being
115   emotional or shy (less sociable) have been related to children's unwillingness to try new
116   foods (Pliner & Loewen, 1997). Moreover, children having a difficult temperament
117   (characterised by high emotionality and low sociability) has been associated with difficult
118   mealtimes and food refusal in children (Farrow & Blissett, 2007). Together, this research
119   indicates that some aspects of child temperament may be linked to more difficult eating
120   behaviours in children and also to the success of vegetable interventions.

121

122   Children's general eating behaviours are also likely to be important in determining their
123   intake of healthy foods. Enjoyment of food has been positively related to vegetable liking
124   (Fildes et al., 2015) as well as fruit and vegetable consumption in pre-schoolers (Cooke et

125 al., 2004) and food enjoyment has also been found to be a predictor of consumption change
126 across previous vegetable interventions, with those who enjoy food more achieving greater
127 increases in consumption in Caton et al.'s (2014) study. Food fussiness is also likely to
128 influence children's eating behaviours. Children who are picky or fussy eaters like
129 vegetables less (e.g., Fildes et al., 2015) and often consume fewer fruits and vegetables
130 than other children (e.g., Galloway et al., 2005), while recent research suggests that the
131 underpinnings of food fussiness lie in a child's genetic make-up (Fildes, van Jaarsveld,
132 Cooke, Wardle & Llewellyn, 2016). Food fussiness has been reported to correlate negatively
133 with enjoyment of food and food responsiveness and positively with satiety responsiveness
134 (Svensson et al., 2011; Wardle, Guthrie, Sanderson, & Rapoport, 2001). Research has
135 investigated whether children's food responsiveness is associated with how successful
136 parents' methods of encouraging consumption of novel fruits are, finding that children who
137 are less responsive to food may respond more to parental modelling of consumption
138 (Blissett, Bennett, Fogel, Harris & Higgs, 2016). As a body of literature, this suggests that
139 enjoyment of food, food responsiveness, satiety responsiveness and food fussiness may
140 influence the choices children make about what and when they eat, including vegetables.

141

142 In summary, it is known that most children do not eat enough fruits and vegetables (Lennox,
143 Olson, & Gay, 2011). Furthermore, it is likely that parent factors (such as feeding practices)
144 and child factors (such as temperament and eating behaviour) contribute to children's low
145 consumption of vegetables. The aim of this study was to examine whether parental feeding
146 practices, child temperament, and child eating behaviours were associated with children's
147 acceptance of a disliked vegetable after a home-based, parent led, repeated exposure
148 intervention. Factors that were significantly associated were then examined for their ability to
149 predict the success or failure of the repeated exposure interventions. It was hypothesised
150 that a repeated exposure based intervention would result in greater consumption of a
151 disliked vegetable for children whose parents report using health-promoting feeding
152 practices, including encouraging balance and variety, involving their child in meal planning
153 and preparation, modelling healthy eating, teaching about nutrition, keeping a healthy home
154 food environment, and for children who display higher levels of food approach behaviours
155 (i.e. enjoyment of food and food responsiveness). It was further hypothesised that a
156 repeated exposure based intervention would result in lower consumption of a disliked
157 vegetable for children who are described as higher in emotionality, lower in sociability,
158 display higher levels of food avoidant behaviours (i.e. food fussiness and satiety
159 responsiveness), and whose parents use greater pressure to eat.

160

161

162   **Method**

163   *Participants*

164   Ninety parent-child pairs took part in this study. Children were aged from 27 to 55 months (*M*

165   = 39 months; SD = 7.77 months). Parents' age ranged from 22 to 46 years (*M* = 35.85 years,

166   SD = 4.82 years). Child height and weight were measured by the researcher and converted

167   into age and gender adjusted BMI z-scores (Cole, Freeman, & Preece, 1995). Children's

168   BMI z-scores ranged from -3.07 to 1.73 (*M* = 0.21, SD = 0.90). Parents' BMI (kg / m^2) ranged

169   from 25.60 to 38.44 (*M* = 25.60, SD = 4.66), and 42% of the children who took part were

170   male (n = 38).

171

172   *Procedure*

173   Full ethical clearance for this study was obtained from Loughborough University's

174   Institutional Review Board. Parents were recruited from toddler groups across the East

175   Midlands of the UK. Individuals with children aged between two and four years old were

176   approached and asked if they would like to take part in a study which aimed to encourage

177   their child to eat disliked vegetables. Following recruitment, all parents provided informed

178   consent and were fully advised of their right to withdraw themselves or their child at any

179   point. Children also assented to take part in the study.

180

181   *Baseline*

182   During a baseline session, parents were asked to complete a series of validated

183   questionnaire measures, described below, as well as to provide demographic information for

184   themselves and their child, including age, gender, ethnicity, and level of education. Children

185   were also assigned a target vegetable from a list of commonly consumed vegetables

186   (ensuring they are disliked rather than novel; tomato, celery, cucumber, pepper, baby corn

187   and sugar snap peas) which, in line with previous studies (e.g., Cooke et al., 2011), parents

188   rated as being disliked by their child. This dislike was confirmed by the child during a taste

189   test and five minute free-eating session. If dislike was not confirmed by the child, the

190   process was repeated to find a suitable alternative vegetable.

191

192   Parent-child dyads all took part in a parent led, home-based 14 day intervention designed to

193   increase children's consumption of a disliked vegetable. This length of intervention was

194   chosen on the basis of previous research (e.g., Cooke et al., 2011) whilst allowing testing of

195   consumption at weekly toddler groups. Each dyad was assigned to one of four experimental

196   groups: one where parents simply offered the vegetable daily (condition 1 - repeated

197   exposure); one where parents modelled eating the target vegetable and then offered it to

198   their child (condition 2 - modelling and repeated exposure); one where parents gave small

199 incentives and praise in exchange for trying the vegetable (condition 3 - rewards and
200 repeated exposure); and one combining modelling, rewards and daily offering (condition 4).
201 For this intervention, all parents were asked to offer they child a small piece of a target
202 vegetable outside of a mealtime, using the methods assigned to them (either simple offering,
203 modelling tasting, rewarding tasting or all of these methods). Parents were also asked to
204 complete a daily tasting diary, recording whether offerings were performed in line with the
205 instructions and whether these offerings resulted in tastings. On average, caregivers made
206 12 offerings (M =11.95, SD =2.49), showing good compliance with the study protocol.

207

208 After the 14 day intervention period, parent-child dyads attended a follow-up session. This
209 session was identical in format to the baseline session to allow comparison of liking and
210 consumption of the targeted vegetables pre and post-intervention. Parent and child height
211 and weight were also measured (using Salter scales/Stanley tylon pocket tape measure),
212 and parents returned their completed tasting diaries.

213

214 Both pre (baseline) and post intervention, each child was provided with a weighed and
215 chopped 30g portion of their disliked target vegetable. Each child was asked to try a piece of
216 the vegetable, and told they could eat as much as they liked during a five minute free eating
217 session. The portion was removed and re-weighed to measure consumption once five
218 minutes had passed or the child had terminated the session

219

220 ***Measures***
221 *Comprehensive Feeding Practices Questionnaire (CFPQ; Musher-Eizenman & Holub, 2007*)
222 Feeding practices were measured using five subscales of the CFPQ. These subclass were:
223 Pressure to eat (e.g. '*If my child says, "I'm not hungry," I try to get him/her to eat anyway*');
224 Modelling (e.g. '*I show my child how much I enjoy eating healthy foods*'); Environment (e.g.
225 '*Most of the food I keep in the house is healthy*'); Encourage balance and variety (e.g. '*I
226 encourage my child to eat a variety of foods*'); and Teaching about nutrition (e.g. '*I discuss
227 with my child the nutritional value of foods*'). Items are responded to on a five-point likert
228 scale. Mean scores are generated for each subscale, with possible scores between one and
229 five. Higher scores indicate greater use of the feeding practice. This measure has been
230 validated and shown to have good test-retest reliability (Musher-Eizenman & Holub, 2007).
231 Most subscales showed adequate internal validity in the current sample, with Cronbach's
232 alpha values ranging from .60 to .81.

233

234 *EAS Temperament survey for children* (*EAS; Buss & Plomin, 1984*)

Two aspects of child temperament were assessed using the EAS: Sociability (e.g. '*Child likes to be with people*'); and Emotionality (e.g. '*Child cries easily*'). Parents are asked to state how characteristic of their child each statement is on a five-point likert scale. Mean scores are then calculated for each subscale, with possible scores ranging from one to five. Higher scores on each subscale represent higher levels of that trait (i.e. higher emotionality or sociability). The EAS is a valid measure of young children's temperament as reported by parents (Mathiesen & Tambs, 1999). Cronbach's alphas in the current sample were .65 for the Sociability subscale and .90 the Emotionality subscale.

Children's Eating Behaviour Questionnaire (CEBQ; Wardle et al., 2001)

The CEBQ was used to assess child eating behaviours. Four of the subscales were used for the purposes of this study; two measuring food approach eating behaviours (food responsiveness and enjoyment of food), and two measuring food avoidance (satiety responsiveness and food fussiness). Parents are asked to respond to each statement using a five-point likert scale ranging from never to always, and mean scores for each subscale are calculated. Scores range from one to five, with higher scores indicating higher frequency of that behaviour. The CEBQ has been demonstrated as having good internal validity and test-retest reliability (Wardle et al., 2001). For the current sample, Cronbach's alphas were good, ranging from .76 to .89.

Outcome variables

The main outcome measures for the study were post-intervention consumption of the disliked vegetable (measured after the 14 day intervention period) and consumption change across the study. Consumption change was calculated by subtracting pre-intervention consumption from post-intervention consumption, allowing for comparison regardless of baseline consumption. Positive change scores represented an increase in consumption across the study, while negative scores indicated a decrease in consumption.

Data analysis

In order to examine whether parental feeding practices, child temperament, and child eating behaviours were associated with children's acceptance of a disliked vegetable after a home-based, parent led, repeated exposure intervention, data from the four repeated exposure intervention conditions were pooled. Power recommendations from Cohen (1992) were used to inform the size of sample who participated in the intervention study. The total sample (n=90) of experimental dyads met Cohen's (1992) power recommendations for correlation and regression analysis with an alpha of .05 and to detect medium effect sizes. A series of Kolmogorov-Smirnov tests indicated that the majority of the study's variables were not

272 normally distributed therefore non-parametric tests were used, where possible, to test the
273 study's hypotheses. Preliminary one-tailed Spearman's correlations were run between
274 parent and child age and BMI/BMIz with the study variables. Child age was significantly
275 correlated with teaching about nutrition (r=.27, p=.003) and child BMIz was significantly
276 related to child enjoyment of food (r=.32, p=.002). Analyses involving the teaching about
277 nutrition and enjoyment of food subscales controlled for child age and BMIz, respectively.
278 Parent age and BMI were not significantly related to any of the feeding practices.

279

280 One-tailed Spearman's correlations (or partial correlations, where appropriate) were used to
281 investigate associations between child temperament, eating behaviours and parental feeding
282 practices with pre-intervention consumption, post-intervention consumption, and
283 consumption change across the intervention period. Significant correlates of each of these
284 outcome measures were then combined and entered into a forced entry, one-tailed logistic
285 regression model to assess which factors could best predict success of the interventions.
286 Success was a binary variable, with any increase in grams of vegetable consumed between
287 pre and post-intervention categorised as success, and no change or a decrease in
288 consumption categorised as not successful.

289

290 Due to the large number of correlations conducted and the associated risk of type 1 errors, a
291 more stringent significance level of p<.01 was used for the correlations. Significance was
292 set at p<.05 for the regression analyses as variables had already been selected based on
293 alpha of .01.

294

295   **Results**
296 ***Descriptive statistics***
297 Descriptive statistics for all measures are displayed in Table 1. The study sample's mean
298 scores for the CEBQ, CFPQ and EAS subscales are similar to other means from similar
299 samples (e.g., Ashcroft, Semmler, Carnell, van Jaarsveld, & Wardle, 2008; Haycraft et al.,
300 2011; Musher-Eizenman & Holub, 2007). On average, consumption of the disliked vegetable
301 increased markedly across the intervention period, with post-intervention consumption more
302 than eight times greater than pre-intervention consumption.

303
304

305 **Table 1**: Mean and standard deviation (SD) scores for parent feeding practices, child
306 temperament, child eating behaviours and measures of vegetable consumption

Measure	Mean (SD)	Min/Max
Parental feeding practices		
Pressure to eat	3.32 (0.82)	1.25/4.75
Modelling	4.11 (0.75)	1.75/5.00
Environment	3.67 (0.68)	2.25/5.00
Encourage balance and variety	4.33 (0.49)	3.00/5.00
Teaching about nutrition	3.63 (0.83)	1.67/5.00
Child temperament		
Sociability	3.55 (0.67)	1.00/5.00
Emotionality	2.76 (1.03)	1.00/5.00
Child eating behaviours		
Food responsiveness	2.53 (0.73)	1.20/4.60
Enjoyment of food	3.64 (0.72)	1.00/5.00
Satiety responsiveness	3.05 (0.60)	1.60/6.00
Food fussiness	3.00 (0.75)	1.17/5.00
Pre-intervention consumption[†]	0.43 (0.84)	0.00/3.60
Post-intervention consumption[†]	3.78 (6.57)	0.00/30.00
Consumption change[†]	3.36 (6.43)	-3.60/29.80

307
308 [†] Grams of vegetable eaten during the testing period
309
310 ***Relationships between parents' feeding practices, child temperament and eating***
311 ***behaviours with measures of consumption***
312
313 One-tailed correlations were run to assess whether there were any significant associations

314 between parents' feeding practices, child temperament or eating behaviours with pre-

315 intervention consumption of a disliked vegetable, post-intervention consumption of a disliked

316 vegetable, and consumption change. There was a trend towards a positive correlation of

317 parents providing a healthy home environment with higher post-intervention consumption of

318 the disliked vegetable. Greater child sociability was significantly correlated with greater post-

319 intervention consumption of a disliked vegetable and greater consumption change scores.

320 Greater child food fussiness was significantly correlated with lower pre and post-intervention

321 consumption of a disliked vegetable, and there was a trend towards a negative correlation

322 with change in consumption across the intervention. There were no other significant

323 relationships (see Table 2).

324

325 **Table 2:** One-tailed Spearman's correlations between parent and child factors with
326 consumption scores (N=90).

Measure	Pre-consumption		Post-consumption		Consumption change	
	R_s	p	R_s	p	R_s	p
Encourage balance and variety	.16	.07	.12	.12	.10	.17
Environment	.02	.42	.20	.03	.17	.06
Modelling	.05	.34	.15	.08	.11	.16
Pressure to eat	-.01	.47	-.04	.35	-.02	.44
Teaching about nutrition[†]	-.06	.30	-.10	.18	-.10	.19
Emotionality	-.05	.34	-.04	.36	-.08	.46
Sociability	.01	.45	**.23**	**.01**	**.28**	**.01**
Food responsiveness	.03	.39	.05	.32	.02	.44
Enjoyment of food[‡]	-.07	.29	-.07	.27	-.07	.29
Satiety responsiveness	-.05	.31	-.13	.12	-.07	.26
Food fussiness	**-.25**	**.01**	**-.31**	**.00**	-.20	.03
Child age (months)	.05	.31	-.07	.26	-.12	.13
Child BMIz	.12	.14	.12	.15	.12	.15

327 [†]partial correlation controlling for child age
328 [‡]partial correlation controlling for child BMI z-score

329
330 ***Predictors of the success of the interventions***

331
332 In order to identify intervention 'success', the consumption change data were split to form

333 two groups: those for whom the interventions were successful (as categorised by showing

334 any increase in grams of vegetable consumed between pre and post-intervention), and

335 those for whom the interventions were not successful (categorised by no change or a

336 decrease in consumption). Descriptive statistics for these two groups are displayed in Table

337 3. Mann-Whitney U analysis revealed that consumption change was significantly different

338 between these two groups (U=0.00, z=-8.42, p<.001).

339
340

341 **Table 3:** Descriptive statistics for change in vegetable consumption for children for whom
342 the interventions were successful or not

	N	Median (g)	Mean (g)	SE mean	Range (g)
Successful	44	4.60	7.00	1.31	0.10 to 29.80
Not successful	46	0.00	-0.30	0.11	-3.60 to 00.00

343
344 g = grams, positive mean and median values indicate an increase in consumption
345

346 These two groups were then used to explore whether intervention success can be predicted
347 by food fussiness and sociability (the only two significant correlates). A one-tailed logistic
348 regression was performed, using the enter method. The model was a significant fit for the
349 data (x^2(2)=6.56, p=.02) and was able to correctly predict success of the intervention in 61%
350 of cases. Sociability, but not food fussiness, was a significant individual predictor of
351 intervention success (Table 4).

352

353 **Table 4:** Coefficients for the logistic regression model predicting success of the interventions
354 from children's sociability and food fussiness (N=90)

				95% CI for Odds Ratio		
	b	SE B	p	*Lower*	*Odds*	*Upper*
Sociability	0.71	0.36	.03	1.00	2.03	4.11
Food fussiness	-0.35	0.30	.12	0.39	0.70	1.27

355
356
357
358 **Discussion**
359

360 This study aimed to examine whether individual differences in caregivers' feeding practices
361 or children's characteristics are associated with children's acceptance of a disliked vegetable
362 after a home-based, parent led, repeated exposure intervention. The ability of these
363 variables to predict the success of this intervention was then tested. It was hypothesised that
364 this repeated exposure based intervention would result in greatest acceptance for children
365 who display higher levels of food approach behaviours and for children whose parents use
366 more health-promoting feeding practices. It was further hypothesised that this repeated
367 exposure based intervention would result in least acceptance among children whose parents
368 use more pressure to eat, who are lower in sociability, higher in emotionality and more food
369 avoidant. These hypotheses were partially supported. While there were no significant
370 correlations between feeding practices and the outcome of the repeated exposure
371 intervention, children's sociability and food fussiness were significantly correlated with the
372 outcomes of this intervention and, in combination, were able to predict their success.

373

374 As hypothesised, parent led repeated exposure interventions appeared to be more
375 successful for children who were more sociable. Here, sociability was significantly
376 associated with post intervention vegetable consumption as well as with increased intake
377 across the interventions. Sociability was also able to predict the success of the interventions.
378 This is in line with Social Learning Theory (Bandura, 1977), where it is claimed that learning
379 takes place within a social context. For children who are low in sociability, their capacity to
380 learn through others may be diminished, whereas children who are more sociable may be
381 more open to the influence of factors such as parental modelling or rewards (particularly
382 praise). Previous research supports this notion, where children who are shy or less sociable
383 have shown lower initial acceptance of novel foods (Moding et al., 2014), and a higher
384 prevalence of feeding difficulties has been found in unsociable children (e.g., Hagekull,
385 Bohlin, & Rydell, 1997; Pliner & Loewen, 1997). Moreover, sociability may influence the
386 nature of tastings made during the intervention. Parents were told that a range of behaviours
387 from licking and sucking to biting or eating qualified as tasting the vegetable. Therefore, it is
388 possible that more sociable children were more motivated to suck or eat the piece of
389 vegetable so as to please their parent, and that these types of tastings may be better for
390 increasing acceptance of the target vegetable than a brief lick or bite of the piece.

391

392 Food fussiness was found to be significantly negatively correlated with consumption of the
393 disliked vegetable, both pre and post intervention, which supported predictions. This is in
394 line with previous research suggesting that picky/fussy eaters consume fewer vegetables
395 (Galloway et al., 2005). With specific reference to the influence of fussiness on intervention
396 outcomes, research by Caton et al. (2014) has suggested that children who are fussier are
397 more likely to consume a very small amount or none of a target vegetable during
398 interventions. In the current study, food fussiness was correlated with pre intervention
399 consumption as well as post intervention consumption, but was not correlated with
400 consumption change (although there was a trend towards this). This suggests that rather
401 than food fussiness having a strong influence on the outcome of repeated exposure
402 interventions, food fussiness may have a more pervasive effect on consumption of
403 vegetables in general. This suggestion is supported by recent literature (Fildes et al., 2016)
404 which suggests that children's food fussiness and liking for vegetables has a shared genetic
405 underpinning, which would also infer a pervasive effect of fussiness. This notion is further
406 corroborated by the regression analyses performed in this study, where although food
407 fussiness and sociability formed a model which could significantly predict success of the
408 intervention, only sociability was a significant predictor of success when used alone.
409 Together, these findings suggest that while children's food fussiness is likely to influence

410   children's general consumption of vegetables (as indicated by being associated with lower
411   pre and post intervention consumption), fussy children may still benefit from interventions
412   aimed at improving healthy eating (as suggested by the lack of significant association
413   between fussiness and consumption change across the intervention). Having said this, the
414   trend towards an association between food fussiness and lower consumption change across
415   the intervention suggests that fussy children may benefit from components additional to
416   those in this intervention. Future work may need to tailor interventions to promote tasting –
417   and encourage repeated exposure and trying – in children who are inherently more fussy.

418

419   Contrary to the hypotheses, no significant correlations were found between food approach
420   behaviours or feeding practices and children's consumption of the target vegetable in the
421   interventions. However, in line with previous research on availability (e.g., Hanson,
422   Neumark-Sztainer, Eisenberg, Story, & Wall, 2005), there was a trend towards an
423   association between parents keeping a healthy home environment and higher post-
424   intervention consumption. This was an exploratory study, as there is currently very limited
425   research investigating the impact of these factors on intervention outcomes. One previous
426   study has found that children's enjoyment of food can predict consumption change across
427   an intervention (Caton et al., 2014). However, it should be noted that Caton et al.'s study
428   was with a large sample of children (N = 332), who were younger (M = 18.9 months) than
429   those in this study, and that the intervention groups involved repeated exposure with either
430   flavour-flavour or flavour-nutrient learning, rather than modelling and rewards. Furthermore,
431   it is possible that child eating behaviours and maternal feeding practices were not relevant
432   within the context of this study. For example, in the case of food (and indeed satiety)
433   responsiveness, parents were asked to offer their child the target vegetable at their usual
434   snack time, or before a meal. This should have ensured that children in the study were
435   hungry when offerings occurred, minimising the effect of individual differences in food/satiety
436   responsiveness.

437

438   Contrary to the hypotheses, children's emotionality and parental use of pressure to eat were
439   not significantly correlated with post intervention consumption of the disliked vegetable or
440   consumption change across the intervention period. Although previous research suggests
441   that use of pressure to eat results in lower consumption of the pressured foods (Galloway et
442   al., 2005), it is not clear whether parents who would ordinarily use pressure to eat did so
443   during the course of the intervention. It is possible that parents in fact adhered to the study
444   protocol, and as such would not have used controlling feeding practices to encourage
445   consumption during the study.

446

447   This study has a number of strengths and limitations. First, as there are very few previous

448   studies into the effect of individual differences on intervention outcomes, the current study is

449   novel and adds to previous literature by helping to guide the potential tailoring of future

450   interventions. However, the intervention groups were combined for the analyses so as to

451   optimise statistical power but this precluded the ability to detect correlations between

452   individual differences and intervention outcomes, where these might have varied between

453   the intervention groups. To better assess this, future research with similar interventions

454   should employ larger samples, to allow for the impact of parent and child differences to be

455   assessed separately for each intervention condition. The measures of child eating

456   behaviours, parent feeding practices and temperament were all self-report measures. As

457   such, there may have been a degree of inaccuracy in parents' reports, which may also

458   explain the lack of significant findings in this study (possibly explaining the low variance seen

459   in scores). The sample employed was also not particularly diverse; despite attempts to

460   recruit a less homogenous sample (by recruiting from Sure Start toddler groups as well as

461   community groups), the majority of this sample were white and middle class. The

462   applicability of these findings to other samples must therefore be considered.

463

464   The study's findings indicate that parent led, home-based, repeated exposure interventions

465   are more successful with sociable children, and that other types of interventions might need

466   to be tailored to children with different temperamental predispositions. For example, children

467   who are more sociable may benefit from interventions with more social components such as

468   modelling and rewards, while less sociable children may benefit from interventions which

469   promote change in other ways. Furthermore, these results suggest that food fussiness may

470   have a prevailing effect on eating behaviour and vegetable consumption, rather than

471   specifically altering the outcome of interventions such as these. This suggests that in order

472   for vegetable consumption to be increased in individuals with food fussiness, interventions

473   may be better targeted at reducing food fussiness than specifically increasing consumption

474   of vegetables.

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