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**‘Why don’t you try it again?’ A comparison of parent led, home based interventions  
aimed at increasing children’s consumption of a disliked vegetable**

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Running head: Increasing consumption of a disliked vegetable

22

**Abstract**

23 Previous research suggests that the use of modelling and non-food rewards may be  
24 effective at increasing tasting, and consequential liking and acceptance, of a previously  
25 disliked food. Although successful school-based interventions have been developed, there is  
26 a lack of research into home-based interventions using these methods. This study aimed to  
27 develop and investigate the efficacy of a parent led home-based intervention for increasing  
28 children's acceptance of a disliked vegetable. A total of 115 children aged 2-4 years were  
29 allocated to one of four intervention groups or to a no-treatment control. The four intervention  
30 conditions were: repeated exposure; modelling and repeated exposure; rewards and  
31 repeated exposure; or modelling, rewards and repeated exposure. Children in all of the  
32 intervention conditions were exposed by a parent to daily offerings of a disliked vegetable for  
33 14 days. Liking and consumption of the vegetable were measured pre and post-intervention.  
34 Significant increases in post-intervention consumption were seen in the modelling, rewards  
35 and repeated exposure condition and the rewards and repeated exposure condition,  
36 compared to the control group. Significant post-intervention differences in liking were also  
37 found between the experimental groups. Liking was highest (>60%) in the modelling,  
38 rewards and repeated exposure group and the rewards and repeated exposure group,  
39 intermediate (>26%) in the modelling and repeated exposure and repeated exposure  
40 groups, and lowest in the control group (10%). Parent led interventions based around  
41 modelling and offering incentives may present cost efficient ways to increase children's  
42 vegetable consumption.

43

44 **Key words:** role modelling; non-food rewards; repeated exposure; vegetable; parent led;  
45 intervention

46 **'Why don't you try it again?' A comparison of parent led, home based interventions**  
47 **aimed at increasing children's consumption of a disliked vegetable**

48

49 Childhood obesity is one of the biggest public health challenges of the 21st century,  
50 with more than 40 million children under the age of five being overweight or obese globally  
51 (World Health Organisation, 2014). As part of a healthy lifestyle, adequate vegetable  
52 consumption is known to provide numerous benefits including preventing obesity and  
53 chronic disease (Heidemann et al., 2008; Maynard, Gunnell, Emmett, Frankel, & Davey  
54 Smith, 2003; Vioque, Weinbrenner, Castelló, Asensio, & Garcia de la Hera, 2008). However,  
55 many adults and children are failing to consume the recommended UK quota of five portions  
56 of fruit and vegetables a day (e.g., Guenther, Dodd, Reedy, & Krebs-Smith, 2006; Lennox,  
57 Olson, & Gay, 2011). Given that eating behaviours track through childhood into adulthood  
58 (e.g., Lytle, Seifert, Greenstein, & McGovern, 2000; Mikkilä, Räsänen, Raitakari, Pietinen, &  
59 Viikari, 2007), effective interventions aimed at increasing vegetable consumption early in  
60 childhood are required.

61 The development of liking and acceptance of foods is influenced by numerous  
62 factors, such as how palatable foods are, their nutritional content and their associated  
63 emotional experience (e.g. party or reward foods versus everyday foods) (e.g., Birch,  
64 Zimmerman, & Hind, 1980; Mikula, 1989; Mobini, Chambers, & Yeomans, 2007; Steiner,  
65 1979). One theory behind acquisition of liking and acceptance of foods is 'learned safety',  
66 where repeated ingestion of an unfamiliar food without negative gastro-intestinal  
67 consequences leads to increased acceptance of that food (Kalat & Rozin, 1973).  
68 Furthermore, if positive consequences are experienced (such as satiety), preference may  
69 develop for that food (Kalat & Rozin, 1973). In this way, repeated exposure can be used to  
70 transform disliked or unfamiliar foods into accepted (Pliner & Loewen, 1997) or even liked  
71 (Lakkakula, Geaghan, Zanovec, Pierce, & Tuuri, 2010) foods. Previous research suggests  
72 that in order to increase liking of novel foods in two year olds, between five and 10  
73 exposures may be necessary (Birch, Birch, Marlin, & Kramer, 1982; Birch, Gunder, Grimm-

74 Tomas, Laing, & Grimm-Thomas, 1998) , while 15 exposures may be required to increase  
75 preferences among 3-4 year olds (Sullivan & Birch, 1990). Vegetables are commonly  
76 disliked by children (e.g., Cashdan, 1998; Skinner, Carruth, Bounds, & Ziegler, 2002) and a  
77 body of evidence supports the use of repeated exposure to increase children's liking of  
78 vegetables (e.g., Ahern, Caton, Blundell, & Hetherington, 2014; Caton et al., 2013; Hausner,  
79 Olsen, & Møller, 2012; Wardle, Herrera, Cooke, & Gibson, 2003; Wardle et al., 2003).  
80 Although this is promising evidence for the use of repeated exposure to transform children's  
81 dislike of vegetables, persuading children to repeatedly try previously rejected vegetables  
82 may prove difficult. Indeed, many parents do not continue to expose children to foods once  
83 they have been rejected (Birch, McPhee, Shoba, Pirok, & Steinberg, 1987), where the  
84 number of exposures necessary to alter a child's preferences is more than parents offer.  
85 Combining other methods with repeated exposure may help to encourage parents to  
86 repeatedly offer, in turn improving children's liking and acceptance of vegetables. With this in  
87 mind, it would be valuable to explore techniques which may be used alongside repeated  
88 exposure to facilitate tasting and improve the likelihood of increasing children's intake of  
89 previously refused vegetables.

90         One technique that could be used alongside repeated exposure is modelling.  
91 Modelling occurs through a process of observational learning, where encouragement and  
92 facilitation of behaviours results in them becoming habitual (Bandura, 1977). Peer modelling  
93 of eating behaviour has been shown to be effective at increasing children's acceptance of  
94 novel healthy foods (Hendy, 2002) as well as altering children's food choices (Birch, 1980).  
95 Parental modelling of healthy eating has also been associated with children's subsequent  
96 consumption of fruits and vegetables (Draxten, Fulkerson, Friend, Flattum, & Schow, 2014;  
97 Gregory, Paxton, & Brozovic, 2010; Palfreyman, Haycraft, & Meyer, 2012). Parental  
98 modelling has been shown to significantly increase children's willingness to try an unfamiliar  
99 food compared to when children were simply offered the unfamiliar food (Harper & Sanders,  
100 1975), suggesting that parental modelling could indeed be a successful method for  
101 increasing children's willingness to taste novel or disliked foods.

102           In addition, the use of contingent non-food rewards may be another strategy which  
103 can be used to aid children's liking of new or previously refused foods. One contingent  
104 reward or incentive that is often used with young children is a sticker. The use of stickers as  
105 rewards has been shown to be successful at increasing consumption of healthy snack foods  
106 in eight children aged between three and six (Stark, Collins, Osnes, & Stokes, 1986).  
107 Furthermore, non-food rewards have proved to be a successful component of repeated  
108 exposure interventions aimed at increasing children's consumption of disliked or novel  
109 vegetables in both the school (Añez, Remington, Wardle, & Cooke, 2013; Cooke et al.,  
110 2011; Hendy, Williams, & Camise, 2005) and home environments (Corsini, Slater, Harrison,  
111 Cooke, & Cox, 2013; Remington, Anez, Croker, Wardle, & Cooke, 2012). Although these  
112 programmes generally describe the rewards given as tangible rewards (e.g., stickers or a  
113 small toy), such reward systems inevitably have a social reward element entrenched within  
114 them (i.e. praise).

115           Previous research has investigated the use of these techniques (repeated exposure,  
116 modelling and non-food rewards) in combination to increase children's liking and  
117 consumption of vegetables. Interventions using these techniques within a school-based  
118 setting have already generated successful results. For example, the Bangor Food Research  
119 Unit's 'Food Dudes' programme (Lowe, Dowey, Horne, & Murcott, 1998), which combines  
120 peer modelling, rewards and exposure, has been rolled out in schools across the UK and  
121 Ireland. Although successful at increasing children's liking and consumption of vegetables in  
122 the short term (e.g., Horne, Lowe, Bowdery, & Egerton, 1998; Horne et al., 2011; Lowe et  
123 al., 1998; Lowe, Horne, Tapper, Bowdery, & Egerton, 2004; Tapper, Horne, & Lowe, 2003),  
124 the 'Food Dudes' and other similar programmes rely on local government funding and whole  
125 school sign-up, making such programmes inaccessible for many families. Home-based  
126 parent led interventions provide an alternative to such programmes (Fildes, van Jaarsveld,  
127 Wardle, & Cooke, 2013). Similar research about parent led interventions in the home setting  
128 has been conducted (e.g., Añez et al., 2013; Corsini et al., 2013; Remington et al., 2012),  
129 and these studies suggest that repeated exposures incentivised with rewards can be



157

**158 Procedure**

159 Full ethical clearance for this study was obtained from Loughborough University's  
160 Institutional Review Board. Informed consent was obtained from all parents before the onset  
161 of the study, with parents fully advised of their right to withdraw themselves and their child at  
162 any point.

163

*164 Recruitment*

165 Parents were recruited via 20 parent and toddler groups and childcare centres in the  
166 East Midlands, UK. Following approval from the manager or group leader, mutually  
167 convenient times were agreed for testing to take place. Parents were approached by the  
168 researcher and invited to participate in a home-based study investigating methods which  
169 parents can use to help their children eat vegetables. Parents who expressed an interest in  
170 participating were then given an information sheet detailing the study before providing  
171 consent for their own and their child's participation, with participation limited to one child per  
172 family. Parents were not compensated for their participation in this study.

173

*174 Target vegetables*

175 In line with previous research (e.g. Remington et al., 2012), each child was assigned  
176 a single target disliked vegetable. Assigning just one target vegetable also helped to keep  
177 the intervention simple and minimised the chances of the participants being overwhelmed or  
178 put-off by the intervention. Parents were asked to rank a list of six raw vegetables (baby  
179 corn, celery, red pepper, cherry tomato, cucumber, and sugar snap peas) in order of their  
180 own preference, with 1 being the one they liked best and 6 being the one they liked least.  
181 Parents were told that if they did not know whether their child liked the vegetable (as the  
182 vegetable was not familiar to the child) they should not rank the vegetable. This allowed  
183 disliked vegetables to be assigned rather than novel ones. These six vegetables were  
184 chosen as the research team deemed them to be commonly consumed by adults, readily

185 available, being simple to prepare, and keeping in the fridge for a number of days without  
186 spoiling (thereby minimising waste). Parents were then asked to repeat this process  
187 according to their child's preferences. The vegetable ranked fourth for the child was  
188 allocated as the target vegetable for the intervention, avoiding those ranked fifth or sixth to  
189 allow for both positive and negative shifts in liking (Cooke et al., 2011). Because some  
190 conditions required parents to model eating the vegetable, if the child's fourth ranked  
191 vegetable was ranked as fifth or sixth by parents, an alternative disliked vegetable was  
192 selected to limit any confounding effects of parental preferences. Children's dislike of the  
193 target vegetable was confirmed during a baseline session with the researcher (see *Baseline*  
194 section below).

195 All target vegetables were presented at baseline and post intervention in their raw  
196 form, washed, chopped into approximately 2.5g pieces (which were small enough to fit in the  
197 mouth) and served in 30g portions, weighed using Salter dietary electronic scales 1250. This  
198 weight was chosen as it represents more than an age-appropriate portion for children in this  
199 age group (NHS Choices, 2009; Infant & Toddler Forum, 2013), thereby reducing the  
200 possibility that any child would choose to eat the entire portion.

201

## 202 *Baseline*

203 During a baseline session, parent-child dyads were each tested separately from  
204 other dyads. Parents were asked to provide demographic information for themselves and  
205 their child including age, ethnicity, number of children and their highest level of education.

206

## 207 *Measures*

208 Children's liking of the target vegetable was measured using a 3-point smiley face  
209 scale (Birch, Zimmerman, & Hind, 1980) which comprises three stylised, gender neutral  
210 faces. One with a broad smile to represent 'yummy, I like it!', one neutral to represent 'ok'  
211 and one with a down-turned mouth to represent 'yucky, I don't like it!'. The smiley faces  
212 rating scale is seen as a more reliable measure of liking than pure verbalisations in children



213 of this age (Blissett, Haycraft, & Farrow, 2010; Weisberg & Beck, 2010). Children were  
214 familiarised with this scale at a baseline session.

215

#### 216 *Familiarisation*

217 Children were shown a brief child-friendly information sheet, which largely comprised  
218 pictures, to familiarise them with the protocol of the session and the researcher talked to  
219 them about what would be involved. Children were also familiarised with the 3-point smiley  
220 faces scale. Each face was explained to them (with a description of how each of the faces  
221 would reflect how much they liked a food) and their ability to correctly identify the expression  
222 of each face's was verified in a procedure similar to Weisberg & Beck (2010). Here, each  
223 child was asked to correctly identify which face represented "yucky", "yummy" or "just ok".  
224 Next, children were shown and asked to name the target vegetable which had been  
225 assigned to them, with it presented in its whole form. Children who could not name the  
226 vegetable were told its name and the vegetable was placed on the table in front of them.

227

#### 228 *Testing baseline consumption and liking*

229 Children were then given a small plastic pot containing 30g of their target vegetable.  
230 The vegetable had been chopped into child-sized pieces (~2.5g). The children were asked  
231 to remove the lid of the pot and tell the researcher what was inside. Again, children who  
232 could not name the chopped vegetable were told its name. This process was chosen to  
233 ensure that the children linked the chopped vegetable to what it looks like in its whole form,  
234 aiming to minimise the effects of how the vegetable was later presented by parents. Children  
235 were then asked to try a piece of the target vegetable. If reluctant, children were gently  
236 encouraged by the researcher to first choose a piece to pick up with their fingers, then to lick  
237 the piece and, if possible, to progress to biting or eating the piece. Children were not  
238 encouraged to swallow the piece, so as to avoid causing stress to the children, and in an  
239 effort to increase their willingness to try the vegetable. Whether or not each child tasted the

240 vegetable (defined as licking, sucking, biting or chewing) was then recorded by the  
241 researcher.

242           Once the children had tried the vegetable (or after they had refused to try it) they  
243 were asked “Do you like [name of vegetable]?”. They were then asked to rate their liking  
244 using the 3-point smiley faces scale (‘yummy’, ‘ok’ or ‘yucky’). Children were then told that  
245 they could eat as much as they wanted of the vegetable in the pot, and a free eating session  
246 commenced. This session lasted a maximum of five minutes or was terminated when the  
247 children said that they did not want any more or when they left the test table. The test portion  
248 of the target vegetable was then removed and re-weighed (including pieces which were  
249 tasted but not consumed - i.e. licked or chewed but rejected) in order to measure  
250 consumption.

251

#### 252 *Intervention groups and allocation*

253           Recruitment centre groups were systematically assigned by the primary investigator  
254 to one of four experimental conditions: 1. repeated exposure; 2. modelling and repeated  
255 exposure; 3. rewards and repeated exposure; or 4. modelling, rewards and repeated  
256 exposure. This method of allocation was chosen to prevent discussion of the study methods  
257 between parents in different intervention groups. Consecutive sampling was used, so that a  
258 maximum number of dyads could be recruited from each centre. Centres were sequentially  
259 allocated to each condition. If there was not space in the next condition in the sequence, the  
260 centre was pragmatically assigned to an alternative condition, creating even sized  
261 conditions. Parents in all of these conditions were instructed to offer their child a small piece  
262 (~2.5g, which they were shown an example of during the baseline session) of the target  
263 vegetable (which was provided for parents by the research team) each day for 14  
264 consecutive days, using the protocol for the intervention condition to which they were  
265 assigned. Parents were asked to conduct all offerings outside of a mealtime in line with  
266 previous research (Fildes et al., 2013), in order to avoid adding any potential stress  
267 associated with mealtimes. Parents in the repeated exposure condition (1) were instructed to

268 simply offer their child a small piece of the target vegetable without eating it themselves.

269 They were also asked to remain neutral in their responses to whether or not their child tasted

270 the piece. Parents in the modelling and repeated exposure condition (2) were instructed to

271 eat a small piece of the target vegetable in front of their child, expressing a positive response

272 such as “oh this [name of vegetable] is really nice!”. These parents were instructed to offer

273 their child a small piece of the vegetable immediately afterwards, but to remain neutral

274 regardless of whether their child tried a piece of the vegetable. Parents in the rewards and

275 repeated exposure condition (3) were asked to offer their child a small piece of the target

276 vegetable, telling them that if they try a piece they can choose a sticker from a sheet

277 provided for the study. Parents were further told that if their child did try a piece of the

278 vegetable, they should not only give them the sticker they chose but also praise them with a

279 phrase such as “well done, you tried your [name of vegetable]!” and to tell their child that

280 they were receiving a sticker because they tried the vegetable. Finally, parents in the

281 modelling, rewards and repeated exposure condition (4) were instructed to eat a piece of the

282 target vegetable in front of their child, saying how nice it was, and then to offer their child a

283 piece telling them they could choose a sticker if they tried it, and giving praise if the child did

284 indeed try a piece. Parents in all conditions were instructed to adhere to their assigned

285 method of offering for the entire 14 day period, and to record the success of the protocol in a

286 ‘tasting diary’. This diary asked parents to record whether they completed each daily

287 offering, and included a daily manipulation check (e.g., ‘Did you stay neutral?’ in the

288 repeated exposure group) as well as a record of whether each offering resulted in a tasting

289 (defined as contact with the child’s mouth, including licking, sucking, biting and chewing,

290 where swallowing was not necessary). During the baseline session, the researcher verbally

291 explained to parents how to offer the vegetable and how to use the diary, and written

292 instructions on how to complete the daily offerings were also provided. Parents were also

293 given the opportunity to ask any questions about the protocol, and given the researcher’s

294 contact information should they have any further queries.

295

296 *Fourteen day follow-up consumption and liking*

297           After the 14 day intervention period, parent-child dyads attended a follow-up session  
298 at the toddler group they attended at baseline. This session was identical in format to the  
299 baseline session, in order to allow for comparison of liking and consumption of the target  
300 vegetable pre and post-intervention. Parent and child height (cm) and weight (kg; using  
301 Salter 9059 SS3R ultra-slim scales) were measured. Parents also returned their completed  
302 tasting diaries.

303

304 **Data analysis**

305           Sample size was calculated following Cohen's (1992) guidelines of adequate sample  
306 size for statistical power. Based on these guidelines, a minimum of 16 dyads in each  
307 condition was required in order to detect a small effect with power of 0.8 and  $p < .05$ . To  
308 account for attrition across the study, participants were over-recruited by fifty percent,  
309 meaning that a minimum of eight additional dyads were recruited to each condition. For  
310 detailed information about attrition per condition please see Figure 1. Child height and  
311 weight were converted into age and gender adjusted BMI z scores (Cole, Freeman, &  
312 Preece, 1995; Freeman et al., 1995). Exploratory analyses were conducted to check  
313 normality of the data. Parent BMI and child age and the total tastings achieved were non-  
314 normally distributed. Consumption data both pre and post were also non-normally  
315 distributed, with a floor effect of a large number of zero scores. For these reasons, data were  
316 analysed using non-parametric tests where possible and parametric tests (ANOVAs) were  
317 conducted where there was no suitable alternative. Repeated measures ANOVAs were used  
318 to assess whether there were significant differences in any changes in consumption between  
319 the groups across the intervention period. Kruskal-Wallis analyses were conducted to  
320 investigate any potential differences between group consumption pre-intervention,  
321 consumption post-intervention, and the total tastings achieved. Mann-Whitney U analyses  
322 were then used to compare each experimental group's target vegetable consumption to that  
323 of the control group and the total tastings achieved between experimental groups. This

324 allowed for assessment of whether, post-intervention, participants in each condition  
325 consumed significantly more in comparison to the control group. Finally, chi-square analyses  
326 were used to look for differences in liking of the target vegetable between groups, both pre  
327 and post-intervention.

328

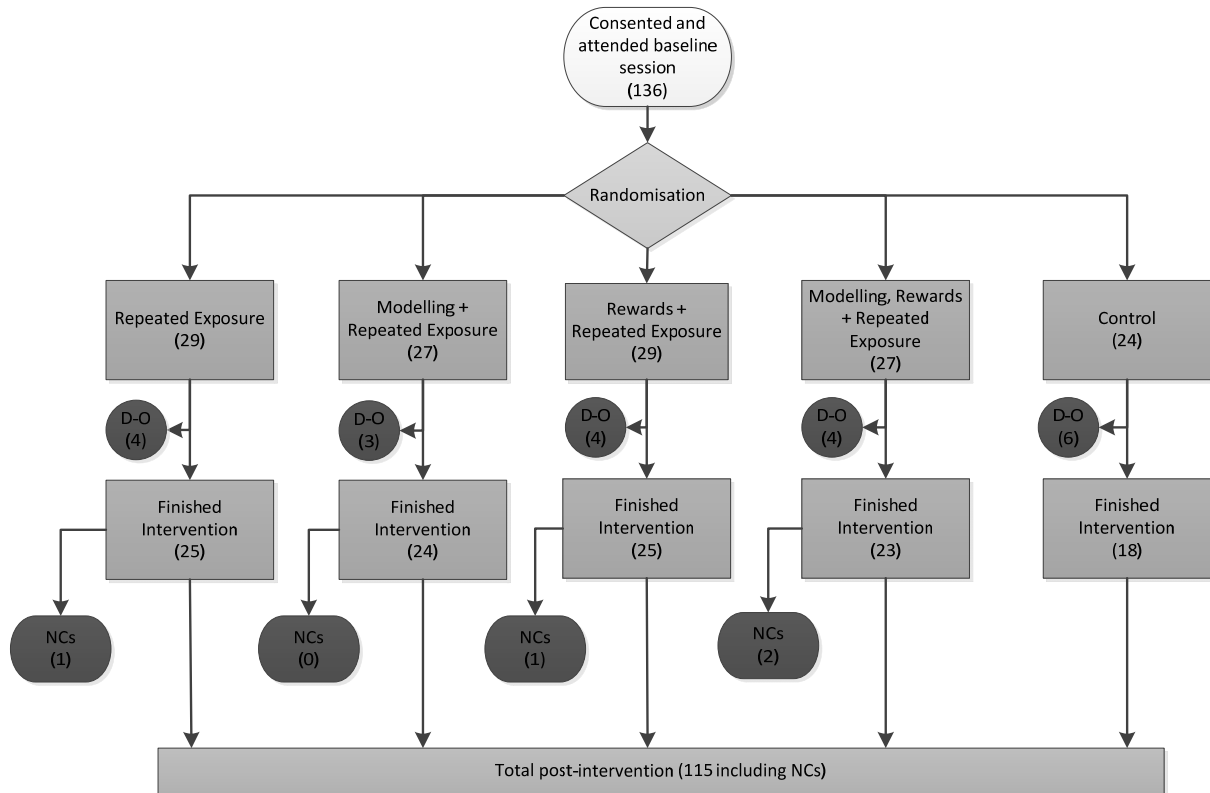
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## Results

330

### Sample and attrition

331           Of the 136 participants who completed the baseline session, 21 families (14.8%)  
332 were unavailable for the 14 day follow-up or withdrew from the study (due to illness, work  
333 commitments, or other personal reasons), leaving a sample of 115 parent-child dyads. Of  
334 these participants, 98 parents identified themselves as White/Caucasian, six identified as  
335 Black/Black British, two identified as Asian/Asian British and nine parents did not provide this  
336 information. The flow of participants through the study is shown in Figure 1. Based on  
337 previous research suggesting that 10 tastings of a disliked food are necessary for children to  
338 acquire liking (Sullivan & Birch, 1990), all analyses were repeated for a subset of the sample  
339 whose tasting diaries indicated that they had achieved 10 or more offerings (and removing  
340 those classed as 'non-completers' who achieved fewer than 10 offerings). However, as the  
341 findings of these analyses were unchanged from those using the full sample, full sample  
342 analyses are reported.



343

344 D-O: Dropout

345 NCs: Non-completers - i.e. those children who received fewer than 10 offerings of the target  
 346 vegetable during the 14 day intervention period

347 Figure 1: Flow of parent-child dyads from baseline to post-intervention during a vegetable  
 348 intervention for each of five experimental conditions.

349

350 **Descriptive statistics**

351 All groups were compared for differences in child and parent characteristics,  
 352 including age, gender, parental education, and BMI. There were no significant differences  
 353 were found for these characteristics between groups and this information is displayed in  
 354 Table 1.

355 Table 1: Child and parent characteristics of the final sample by experimental group, and Chi-square/ANOVA tests of difference between  
 356 conditions

	Repeated Exposure (1)	Modelling + Repeated Exposure (2)	Rewards + Repeated Exposure (3)	Modelling, Rewards + Repeated Exposure (4)	Control (5)	Group difference
<b>Parent</b>						
Parent Age [Years]	34.15 (4.74)	35.97 (5.11)	35.93 (5.71)	36.49 (3.64)	32.81 (4.03)	$F = 2.15$ , n.s.
Parent BMI	25.5 (5.04)	26.03 (5.18)	25.43 (3.83)	25.59 (5.03)	22.72 (2.57)	$F = .58$ n.s.
Education Level [ $n$ (%)]						$\chi^2 = 2.88$ n.s.
Non-University graduate	14 (61)	12 (55)	10 (42)	9 (43)	9 (60)	
University level or higher	9 (39)	10 (45)	14 (58)	12 (57)	6 (40)	
<b>Child</b>						
Child Age [Months]	38.24 (8.82)	39.68 (9.01)	40.20 (6.58)	38.09 (8.16)	34.17 (6.17)	$F = .14$ n.s.
Child BMI Z score	0.29 (1.04)	0.27 (.77)	0.07 (.81)	0.19 (1.01)	0.50 (.58)	$F = .46$ n.s.
Child Gender [ $n$ (%)]						$\chi^2 = .99$ n.s.
Male	11 (46)	10 (42)	9 (38)	8 (38)	6 (33)	
Female	13 (54)	14 (58)	15 (63)	13 (62)	12 (67)	

357 Note: Mean (SD) displayed unless otherwise stated. Descriptive statistics are based on available data, with missing data in some categories.

358 \* $p < .05$

359 **Exploring differences among intervention and control conditions on children's**  
 360 **consumption of a disliked vegetable**

361 In order to examine group differences in consumption of the target vegetable across  
 362 the study, repeated measures ANOVAs were conducted. Consumption of the target  
 363 vegetable significantly increased over the intervention period in all groups, with a main effect  
 364 of time ( $F(1,110) = 25.80, p < .001$ ). However, there was not a significant group by time  
 365 interaction ( $F(4, 110) = .89, p = .48$ ). Pre and post-intervention consumption data per  
 366 experimental group can be seen in Table 2.

367

368 Table 2: Mean pre and post-intervention consumption of the target vegetable (in grams) per  
 369 intervention condition, including minimum and maximum values with significant group  
 370 differences indicated.

371

372

Intervention condition	Pre consumption			Post consumption	
	N	Mean (g) (SD)	Min / max	Mean (g) (SD)	Min / max
Repeated exposure (1)	25	0.28 (0.78)	0.00 / 3.60	2.90 (5.30)	0.00 / 19.35
Modelling + repeated exposure (2)	24	0.36 (0.60)	0.00 / 2.00	4.68 (8.37)	0.00 / 30.00
Rewards + repeated exposure (3)	25	0.48 (0.87)	0.00 / 2.50	3.65 <sup>a</sup> (6.83)	0.00 / 30.00



Modelling, rewards + repeated exposure (4)	23	0.61 (1.06)	0.00 / 3.40	3.96 <sup>b</sup> (5.64)	0.00 / 22.15
Control (5)	18	0.25 (0.54)	0.00 / 2.15	1.14 <sup>ab</sup> (1.92)	0.00 / 5.85

373 <sup>a</sup> Significant difference in post-intervention consumption between groups 3 and 5 ( $p < .05$ )

374 <sup>b</sup> Significant difference in post-intervention consumption between groups 4 and 5 ( $p < .05$ )

375

376 Kruskal-Wallis analyses revealed that pre-intervention, there were no significant  
 377 differences between the groups on children's consumption of the target vegetable ( $H(4) =$   
 378  $3.29$ ,  $p = .51$ ). A series of Mann-Whitney U tests revealed that pre-intervention there were no  
 379 significant differences in consumption of the target vegetable between any pairings of the  
 380 five groups. There were also no significant differences between the groups on children's  
 381 consumption of the target vegetable post-intervention ( $H(4) = 5.07$ ,  $p = .28$ ). However,  
 382 Mann-Whitney U tests revealed that post-intervention, consumption was significantly higher  
 383 for children in the modelling, rewards and repeated exposure group (4) (Mdn = 1.65, U =  
 384  $137.00$ ,  $z = -1.98$ ,  $p = .02$ ,  $r = -.31$ ), and the rewards and repeated exposure group (3) (Mdn  
 385 =  $50$ , U =  $155.00$ ,  $z = -1.82$ ,  $p = .03$ ,  $r = -.28$ ) compared to the control group (Mdn =  $.00$ ).  
 386 No significant differences were observed in post-intervention consumption amongst the  
 387 modelling and repeated exposure (2) (Mdn =  $.00$ , U =  $176.00$ ,  $z = -1.14$ ,  $p = .13$ ,  $r = .18$ ) or  
 388 the repeated exposure group (1) (Mdn =  $.00$ , U =  $198.00$ ,  $z = -.77$ ,  $p = .23$ ,  $r = .12$ ), when  
 389 compared to the control group (Mdn =  $.00$ ).

390

### 391 **Exploring differences between the intervention conditions on the total number of** 392 **tastings achieved**

393 Previous research has shown that children need to try disliked foods a large number  
 394 of times for them to become liked (e.g., Sullivan & Birch, 1994). With this in mind, analyses

395 were used to explore whether there were significant differences in the number of tastings  
396 achieved between the intervention groups. Tasting data were the total number of reported  
397 tastings from the parent diaries. Kruskal-Wallis analysis revealed that there were significant  
398 group differences in the number of tastings achieved across the intervention period ( $H(3) =$   
399  $15.53$ ,  $p = .001$ ). A series of Mann-Whitney U tests revealed that the number of tastings  
400 achieved was significantly higher in the modelling, rewards and repeated exposure group (4)  
401 (Mdn = 12.00,  $U = 116.50$ ,  $z = -2.63$ ,  $p = .004$ ,  $r = -.06$ ) and rewards and repeated exposure  
402 group (3) (Mdn = 11.00,  $U = 137.50$ ,  $z = -2.61$ ,  $p = .004$ ,  $r = -.06$ ) compared to the repeated  
403 exposure group (1) (Mdn = 6.00). The modelling, rewards and repeated exposure group (4)  
404 (Mdn = 12.00,  $U = 105.50$ ,  $z = -2.90$ ,  $p = .002$ ,  $r = -.07$ ) and rewards and repeated exposure  
405 group (3) (Mdn = 11.00,  $U = 125.00$ ,  $z = -2.90$ ,  $p = .002$ ,  $r = -.06$ ) also achieved significantly  
406 more tastings than the modelling group (2) (Mdn = 5.00). There were no significant  
407 differences in the number of tastings achieved between the modelling, rewards, and  
408 repeated exposure group (4) (Mdn = 12.00,  $U = 229.00$ ,  $z = -.53$ ,  $p = .30$ ,  $r = -.01$ ) and the  
409 rewards group (3) (Mdn = 11.00), or between the modelling and repeated exposure group  
410 (2) (Mdn = 5.00,  $U = 220.50$ ,  $z = .00$ ,  $p = .50$ ,  $r = .00$ ) and the repeated exposure group (1)  
411 (Mdn = 6.00).

412

### 413 **Exploring differences among the intervention and control conditions on children's** 414 **liking of a previously disliked vegetable**

415 Of the 115 children who took part in the study, 39 did not appear to fully understand  
416 the smiley faces rating scale which was used to determine children's opinion of the target  
417 vegetable. These children could not correctly identify the "yummy" or "yucky" faces on  
418 request. Children who could not use the smiley faces rating scale were removed from the  
419 liking analyses, although it is noted that this resulted in uneven group sizes. The number of  
420 children able to use the smiley faces rating scale can be seen in Table 3, alongside the  
421 percentages of children within each condition who rated the target vegetable as "yummy"  
422 both pre and post-intervention.

423

424 Table 3: Number of children rating the target vegetable as “yummy” on the smiley faces  
 425 rating scale pre and post-intervention per condition

Experimental Group	N	Yummy Pre	Yummy Post
Repeated Exposure (1)	20	0	7
Modelling + Repeated Exposure (2)	15	0	4
Rewards + Repeated Exposure (3)	16	1*	10
Modelling, Rewards + Repeated Exposure (4)	15	2*	9
Control (5)	10	0	1

426 \* Children were only assigned this vegetable when they rated it as yummy but then only ate  
 427 one small piece of it or less – i.e. where their response was considered incongruent with  
 428 their true liking.

429

430 Chi-Square analyses revealed that pre-intervention, there was no significant  
 431 difference in rated liking between the five groups ( $\chi^2(8, N = 76) = 11.52, p = .16, V = .28$ ).  
 432 However, post-intervention there was a significant difference between the groups on  
 433 children’s rated liking of the target vegetable ( $\chi^2(8, N = 76) = 15.48, p = .05, V = .32$ ). Here,  
 434 the proportion of children who rated the target vegetable as “yummy” was highest in the  
 435 modelling, rewards and repeated exposure (4) and rewards and repeated exposure (3)  
 436 groups (over 60%), intermediate in the modelling and repeated exposure (2) and repeated  
 437 exposure (1) groups (over 26%), and lowest in the control group (5) (10%). For exact  
 438 numbers of children who rated the vegetable as “yummy” refer to table 3.

439

440

### Discussion

441 The aim of this study was to assess the effectiveness of a home-based rewards,  
 442 modelling and repeated exposure intervention for increasing children’s liking and acceptance  
 443 of a disliked vegetable. It was predicted that children who participated in the all methods  
 444 condition (4) would show significant post-intervention increases in both liking and

445 consumption of a previously disliked target vegetable, compared to the control group (5). It  
446 was further predicted that there would be intermediate increases in liking and consumption  
447 of the target vegetable for children who were in the modelling and repeated exposure  
448 condition(2), or the rewards and repeated exposure condition (3). Finally, it was predicted  
449 that children in the repeated exposure group (1) would have the smallest post-intervention  
450 increases in liking or consumption of the target vegetable, in comparison to the control group  
451 (5). These hypotheses were partially supported.

452 In the current study, post-intervention consumption and liking of the previously  
453 disliked vegetable was significantly greater amongst children who were in the all methods  
454 condition (4) than the control group (5), suggesting that a combination of parental modelling,  
455 rewards and repeated exposure is effective at increasing children's consumption and liking  
456 of a previously disliked vegetable. This is consistent with previous research using mixed  
457 methods interventions, such as the 'Food Dudes' (Horne et al., 2011; Lowe et al., 1998,  
458 2004) and the 'Kids Choice' (Hendy et al., 2005) programmes. The current study adds to the  
459 results of these school-based interventions by suggesting that, alongside rewards, parental  
460 modelling could be an effective alternative to the peer modelling component of these  
461 interventions. It also suggests that the home environment can be a suitable setting for such  
462 interventions.

463 Greater consumption and liking of the disliked vegetable post-intervention was found  
464 amongst children who were in the rewards and repeated exposure condition (3), as well as  
465 the modelling, rewards and repeated exposure condition (4) when compared to those in the  
466 control group (5). Moreover, the number of tastings achieved by the intervention groups  
467 fitted the same pattern as was found for increases in liking and consumption. Specifically,  
468 the all methods group (4) and the rewards and repeated exposure group (3) achieved  
469 approximately twice as many tastes as children in the modelling and repeated exposure (2)  
470 or repeated exposure alone (1) groups. Taste exposures are likely to be necessary for a  
471 young child to accept and acquire a liking for novel or disliked foods (Birch et al., 1987), and  
472 the combination of rewards and repeated exposure appears to be most effective at

473 increasing such tasting and subsequent consumption in this study. This finding is in line with  
474 previous research suggesting that small tangible rewards can be effective when combined  
475 with repeated exposure in both the school (Wardle et al., 2003) and home settings (Fildes et  
476 al., 2013; Remington et al., 2012). Although this appears to contradict the over-justification  
477 hypothesis of rewards (Deci, Koestner, & Ryan, 1999), where giving rewards in exchange for  
478 consumption decreases liking for that food, it does support the current literature to date on  
479 rewarding tasting disliked compared to liked foods. As Cooke, Chambers, Añez, and Wardle  
480 (2011) discuss, rewarding children for consuming large amounts of already liked foods may  
481 actually lower the intrinsic value attributed to such foods. However, if foods are not already  
482 liked, then pairing such foods with a reward can result in increased liking via a process of  
483 paired conditioning.

484         The current study found no significant differences in consumption or liking of the  
485 disliked vegetable post-intervention between children in the modelling and repeated  
486 exposure condition (2) when compared to those in the control group. This suggests that the  
487 combination of modelling and repeated exposure alone, without rewards, may not be  
488 effective at increasing liking or consumption of a previously disliked food. Although previous  
489 research suggests that enthusiastic parental modelling can be a useful tool for increasing  
490 vegetable consumption in children (e.g., Gregory et al., 2010; Harper & Sanders, 1975;  
491 Palfreyman et al., 2012; Pearson, Biddle, & Gorely, 2009; Tibbs et al., 2001), to our  
492 knowledge there are currently no successful interventions which use parental modelling. It is  
493 possible that previous research showing modelling to be effective has had subtle elements  
494 of rewards within the design, such as praise for tasting. In an effort to unpack the effects of  
495 rewards and modelling, parents in the current study's modelling and repeated exposure  
496 condition (2) were asked to enthusiastically model tasting of the food but were explicitly  
497 asked to remain neutral regardless of whether their child tried the vegetable (i.e. not to  
498 praise their child). Whilst previous research suggests that modelling is a relatively commonly  
499 used practice (with approximately one third of parents in Musher-Eizenman and Holub's  
500 2007 study); this may have resulted in the parents' modelling being unnatural, where they

501 were focused on remaining neutral or following the study instructions. It is also possible that  
502 children in this condition found it strange that they were not praised for trying a food their  
503 parent was enthusiastic about eating, as praise is thought to be a fairly common feeding  
504 practice (with 30% of parents in Orrell-Valente et al.,'s 2007 study using praise). This in turn  
505 may have reduced these children's enjoyment and subsequent liking of the vegetable.  
506 Moreover, although parents were given instructions on how to model appropriately, they may  
507 not have been sufficiently enthusiastic (see Hendy & Raudenbush, 2000) or their enthusiasm  
508 may not have lasted for the duration of the intervention, thereby potentially reducing the  
509 effectiveness of their efforts.

510         No significant differences in post-intervention liking or consumption of the target  
511 vegetable were found between the repeated exposure group (1) and the control group. It is  
512 likely that this is because children in the repeated exposure alone group did not achieve the  
513 10-15 tastings necessary to increase liking and consumption of the target vegetable (Birch et  
514 al., 1982; Sullivan & Birch, 1990). Although repeated taste exposures are vital to encourage  
515 children to taste disliked foods, repeatedly offering in a neutral way did not appear to ensure  
516 tastings in this study. These findings suggest that additional methods are necessary to  
517 achieve the taste exposures needed to induce liking and acceptance of a disliked vegetable.

518         Overall, this study has made a valuable contribution to the knowledgebase about  
519 successful methods which can be used to encourage children to eat, and like, more  
520 vegetables. By gathering data concerning tasting, liking and consumption and including a  
521 control group as well as a repeated exposure group, we are able to build on previous  
522 research (e.g., Lowe et al., 2004; Remington et al., 2012) to compare the effects of each  
523 component of the intervention. Nevertheless, the study does have limitations. Firstly, this  
524 study sample has limited ethnic diversity, which must be considered. Due to the parent led  
525 nature of the study we were unable to fully control parents' reactions when offering the  
526 vegetable or their response to children tasting. While this means that fidelity to the  
527 intervention cannot be guaranteed for all participants, this is a wholly necessary part of  
528 developing a home-based intervention which results in high ecological validity. We also do

529 not know whether parents offered the target vegetable at other times during the intervention,  
530 and future studies should aim to control for this. It is also important to acknowledge that  
531 some children ate the disliked food at baseline, however these children were only assigned  
532 the vegetable as their target vegetable if they ate a very small quantity, such as only the first  
533 piece they were asked to try. It is also possible that some of the target vegetables which  
534 were assigned were not strictly disliked, and may have in fact been novel, although this was  
535 controlled for wherever possible with information from parents.

536         These findings indicate that parent led home-based interventions comprised of  
537 repeated exposure and rewards, with or without the addition of parental modelling, are  
538 successful at increasing children's consumption and liking of a previously disliked vegetable.  
539 These results also suggest that in home-based interventions, neither parental modelling nor  
540 repeated exposure are sufficient for increasing children's liking and consumption of a  
541 disliked vegetable without the use of rewards. Although this finding is contrary to what was  
542 initially expected, it could be promising that parental modelling is not vital to increase liking  
543 and consumption, especially for parents who do not eat vegetables themselves or do not  
544 often eat meals with their child. Such interventions have minimal economic burden and may  
545 prove to be a viable alternative to school programmes which tend to be costly and exclusive.  
546 Further research is required to identify whether increases in liking and consumption of a  
547 previously disliked vegetable are maintained over time.

548

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