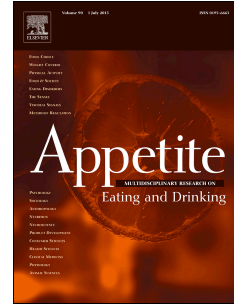


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If at first you don't succeed: Assessing influences associated with mothers' reoffering of vegetables to preschool age children

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Short running title: Reoffering of vegetables

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CF contributed to the design, analysis and write up.

23 **Abstract**

24 Repeatedly offering vegetables has been shown to be one of the most effective methods for
25 increasing acceptance and subsequent intake in young children. In order to increase
26 successful offerings of vegetables and resultant consumption amongst young children, it is
27 necessary to consider the influences on maternal reoffering of vegetables. This study aimed to
28 investigate the relationships between mothers' tendency to reoffer vegetables and a range of
29 demographic factors and psychological variables. A cross-sectional design was used, where
30 mothers completed questionnaires assessing how often they reoffer rejected vegetables,
31 concerns for economic factors, and a range of possible child and maternal influences.
32 Mothers of preschool children were recruited from toddler groups across Leicestershire, UK,
33 as well as online. Spearman's correlations were run to look for associations between
34 demographic and psychological factors with maternal reoffering of vegetables. Significantly
35 associated factors were then entered into a stepwise regression to predict maternal reoffering
36 of vegetables. Mothers were significantly less likely to reoffer rejected vegetables if they
37 were concerned about time, money, and waste, were influenced by their child's mood, or
38 were concerned about their child having tantrums. Moreover, mothers who consumed more
39 vegetables themselves reoffered vegetables more frequently. Regression analyses revealed
40 that mothers' concern about food waste and tantrums, as well as maternal vegetable
41 consumption, all significantly predicted mothers' reoffering of vegetables. With these
42 findings in mind, mothers should be educated and supported with how to tackle and minimise
43 children's tantrums during feeding, as well as being made aware of effective methods for
44 avoiding food waste. Moreover, given that mothers' own vegetable consumption is
45 associated with lower reoffering of vegetables to their child, interventions which seek to
46 increase familial vegetable consumption should be pursued.

47 **Keywords:** maternal; child; vegetable consumption; feeding; repeated exposure; reoffering

48 **If at first you don't succeed: Assessing influences associated with mothers' reoffering of**
49 **vegetables to preschool age children**

50 Vegetable consumption in children is low and vegetables are commonly rejected by children
51 (e.g., Cooke & Wardle, 2005). Previous research suggests that in order for children to like
52 and accept a rejected food they may need to try it as many as 10 to 15 times (e.g., Birch &
53 Marlin, 1982; Birch, Gunder, Grimm-Thomas, & Laing, 1998; Sullivan & Birch, 1990).
54 Research suggests that early and sustained experiences with vegetables are the key to
55 children's acceptance (Johnson, 2016), with a recent systematic review of experimental
56 studies demonstrating that repeated exposure to the taste of vegetables is the most successful
57 method of increasing vegetable consumption in early childhood (Holley, Farrow, & Haycraft,
58 2017). Specifically, experimental research has found that young children between two and
59 five who experience more than five taste exposures to a novel or disliked food will consume
60 significantly more of the food than on the first exposure (Birch & Marlin, 1982; Birch,
61 McPhee, Shoba, Pirok, & Steinberg, 1987; Sullivan & Birch, 1990). Experimental research
62 also suggests that repeated taste exposure can not only increase three to six year old
63 children's consumption of vegetables, but also their liking (Anzman-Frasca, Savage, Marini,
64 Fisher, & Birch, 2012). These effects have been found to be pervasive in preschoolers, with
65 support for these findings coming from various contexts including nurseries, preschools, the
66 home and in laboratory studies (e.g., Bouhlal, Issanchou, Chabanet, & Nicklaus, 2014; Caton
67 et al., 2013; Fildes, van Jaarsveld, Wardle, & Cooke, 2013; Hausner, Olsen, & Møller, 2012).
68 Moreover, questionnaire studies have consistently found that earlier introduction to foods is
69 associated with higher consumption later in childhood, or with consumption of a greater
70 variety of foods (e.g., Cashdan, 1994; Cooke et al., 2004; Skinner, Carruth, Bounds, Ziegler,
71 & Reidy, 2002). Furthermore, a more recent narrative review suggests that even visual
72 exposure to unfamiliar foods can increase children's willingness to try and to accept these

73 foods in the future (Heath, Houston-Price, & Kennedy, 2011). Despite this large body of
74 evidence for the effectiveness of repeated exposure, less than 9% of mothers of infants and
75 toddlers reoffer new foods to their children as many as 10 times (Carruth, Ziegler, Gordon, &
76 Barr, 2004). In light of this, it is crucial to consider the influences on caregivers' reoffering of
77 vegetables, in order to increase children's consumption. It is optimal to investigate reoffering
78 with preschool children, who will reap the maximal benefits resulting from increased
79 vegetable consumption across the lifespan.

80

81 A previous qualitative study identified that the majority of influences on caregivers' offering
82 of vegetables to preschool children fell into three categories: economic factors, child factors
83 and maternal factors (Holley, Farrow, & Haycraft, 2016). To apply these findings more
84 widely, it is necessary to conduct further, large scale research that determines which factors
85 influence caregivers' reoffering of vegetables to young children. This information could then
86 be used to inform future education for parents and interventions aimed at increasing
87 children's vegetable consumption. For the current paper, reoffering is defined as presenting a
88 previously rejected food to a child.

89

90 Economic influences on reoffering of vegetables can take several forms. One of these
91 influences is time, where adults in previous research have reported that they do not have the
92 time available to shop for fresh fruits and vegetables on a regular basis (Anderson & Cox,
93 2000), and both high and low socioeconomic status (SES) groups report that preparing
94 vegetables is time consuming (Holley et al., 2016; Kilcast, Cathro, & Morris, 1996). Another
95 economic influence is food waste. Previous research has highlighted the significant effect that
96 potential food waste has on low SES and low vegetable consumers' choice to buy vegetables
97 (Kilcast et al., 1996). Moreover, parents of three to five year old children with unhealthy food

98 preferences have stated that reoffering previously rejected (typically healthy) foods to their
99 child was wasteful, as their child would again refuse the food (Russell, Worsley, & Campbell,
100 2015).

101

102 As well as time and food waste, the financial cost of vegetables can also be important, with
103 some evidence suggesting that a diet rich in fruits and vegetables can cost more than a diet
104 higher in sugar and fats (Drewnowski, Darmon, & Briend, 2004). This factor impacts upon
105 families of lower SES more significantly than those of higher SES, with a consistent body of
106 literature demonstrating that lower parental SES is significantly associated with less frequent
107 consumption of vegetables (see Rasmussen et al., 2006, for a review). The cost of vegetables
108 has previously been shown to be a potential barrier to individuals increasing their vegetable
109 consumption (Cox, Anderson, & Lean, 1998). Moreover, evidence suggests that food cost
110 can be a barrier to consumption in both low and high SES families (Cox et al., 1998). It is
111 therefore important that such factors be considered in populations other than the lowest SES
112 groups. Furthermore, this literature suggests that caregivers' concerns about the cost of
113 vegetables should be assessed as a possible significant factor in reoffering of vegetables to
114 their child. With public and private funding sources for food scarce and current food policies
115 not improving the cost of healthy eating, food cost is particularly pertinent (Brambila-Macias
116 & Shankar, 2011).

117

118 A range of child factors may also influence caregivers' reoffering of previously rejected
119 vegetables. Previous research has posited that children's general eating behaviours are related
120 to their vegetable consumption, where fussiness is associated with lower consumption among
121 seven to nine year olds (Galloway, Fiorito, Lee, & Birch, 2005), and enjoyment of food is
122 associated with higher consumption of vegetables among five to seven year olds (Cooke et al.,

123 2004). Moreover, research from Farrow, Galloway, and Fraser (2009) suggests that parents
124 use different feeding practices with fussy three to six year old children compared to their less
125 fussy siblings. Taking this research into consideration, it is possible that caregivers'
126 reoffering of vegetables may be related to children's eating behaviours, such as fussiness. A
127 previous qualitative study revealed additional child factors which may influence reoffering to
128 preschool age children (Holley et al., 2016). Caregivers reported that they may be dissuaded
129 from reoffering vegetables to their child if their child was not particularly hungry or if they
130 believed there was a possibility of their child having a tantrum (Holley et al., 2016). Such
131 findings need elucidating with quantitative research to further understand whether these
132 influence caregivers' reoffering practices more broadly.

133

134 A final group of possible influences on reoffering of vegetables is caregiver factors, such as
135 caregivers' own preferences for and consumption of vegetables, which may influence
136 children's consumption of vegetables. Indeed, literature suggests that children's and
137 adolescents' vegetable intake may be positively related to parental intake (Cooke et al., 2004;
138 Hanson, Neumark-Sztainer, Eisenberg, Story, & Wall, 2005; Palfreyman, Haycraft, & Meyer,
139 2014). However, while maternal factors may influence children's consumption of vegetables,
140 it is important to note that research also suggests that this relationship may be bi-directional
141 or even iterative (e.g., Webber, Hill, & Wardle, 2010). Research has suggested that children's
142 eating behaviour can influence maternal feeding practices (Farrow & Blissett, 2008; Haycraft
143 & Blissett, 2012) and that feeding practices may well be a consequence of children's eating
144 rather than a cause of eating behaviours (Holley, Haycraft, & Farrow, 2017; Webber et al.,
145 2010). With this in mind, it is important to investigate the combined and separate associations
146 of these possible influences on caregivers' reoffering of vegetables.

147

148 The current study seeks to extend previous research, such as that of Carruth et al. (2004), by
149 exploring how frequently mothers reoffer vegetables to preschool children (aged 2 to 5 years),
150 and which factors might influence reoffering of vegetables to preschool children. Specifically,
151 the study had two aims. The first aim was to investigate whether the frequency of reoffering
152 of vegetables is associated with maternal concern about economic factors (time, waste and
153 money), child factors (eating behaviours, hunger, and maternal concern about children's
154 mood and tantrums), and maternal factors (their own dislike of vegetables and vegetable
155 consumption). It was hypothesised that mothers would reoffer rejected vegetables fewer
156 times if they: were concerned about the financial costs of offering (including waste);
157 described their children as fussier eaters; ate fewer vegetables themselves. A second aim of
158 the study was to assess which factors could best predict mothers' frequency of reoffering of
159 previously rejected vegetables.

160

161 **Method**

162 ***Participants***

163 Caregivers of two to five year old children were invited to take part in the study. Using
164 Cohen's (1992) guidelines on appropriate sample size, recruitment was set for a minimum
165 sample of 177 caregivers. Due to the small numbers of other types of caregivers, non-mothers
166 were excluded (n=18), leaving a final sample of 256 mothers who participated in this study.

167

168 Mothers' age ranged from 21.0 to 49.3 years ($M=35.5$; $SD=5.16$) and child age ranged from
169 19.0 to 62.0 months ($M=38.5$; $SD=10.76$). Mothers were predominantly of White ethnicity
170 (n=232) with six mothers identifying as Asian/Asian British, one as Black/Black British, four
171 as Chinese, four as mixed ethnicities, three reporting as 'other' and these data missing for six
172 mothers. Two-thirds of the mothers in this study were educated to University level or higher

173 (n=171) with the remaining third educated below University level (n=83) and these data
174 missing for two mothers.

175

176 *Procedure*

177 *Ethics*

178 Loughborough University Institutional Review Board granted full ethical clearance for this
179 study. Mothers were advised of their right to withdraw from the study at any time. Mothers
180 were further informed that all responses would be confidential and would be used and stored
181 anonymously.

182

183 *Recruitment*

184 Approximately half of the mothers (n=124) were recruited through media outlets, including
185 posters displayed on public noticeboards, posts on social media pages (such as Facebook and
186 Twitter) and an online university noticeboard, as well as through a local radio interview, and
187 through articles in local newspapers. Mothers were asked to complete an online version of the
188 study questionnaire via Bristol Online Surveys. The content of the online survey was
189 identical to the paper survey issued during face-to-face recruitment sessions.

190

191 Permission was sought from group leaders of 17 toddler groups across Leicestershire, UK,
192 for the researcher to attend sessions to recruit willing mothers. Approximately half of the
193 mothers who participated in this study (n=132) were recruited from these groups. Mothers
194 were asked by the researcher if they would like to participate in a study investigating how
195 mothers offer vegetables to their young children. Mothers who expressed an interest in
196 participating were then given an information sheet outlining the details of the study, as well

197 as a consent form to complete if they wanted to take part. Finally, mothers were given a paper
 198 copy of the study questionnaire pack, which took approximately 10 minutes to complete.

199

200 **Measures**

201 This study measured a number of possible influences on mothers' reoffering of vegetables
 202 which were derived from a previous qualitative study (Holley et al., 2016). These influences
 203 can be grouped into three categories: concerns about economic factors; child influences; and
 204 maternal influences. A summary of the constructs measured is presented in Table 1 and they
 205 are briefly described below.

206

207 **Table 1:** Summary of possible influences on mothers' reoffering of vegetables to be
 208 measured. Footnotes denote the measure used for each construct.

Influences

Concerns about economic factors

Time^a

Waste^a

Money^a

Child

Child mood^a

Child hunger^a

Child tantrums^a

Children's slowness in eating^b

Children's enjoyment of food^b

Children's general food fussiness^b

Children's general food responsiveness^b

Children's vegetable consumption^c

Maternal

Mother's own dislike of vegetables^a

Maternal vegetable consumption^c

209 ^a newly developed item

210 ^b Children's Eating Behaviour Questionnaire

211 ^c adapted Food Frequency Questionnaire

212

213 *Children's Eating Behaviour Questionnaire (CEBQ; Wardle, Guthrie, Sanderson, &*
214 *Rapoport, 2001)*

215 The CEBQ is a 35-item questionnaire measuring a variety of children's eating behaviours.
216 Four of its subscales which were expected to be related to mothers' reoffering of vegetables
217 were administered to measure children's: slowness in eating (four items, e.g. "My child eats
218 slowly"); enjoyment of food (four items, e.g. "My child enjoys eating"); food fussiness (six
219 items, e.g. "My child enjoys tasting new foods"); and food responsiveness (five items, e.g.
220 "My child enjoys eating"). This measure has been shown to be reliable in other samples of
221 UK mothers of children of a similar age (e.g., Cooke et al., 2004). All four subscales
222 demonstrated good reliability with the current sample, with Cronbach's alphas ranging
223 from .77 to .89.

224

225 *Measuring maternal and child vegetable consumption: Brief Food Frequency Questionnaire*
226 *(FFQ; Cooke et al., 2003)*

227 The vegetable item from Cooke, Wardle, and Gibson's (2003) brief FFQ was broken to down
228 to assess maternal and child intake of (1) raw vegetables (e.g. carrot sticks, celery); (2)
229 cooked vegetables (including sweet potato but not potato); and (3) salad (e.g. tomatoes,
230 lettuce) (Holley, Haycraft, et al., 2017). These three types of vegetables were included to
231 ensure that all forms of vegetables were captured in maternal estimates of vegetable
232 consumption. Items assessing intake of fruit, meat, fish, sweets, carbohydrates and eggs were
233 not included as they were not relevant to the current study. This FFQ measure was adapted
234 from the Dietary Instrument for Nutrition, a validated measure of dietary intake against 4-day
235 diet recalls (Roe, Strong, Whiteside, Neil, & Mant, 1994). Mothers were asked to report how
236 often they and their child consumes each of these three types of vegetables (raw, cooked and
237 salad) on an eight-point likert scale. For the purposes of this study the categories of this scale

238 were reworded, so that instead of ranging from “never/rarely” to “four or more times a day”,
239 they ranged from “never/rarely” to “four or more portions a day”. This was to enable the
240 extraction of data about the number of portions of vegetables being consumed, rather than the
241 frequency of vegetable consumption, thereby facilitating comparison with government
242 guidelines on vegetable consumption. Mothers were provided with a guide to age-appropriate
243 portions of vegetables for children to assist them in judging their child’s consumption (Infant
244 and Toddler Forum, 2013). This measure is scored by converting intake data to intake per
245 week so as to calculate children’s total vegetable consumption from these three categories
246 (raw, cooked and salad). Responses of ‘never/rarely’ are assigned a score of 0, responses of
247 ‘one or two portions a week’ are assigned a score of 1.5 and so on up to ‘four or more
248 portions a day’ being scored 28. Summed responses for all categories were calculated to give
249 total weekly vegetable consumption in portions. This was then converted into average daily
250 consumption in portions by dividing by seven.

251

252 *Influences on maternal reoffering of vegetables*

253 A single item was developed to evaluate the impact of each of seven of potential influences
254 on maternal offering of vegetables identified in a previous qualitative study (Holley et al.,
255 2016). These possible influences were: time (“I do not offer my child vegetables they don’t
256 like because it takes so much time to buy and prepare them”), waste (“I do not offer my child
257 vegetables they don’t like because of the waste involved”), cost (“I do not offer my child
258 vegetables they don’t like because of the cost”), concerns about child mood (“The mood that
259 my child is in influences whether I offer them vegetables they don’t like”), concerns about
260 child tantrums (“I do not offer my child vegetables they dislike to avoid tantrums”), child
261 hunger (“How hungry my child is influences whether I offer them vegetables they don’t
262 like”), and mothers’ own dislike of vegetables (“How often to you offer your child vegetables

263 that you do not eat yourself?”). These questions were scored on five-point likert scales
264 labelled with “disagree”, “slightly disagree”, “neither agree nor disagree”, “slightly agree”, or
265 “agree” except for the question regarding the influence of mothers’ own dislike of vegetables,
266 which was scored “never”, “rarely”, “sometimes”, “often”, or “always”.

267

268 *Assessing frequency of maternal of reoffering vegetables*

269 Mothers were asked “How many times will you re-offer your child a vegetable they have
270 previously refused to eat on another occasion?” Response options were on a scale from zero
271 to 10+ times. Raw scores on this question were used in the analyses.

272

273 *Demographic measures*

274 Mothers were asked to provide their child’s and their own gender and date of birth. Mothers
275 were also asked to state their relationship to the child, as well as their ethnicity and level of
276 education.

277

278 *Statistical Methods*

279 Kolmogorov-Smirnov tests indicated that the majority of the study’s variables were not
280 normally distributed, therefore non-parametric tests were used, where possible, to test the
281 study’s hypotheses. Preliminary Mann Whitney U analyses confirmed there were no
282 significant differences on the study’s outcome variables between participants who completed
283 the questionnaire online versus on paper. Preliminary one-tailed Spearman’s correlations
284 were run between maternal age, child age and each of the study variables. Child age was
285 significantly correlated with: the influence of food waste ($r=.20$, $p<.01$); children’s food
286 fussiness ($r=.16$, $p<.01$); and tantrums ($r=.16$, $p<.05$). Here, mothers of older children
287 reported greater concerns about food waste, reported having fussier children, and reported

288 more concern about their child having tantrums. Due to these associations, partial correlations
289 (which controlled for child age) were run between each of these associated factors and the
290 outcome variable of reoffering of vegetables. Maternal age was not significantly associated
291 with any of the study variables.

292

293 One-tailed Spearman's correlations were used to investigate associations between maternal
294 reoffering of rejected vegetables and possible influences on reoffering including maternal
295 concern about economic, child and maternal influences. Significant correlates of vegetable
296 reoffering were subsequently entered into a stepwise regression model to assess which factors
297 could best predict frequency of reoffering of vegetables. As child age was significantly
298 related to some of the factors which were entered into the regression model, child age was
299 also entered alongside other significant correlates. Due to the large number of correlations
300 conducted and the associated risk of type 1 errors, a more stringent significance level of
301 $p < .01$ was used for all correlations. Significance was set at $p < .05$ for the regression analyses.

302

303

Results

Descriptive statistics

304 Descriptive statistics for the validated subscales of the CEBQ are displayed in Table 2. The
305 study sample's mean scores for the CEBQ subscales are comparable to means from similar
306 samples (Pliner & Loewen, 1997; Haycraft, Farrow, Meyer, Powell, & Blissett, 2011).

308

309 **Table 2:** Mean and standard deviation (SD) scores for validated measures of children's
 310 eating behaviours (CEBQ subscales) among a sample of 256 2-5 year old children in the UK

Children's eating behaviour	Mean (SD)	Min	Max
Enjoyment of food	3.88 (0.77)	1.00	5.00
Slowness in eating	2.78 (0.75)	1.00	5.00
Food fussiness	2.77 (0.74)	1.00	5.00
Food responsiveness	2.58 (0.80)	1.00	5.00

311

312 Descriptive statistics for the newly developed items are presented in Table 3. Concerns about
 313 waste, children's mood, and maternal dislike were all fairly frequently reported influences on
 314 reoffering of vegetables. Mothers consumed an average of 2.92 portions of vegetables per
 315 day, while children consumed an average of 2.41 portions per day. However, it should be
 316 noted that there was a large degree of variance in consumption with 9.8% of mothers eating
 317 less than one portion of vegetables a day and 13.1% of mothers eating five or more portions a
 318 day. Similarly, 18.8% of children were eating less than one portion of vegetables a day, while
 319 5.3% of children were eating five or more portions a day. Having said this, the average
 320 consumption of vegetables for mothers and children in this sample was higher than recent UK
 321 national averages (Public Health England & Food Standards Agency, 2014). Mothers
 322 reported reoffering disliked vegetables to their children on average 7.68 times, although again
 323 there was a large degree of variance in this, with 54.6% of mothers reoffering disliked
 324 vegetables more than ten times, and some mothers (4.3%) reoffering once if at all.

325

326 **Table 3:** Mean and standard deviation (SD) scores for measures of influences on reoffering
 327 of rejected vegetables among a sample of 256 mothers of 2-5 year old children in the UK.

Newly developed Items	Mean (SD)	Min	Max
Concerns about economic factors			
Time	1.82 (1.13)	1.00	5.00
Waste	2.16 (1.34)	1.00	5.00
Money	1.70 (1.07)	1.00	5.00
Child influences			
Concerns about child mood	2.40 (1.42)	1.00	5.00
Concerns about tantrums	1.72 (1.11)	1.00	5.00
Hunger	1.96 (1.25)	1.00	5.00
Daily vegetable consumption (portions)	2.41 (1.46)	0.00	6.00
Maternal influences			
Own dislike of vegetables	2.41 (1.27)	1.00	5.00
Daily vegetable consumption (portions)	2.92 (1.53)	0.21	7.00
Outcome variables			
Frequency of reoffering of vegetables	7.68 (3.83)	0.00	11.00

328

329 *Investigating whether the frequency of reoffering of vegetables is associated with maternal*
 330 *concern about economic factors, child factors, and maternal factors.*

331 One-tailed correlations were run to investigate associations between the frequency of
 332 maternal reoffering of rejected vegetables and various influences on maternal offering of
 333 vegetables, as reported by mothers (Table 4). Frequency of maternal reoffering of vegetables
 334 to their children was significantly associated with mothers' concerns about economic, child
 335 and maternal influences. Specifically, maternal reoffering was negatively associated with
 336 concern for all the economic influences which were explored (time, waste and money).
 337 Reoffering was also negatively associated with mothers' concern about their children's mood
 338 and tantrums, and positively associated with mothers' own vegetable consumption.

339

340

341 **Table 4:** One-tailed Spearman's correlations (unless otherwise stated) between economic,
 342 child and maternal factors and frequency of reoffering of vegetables in 256 UK mothers of 2-
 343 5-year-old children.

Influence	Frequency of maternal reoffering vegetables	
	r	p
Concerns about economic factors		
Time	-0.24	0.00
Waste ^a	-0.26	0.00
Money	-0.15	0.01
Child		
Slowness in eating ^b	-0.04	0.29
Enjoyment of food ^b	0.07	0.13
Food Fussiness ^{ab}	-0.06	0.17
Food Responsiveness ^b	-0.00	0.48
Concerns about child mood	-0.15	0.01
Concerns about child tantrums ^a	-0.29	0.00
Hunger	-0.07	0.13
Daily vegetable consumption	0.10	0.06
Maternal		
Own dislike of vegetables	0.10	0.06
Daily vegetable consumption	0.19	0.00

344 Significant correlations are presented in bold

345 ^a partial correlation controlling for child age

346 ^b Subscale of the Children's Eating Behaviour Questionnaire

347

348 *Assessing which factors could best predict mothers' frequency of reoffering of previously*
 349 *rejected vegetables*

350 To address the second aim of the study, a stepwise multiple regression was performed to
 351 identify a model which could significantly explain variance in maternal reoffering of rejected
 352 vegetables to their child, as well as identify the strongest statistical predictors of reoffering
 353 (Table 5). Concern for economic factors, child influences and maternal influences which
 354 were found to be significantly associated with re-offering of vegetables (Table 4) were
 355 entered into the regression, namely: time, waste, cost, child mood, child tantrums, and

356 mothers' consumption of vegetables. A final model was identified, where concerns about
 357 food waste, concerns about child tantrums and mothers' own vegetable consumption
 358 explained 12% of the variance in maternal reoffering of vegetables ($F(3,221)=11.55, p<.001$).
 359 Table 5 shows the contribution of all predictors in the final model.

360 **Table 5:** Stepwise regression model predicting frequency of maternal reoffering of
 361 vegetables to 2-5-year-old children in the UK (n=225), with confidence intervals in
 362 parentheses.

	B	SE B	β	p
Concerns about waste	-0.46 (-0.86, -0.06)	0.20	-0.18	0.02
Concerns about tantrums	-0.71 (-1.19, -0.23)	0.24	-0.19	0.00
Mothers' daily vegetable consumption	0.39 (0.09, 0.70)	0.16	0.16	0.01

363

364

Discussion

365 This study aimed to explore whether how frequently mothers reoffered previously rejected
 366 vegetables to their child was associated with mothers' concern about economic factors, child,
 367 and maternal factors; as well as which of these were the strongest predictors of reoffering. It
 368 was hypothesised that maternal concern about the financial costs of offering (including
 369 waste), child fussiness and maternal vegetable consumption would all be associated with
 370 mothers reoffering previously rejected vegetables fewer times. These hypotheses were
 371 partially supported, with concern for economic factors, child factors and maternal vegetable
 372 consumption all significantly associated with reoffering.

373

374 Examination of the factors significantly related to maternal reoffering found that mothers'
 375 concern about the economic factors of time, waste and cost were all significantly associated
 376 with lower maternal reoffering of rejected vegetables. This is in line with both previous
 377 research and the study hypotheses. Research by Drewnowski et al. (2004) asserts that a diet

378 high in fruits and vegetables can indeed cost more than a diet higher in fats as well as refined
379 sugars and grains, and it appears that this increased cost can present a barrier to repeated
380 offering among UK families. Previous research also states that time can be a barrier to
381 increasing vegetable consumption (Fulkerson et al., 2011; Holley et al., 2016; Kearney &
382 McElhone, 1999; Kilcast et al., 1996). It is likely that the relative influence of these economic
383 factors varies according to the income and size of the family, as well as the cooking
384 knowledge of the person who prepares the meals, and that these influences are interdependent.
385 However, the evidence presented suggests that providing mothers with time and money
386 saving tips for vegetable preparation, as well as advice on how to minimise food waste, may
387 be viable methods for increasing reoffering of vegetables to children.

388

389 Findings from our study also suggest that child factors can play a role in the number of times
390 mothers reoffer rejected vegetables to their child, with mothers who are concerned about their
391 child's mood and possible tantrums reporting that they reoffered vegetables fewer times.
392 However, contrary to the study hypotheses and previous research (e.g. Tan & Holub, 2012),
393 children's food fussiness did not significantly correlate with the number of times mothers
394 reoffered disliked vegetables to their child. It is possible that the nature of children's
395 vegetable rejection (such as whether or not they have tantrums) has a greater impact on
396 mothers' reoffering of vegetables than how fussy their child is in general. Moreover, although
397 previous research has found an association between higher food fussiness and parents
398 providing a less healthy home environment (Tan & Holub, 2012), it is possible that other
399 factors, such as concerns about food waste, are more important factors in maternal reoffering
400 of disliked vegetables. These findings therefore suggest that mothers' reoffering may not be a
401 function of children's acceptance of vegetables, which is a promising finding for improving
402 children's consumption of vegetables in future.

403

404 Maternal factors were also associated with maternal reoffering previously rejected vegetables.

405 Mothers' own vegetable consumption was positively associated with reoffering of vegetables

406 to their children. This supports the study hypotheses and previous research suggesting an

407 association between maternal and child vegetable consumption (Cooke et al., 2004; Hanson

408 et al., 2005; Palfreyman et al., 2014), where maternal intake and reoffering can be seen as the

409 gateway to children's consumption of vegetables.

410

411 As several factors were significantly related to maternal reoffering of previously rejected

412 vegetables, we explored the strongest statistical predictors of reoffering. Mothers' concerns

413 about food waste and child tantrums, and mothers' own vegetable consumption, were all

414 found to be significant predictors of maternal reoffering of vegetables to their children, with

415 concern about child tantrums the strongest predictor. While the data presented in this study

416 are cross-sectional and cannot determine causality, it is plausible that there is a cyclical

417 relationship between reoffering of vegetables, and tantrums and waste. Here, reoffering a

418 previously rejected vegetable may result in tantrums in some children, as well as food waste

419 of the reoffered vegetable (or indeed the meal which may be seen by the child as

420 contaminated). Concern about tantrums and food waste may then serve to dissuade mothers

421 from continuing to reoffer rejected vegetables to their child. With this in mind, there is a

422 need to educate mothers that with repeated exposure known to be successful (e.g., Cooke,

423 2007), waste is a short term issue which can be minimised with preparation, cooking and

424 storage methods; practices which mothers of children with higher vegetable consumption

425 demonstrate (Kilcast et al., 1996). Moreover, mothers should be informed about the ways in

426 which tantrums with food can be overcome, and evidence for the best ways to continue

427 offering without risking creating a 'big issue' should be shared with them. For example,

428 further spreading advice such as that of the Ellyn Satter Institute (2016) to overcome tantrums
429 by instructing children that they do not have to eat the food presented and that caregivers
430 should not apply pressure in relation to feeding vegetables.

431

432 There are several strengths and limitations to this study. It performs a novel analysis of the
433 association between several factors with reoffering of vegetables; an area which is lacking in
434 research. Moreover, it allows assessment of which of these factors may be the most
435 significant, helping to direct priority areas for future interventions to increase children's
436 consumption of vegetables. The study also has a good sample size, allowing investigation of
437 the large number of influences which previous studies have identified. However, due to its
438 cross-sectional nature, we are unable to determine causality. It should also be acknowledged
439 that while this study provides valuable information on the influences on reoffering of
440 vegetables as a group of foods, it is likely that influences on reoffering may vary depending
441 on the vegetable in question (e.g. depending on how much they cost, or how long they take to
442 prepare). Moreover, it is possible that mothers' interpretation and indeed reporting of their
443 child's eating behaviour and other variables may be inaccurate, or that mothers' interpretation
444 of what constitutes reoffering varies between participants. Future research should therefore
445 seek to obtain more objective measures of children's eating behaviours and vegetable
446 consumption. This study also recruited a self-selecting, relatively homogenous and well-
447 educated sample, and further research should seek to extend these findings with families from
448 other cultures and socio-economic groups, to allow investigation of these factors in other
449 samples. It should also be acknowledged that while the authors aimed to investigate factors
450 associated with reoffering of vegetables, the reason why mothers in this study ceased to
451 reoffer vegetables cannot be assumed. Furthermore, maternal persistence and motivation may
452 be underlying constructs that help to explain further why some mothers might be more likely

453 to re-offer rejected vegetables than others. It is possible that some mothers ceased reoffering
454 because their child had begun to accept the previously refused vegetables, rather than because
455 of other factors making reoffering unappealing or less possible. Further research should
456 explore this.

457

458 To summarise, this study makes a novel contribution to the evidence base by elucidating the
459 relationships between possible economic, child and maternal factors identified by caregivers,
460 and mothers' persistence with reoffering disliked vegetables. It revealed that concern about
461 children's tantrums may be a significant barrier to reoffering of vegetables by mothers. It
462 further indicates that mothers should be informed about how to manage and avoid their
463 child's tantrums in relation to eating. Information on the importance of being a good role
464 model and on how to avoid food waste may also be a useful resource to encourage mothers to
465 continue to reoffer rejected vegetables to their child.

466

467 In conclusion, this study highlights the importance of mothers' responses to children's
468 difficult eating behaviours (such as tantrums) in decisions about their child feeding
469 behaviours. Future interventions to increase children's vegetable intake should seek to
470 support mothers to increase their reoffering of rejected vegetables whilst tackling difficult
471 mealtime behaviour such as tantrums. This can be achieved by providing information to
472 mothers about how to tackle children's behaviour around eating as well as how to reoffer
473 vegetables in an economical way. Future interventions should also seek to adopt a whole
474 family approach, whereby mothers' vegetable consumption is increased, and positive role
475 modelling is encouraged, as a mechanism towards increasing reoffering and concurrent
476 consumption of vegetables in children.

477

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