

Reoffering of vegetables

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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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Abstract

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

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

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

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

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

81

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

90

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

99 preferences have stated that reoffering previously rejected (typically healthy) foods to their
100 child was wasteful, as their child would again refuse the food (Russell, Worsley, & Campbell,
101 2015).

102

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

118

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

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

134

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

148

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

161

162

Method

Participants

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

168

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

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

176

177 *Procedure*

178 *Ethics*

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

183

184 *Recruitment*

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

191

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

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

200

201 **Measures**

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

207

208 **Table 1:** Summary of possible influences on mothers' reoffering of vegetables to be
 209 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

210 ^a newly developed item

211 ^b Children's Eating Behaviour Questionnaire

212 ^c adapted Food Frequency Questionnaire

213

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

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

225

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

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

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

252

253 *Influences on maternal reoffering of vegetables*

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

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

268

269 *Assessing frequency of maternal of reoffering vegetables*

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

273

274 *Demographic measures*

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

278

279 *Statistical Methods*

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

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

293

294 One-tailed Spearman's correlations were used to investigate associations between maternal
295 reoffering of rejected vegetables and possible influences on reoffering including maternal
296 concern about economic, child and maternal influences. Significant correlates of vegetable
297 reoffering were subsequently entered into a stepwise regression model to assess which factors
298 could best predict frequency of reoffering of vegetables. As child age was significantly
299 related to some of the factors which were entered into the regression model, child age was
300 also entered alongside other significant correlates. Due to the large number of correlations
301 conducted and the associated risk of type 1 errors, a more stringent significance level of
302 $p < .01$ was used for all correlations. Significance was set at $p < .05$ for the regression analyses.

303

304

Results

Descriptive statistics

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

309

310 **Table 2:** Mean and standard deviation (SD) scores for validated measures of children's
 311 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

312

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

326

327 **Table 3:** Mean and standard deviation (SD) scores for measures of influences on reoffering
 328 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

329

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

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

340

341

342 **Table 4:** One-tailed Spearman's correlations (unless otherwise stated) between economic,
 343 child and maternal factors and frequency of reoffering of vegetables in 256 UK mothers of 2-
 344 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

345 Significant correlations are presented in bold

346 ^a partial correlation controlling for child age

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

348

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

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

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

361 **Table 5:** Stepwise regression model predicting frequency of maternal reoffering of
 362 vegetables to 2-5-year-old children in the UK (n=225), with confidence intervals in
 363 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

364

365 Discussion

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

374

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

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

389

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

404

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

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

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

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

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

410 gateway to children's consumption of vegetables.

411

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

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

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

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

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

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

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

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

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

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

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

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

424 2007), waste is a short term issue which can be minimised with preparation, cooking and

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

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

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

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

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

432

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

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

458

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

467

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

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