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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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CH contributed to the data collection, design, analysis and write up of this research; EH and CF contributed to the design, analysis and write up.
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
If at first you don’t succeed: Assessing influences associated with mothers’ reoffering of vegetables to preschool age children

Vegetable consumption in children is low and vegetables are commonly rejected by children (e.g., Cooke & Wardle, 2005). Previous research suggests that in order for children to like and accept a rejected food they may need to try it as many as 10 to 15 times (e.g., Birch & Marlin, 1982; Birch, Gunder, Grimm-Thomas, & Laing, 1998; Sullivan & Birch, 1990). Research suggests that early and sustained experiences with vegetables are the key to children’s acceptance (Johnson, 2016), with a recent systematic review of experimental studies demonstrating that repeated exposure to the taste of vegetables is the most successful method of increasing vegetable consumption in early childhood (Holley, Farrow, & Haycraft, 2017). Specifically, experimental research has found that young children between two and five who experience more than five taste exposures to a novel or disliked food will consume significantly more of the food than on the first exposure (Birch & Marlin, 1982; Birch, McPhee, Shoba, Pirok, & Steinberg, 1987; Sullivan & Birch, 1990). Experimental research also suggests that repeated taste exposure can not only increase three to six year old children’s consumption of vegetables, but also their liking (Anzman-Frasca, Savage, Marini, Fisher, & Birch, 2012). These effects have been found to be pervasive in preschoolers, with support for these findings coming from various contexts including nurseries, preschools, the home and in laboratory studies (e.g., Bouhlal, Issanchou, Chabanet, & Nicklaus, 2014; Caton et al., 2013; Fildes, van Jaarsveld, Wardle, & Cooke, 2013; Hausner, Olsen, & Møller, 2012). Moreover, questionnaire studies have consistently found that earlier introduction to foods is associated with higher consumption later in childhood, or with consumption of a greater variety of foods (e.g., Cashdan, 1994; Cooke et al., 2004; Skinner, Carruth, Bounds, Ziegler, & Reidy, 2002). Furthermore, a more recent narrative review suggests that even visual exposure to unfamiliar foods can increase children’s willingness to try and to accept these
A previous qualitative study identified that the majority of influences on caregivers’ offering of vegetables to preschool children fell into three categories: economic factors, child factors and maternal factors (Holley, Farrow, & Haycraft, 2016). To apply these findings more widely, it is necessary to conduct further, large scale research that determines which factors influence caregivers’ reoffering of vegetables to young children. This information could then be used to inform future education for parents and interventions aimed at increasing children’s vegetable consumption. For the current paper, reoffering is defined as presenting a previously rejected food to a child.

Economic influences on reoffering of vegetables can take several forms. One of these influences is time, where adults in previous research have reported that they do not have the time available to shop for fresh fruits and vegetables on a regular basis (Anderson & Cox, 2000), and both high and low socioeconomic status (SES) groups report that preparing vegetables is time consuming (Holley et al., 2016; Kilcast, Cathro, & Morris, 1996). Another economic influence is food waste. Previous research has highlighted the significant effect that potential food waste has on low SES and low vegetable consumers’ choice to buy vegetables (Kilcast et al., 1996). Moreover, parents of three to five year old children with unhealthy food
preferences have stated that reoffering previously rejected (typically healthy) foods to their child was wasteful, as their child would again refuse the food (Russell, Worsley, & Campbell, 2015).

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

A range of child factors may also influence caregivers’ reoffering of previously rejected vegetables. Previous research has posited that children’s general eating behaviours are related to their vegetable consumption, where fussiness is associated with lower consumption among seven to nine year olds (Galloway, Fiorito, Lee, & Birch, 2005), and enjoyment of food is associated with higher consumption of vegetables among five to seven year olds (Cooke et al.,
2004). Moreover, research from Farrow, Galloway, and Fraser (2009) suggests that parents use different feeding practices with fussy three to six year old children compared to their less fussy siblings. Taking this research into consideration, it is possible that caregivers’ reoffering of vegetables may be related to children’s eating behaviours, such as fussiness. A previous qualitative study revealed additional child factors which may influence reoffering to preschool age children (Holley et al., 2016). Caregivers reported that they may be dissuaded from reoffering vegetables to their child if their child was not particularly hungry or if they believed there was a possibility of their child having a tantrum (Holley et al., 2016). Such findings need elucidating with quantitative research to further understand whether these influence caregivers’ reoffering practices more broadly.

A final group of possible influences on reoffering of vegetables is caregiver factors, such as caregivers’ own preferences for and consumption of vegetables, which may influence children’s consumption of vegetables. Indeed, literature suggests that children’s and adolescents’ vegetable intake may be positively related to parental intake (Cooke et al., 2004; Hanson, Neumark-Sztainer, Eisenberg, Story, & Wall, 2005; Palfreyman, Haycraft, & Meyer, 2014). However, while maternal factors may influence children’s consumption of vegetables, it is important to note that research also suggests that this relationship may be bi-directional or even iterative (e.g., Webber, Hill, & Wardle, 2010). Research has suggested that children’s eating behaviour can influence maternal feeding practices (Farrow & Blissett, 2008; Haycraft & Blissett, 2012) and that feeding practices may well be a consequence of children’s eating rather than a cause of eating behaviours (Holley, Haycraft, & Farrow, 2017; Webber et al., 2010). With this in mind, it is important to investigate the combined and separate associations of these possible influences on caregivers’ reoffering of vegetables.
The current study seeks to extend previous research, such as that of Carruth et al. (2004), by exploring how frequently mothers reoffer vegetables to preschool children (aged 2 to 5 years), and which factors might influence reoffering of vegetables to preschool children. Specifically, the study had two aims. The first aim was to investigate whether the frequency of reoffering of vegetables is associated with maternal concern about economic factors (time, waste and money), child factors (eating behaviours, hunger, and maternal concern about children’s mood and tantrums), and maternal factors (their own dislike of vegetables and vegetable consumption). It was hypothesised that mothers would reoffer rejected vegetables fewer times if they: were concerned about the financial costs of offering (including waste); described their children as fussier eaters; ate fewer vegetables themselves. A second aim of the study was to assess which factors could best predict mothers’ frequency of reoffering of previously rejected vegetables.

Method

Participants

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

Mothers’ age ranged from 21.0 to 49.3 years (M=35.5; SD=5.16) and child age ranged from 19.0 to 62.0 months (M=38.5; SD=10.76). Mothers were predominantly of White ethnicity (n=232) with six mothers identifying as Asian/Asian British, one as Black/Black British, four as Chinese, four as mixed ethnicities, three reporting as ‘other’ and these data missing for six mothers. Two-thirds of the mothers in this study were educated to University level or higher.
(n=171) with the remaining third educated below University level (n=83) and these data missing for two mothers.

Procedure

Ethics

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

Recruitment

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

Permission was sought from group leaders of 17 toddler groups across Leicestershire, UK, for the researcher to attend sessions to recruit willing mothers. Approximately half of the mothers who participated in this study (n=132) were recruited from these groups. Mothers were asked by the researcher if they would like to participate in a study investigating how mothers offer vegetables to their young children. Mothers who expressed an interest in participating were then given an information sheet outlining the details of the study, as well
as a consent form to complete if they wanted to take part. Finally, mothers were given a paper copy of the study questionnaire pack, which took approximately 10 minutes to complete.

**Measures**

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

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

<table>
<thead>
<tr>
<th>Influences</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Concerns about economic factors</strong></td>
</tr>
<tr>
<td>Time(^a)</td>
</tr>
<tr>
<td>Waste(^a)</td>
</tr>
<tr>
<td>Money(^a)</td>
</tr>
<tr>
<td><strong>Child</strong></td>
</tr>
<tr>
<td>Child mood(^a)</td>
</tr>
<tr>
<td>Child hunger(^a)</td>
</tr>
<tr>
<td>Child tantrums(^a)</td>
</tr>
<tr>
<td>Children’s slowness in eating(^b)</td>
</tr>
<tr>
<td>Children’s enjoyment of food(^b)</td>
</tr>
<tr>
<td>Children’s general food fussiness(^b)</td>
</tr>
<tr>
<td>Children’s general food responsiveness(^b)</td>
</tr>
<tr>
<td>Children’s vegetable consumption(^c)</td>
</tr>
<tr>
<td><strong>Maternal</strong></td>
</tr>
<tr>
<td>Mother’s own dislike of vegetables(^a)</td>
</tr>
<tr>
<td>Maternal vegetable consumption(^c)</td>
</tr>
</tbody>
</table>

\(^a\) newly developed item

\(^b\) Children’s Eating Behaviour Questionnaire

\(^c\) adapted Food Frequency Questionnaire

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Children’s Eating Behaviour Questionnaire (CEBQ; Wardle, Guthrie, Sanderson, & Rapoport, 2001)

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

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

The vegetable item from Cooke, Wardle, and Gibson’s (2003) brief FFQ was broken down to assess maternal and child intake of (1) raw vegetables (e.g. carrot sticks, celery); (2) cooked vegetables (including sweet potato but not potato); and (3) salad (e.g. tomatoes, lettuce) (Holley, Haycraft, et al., 2017). These three types of vegetables were included to ensure that all forms of vegetables were captured in maternal estimates of vegetable consumption. Items assessing intake of fruit, meat, fish, sweets, carbohydrates and eggs were not included as they were not relevant to the current study. This FFQ measure was adapted from the Dietary Instrument for Nutrition, a validated measure of dietary intake against 4-day diet recalls (Roe, Strong, Whiteside, Neil, & Mant, 1994). Mothers were asked to report how often they and their child consumes each of these three types of vegetables (raw, cooked and salad) on an eight-point likert scale. For the purposes of this study the categories of this scale...
were reworded, so that instead of ranging from "never/rarely" to "four or more times a day", they ranged from "never/rarely" to "four or more portions a day". This was to enable the extraction of data about the number of portions of vegetables being consumed, rather than the frequency of vegetable consumption, thereby facilitating comparison with government guidelines on vegetable consumption. Mothers were provided with a guide to age-appropriate portions of vegetables for children to assist them in judging their child’s consumption (Infant and Toddler Forum, 2013). This measure is scored by converting intake data to intake per week so as to calculate children’s total vegetable consumption from these three categories (raw, cooked and salad). Responses of ‘never/rarely’ are assigned a score of 0, responses of ‘one or two portions a week’ are assigned a score of 1.5 and so on up to ‘four or more portions a day’ being scored 28. Summed responses for all categories were calculated to give total weekly vegetable consumption in portions. This was then converted into average daily consumption in portions by dividing by seven.

Influences on maternal reoffering of vegetables

A single item was developed to evaluate the impact of each of seven of potential influences on maternal offering of vegetables identified in a previous qualitative study (Holley et al., 2016). These possible influences were: time (“I do not offer my child vegetables they don’t like because it takes so much time to buy and prepare them”), waste (“I do not offer my child vegetables they don’t like because of the waste involved”), cost (“I do not offer my child vegetables they don’t like because of the cost”), concerns about child mood (“The mood that my child is in influences whether I offer them vegetables they don’t like”), concerns about child tantrums (“I do not offer my child vegetables they dislike to avoid tantrums”), child hunger (“How hungry my child is influences whether I offer them vegetables they don’t like”), and mothers’ own dislike of vegetables (“How often to you offer your child vegetables..."
that you do not eat yourself?”). These questions were scored on five-point likert scales labelled with “disagree”, “slightly disagree”, “neither agree nor disagree”, “slightly agree”, or “agree” except for the question regarding the influence of mothers’ own dislike of vegetables, which was scored “never”, “rarely”, “sometimes”, “often”, or “always”.

Assessing frequency of maternal of reoffering vegetables

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

Demographic measures

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

Statistical Methods

Kolmogorov-Smirnov tests indicated that the majority of the study’s variables were not normally distributed, therefore non-parametric tests were used, where possible, to test the study’s hypotheses. Preliminary Mann Whitney U analyses confirmed there were no significant differences on the study’s outcome variables between participants who completed the questionnaire online versus on paper. Preliminary one-tailed Spearman’s correlations were run between maternal age, child age and each of the study variables. Child age was significantly correlated with: the influence of food waste (r=.20, p<.01); children’s food fussiness (r=.16, p<.01); and tantrums (r=.16, p<.05). Here, mothers of older children reported greater concerns about food waste, reported having fussier children, and reported
more concern about their child having tantrums. Due to these associations, partial correlations (which controlled for child age) were run between each of these associated factors and the outcome variable of reoffering of vegetables. Maternal age was not significantly associated with any of the study variables.

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

Results

Descriptive statistics

Descriptive statistics for the validated subscales of the CEBQ are displayed in Table 2. The study sample’s mean scores for the CEBQ subscales are comparable to means from similar samples (Pliner & Loewen, 1997; Haycraft, Farrow, Meyer, Powell, & Blissett, 2011).
Table 2: Mean and standard deviation (SD) scores for validated measures of children’s eating behaviours (CEBQ subscales) among a sample of 256 2-5 year old children in the UK

<table>
<thead>
<tr>
<th>Children’s eating behaviour</th>
<th>Mean (SD)</th>
<th>Min</th>
<th>Max</th>
</tr>
</thead>
<tbody>
<tr>
<td>Enjoyment of food</td>
<td>3.88 (0.77)</td>
<td>1.00</td>
<td>5.00</td>
</tr>
<tr>
<td>Slowness in eating</td>
<td>2.78 (0.75)</td>
<td>1.00</td>
<td>5.00</td>
</tr>
<tr>
<td>Food fussiness</td>
<td>2.77 (0.74)</td>
<td>1.00</td>
<td>5.00</td>
</tr>
<tr>
<td>Food responsiveness</td>
<td>2.58 (0.80)</td>
<td>1.00</td>
<td>5.00</td>
</tr>
</tbody>
</table>

Descriptive statistics for the newly developed items are presented in Table 3. Concerns about waste, children’s mood, and maternal dislike were all fairly frequently reported influences on reoffering of vegetables. Mothers consumed an average of 2.92 portions of vegetables per day, while children consumed an average of 2.41 portions per day. However, it should be noted that there was a large degree of variance in consumption with 9.8% of mothers eating less than one portion of vegetables a day and 13.1% of mothers eating five or more portions a day. Similarly, 18.8% of children were eating less than one portion of vegetables a day, while 5.3% of children were eating five or more portions a day. Having said this, the average consumption of vegetables for mothers and children in this sample was higher than recent UK national averages (Public Health England & Food Standards Agency, 2014). Mothers reported reoffering disliked vegetables to their children on average 7.68 times, although again there was a large degree of variance in this, with 54.6% of mothers reoffering disliked vegetables more than ten times, and some mothers (4.3%) reoffering once if at all.
Table 3: Mean and standard deviation (SD) scores for measures of influences on reoffering of rejected vegetables among a sample of 256 mothers of 2-5 year old children in the UK.

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

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

One-tailed correlations were run to investigate associations between the frequency of maternal reoffering of rejected vegetables and various influences on maternal offering of vegetables, as reported by mothers (Table 4). Frequency of maternal reoffering of vegetables to their children was significantly associated with mothers’ concerns about economic, child and maternal influences. Specifically, maternal reoffering was negatively associated with concern for all the economic influences which were explored (time, waste and money). Reoffering was also negatively associated with mothers’ concern about their children’s mood and tantrums, and positively associated with mothers’ own vegetable consumption.
Table 4: One-tailed Spearman’s correlations (unless otherwise stated) between economic, child and maternal factors and frequency of reoffering of vegetables in 256 UK mothers of 2-5-year-old children.

<table>
<thead>
<tr>
<th>Influence</th>
<th>Frequency of maternal reoffering vegetables</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>r</td>
</tr>
<tr>
<td><strong>Concerns about economic factors</strong></td>
<td></td>
</tr>
<tr>
<td>Time</td>
<td>-0.24</td>
</tr>
<tr>
<td>Waste a</td>
<td>-0.26</td>
</tr>
<tr>
<td>Money</td>
<td>-0.15</td>
</tr>
<tr>
<td><strong>Child</strong></td>
<td></td>
</tr>
<tr>
<td>Slowness in eating b</td>
<td>-0.04</td>
</tr>
<tr>
<td>Enjoyment of food b</td>
<td>0.07</td>
</tr>
<tr>
<td>Food Fussiness ab</td>
<td>-0.06</td>
</tr>
<tr>
<td>Food Responsiveness b</td>
<td>-0.00</td>
</tr>
<tr>
<td>Concerns about child mood</td>
<td>-0.15</td>
</tr>
<tr>
<td>Concerns about child tantrums a</td>
<td>-0.29</td>
</tr>
<tr>
<td>Hunger</td>
<td>-0.07</td>
</tr>
<tr>
<td>Daily vegetable consumption</td>
<td>0.10</td>
</tr>
<tr>
<td><strong>Maternal</strong></td>
<td></td>
</tr>
<tr>
<td>Own dislike of vegetables</td>
<td>0.10</td>
</tr>
<tr>
<td>Daily vegetable consumption</td>
<td>0.19</td>
</tr>
</tbody>
</table>

Significant correlations are presented in bold

a partial correlation controlling for child age

b Subscale of the Children’s Eating Behaviour Questionnaire

Assessing which factors could best predict mothers’ frequency of reoffering of previously rejected vegetables

To address the second aim of the study, a stepwise multiple regression was performed to identify a model which could significantly explain variance in maternal reoffering of rejected vegetables to their child, as well as identify the strongest statistical predictors of reoffering (Table 5). Concern for economic factors, child influences and maternal influences which were found to be significantly associated with re-offering of vegetables (Table 4) were entered into the regression, namely: time, waste, cost, child mood, child tantrums, and
mothers’ consumption of vegetables. A final model was identified, where concerns about food waste, concerns about child tantrums and mothers’ own vegetable consumption explained 12% of the variance in maternal reoffering of vegetables ($F(3,221)=11.55$, $p<.001$).

Table 5 shows the contribution of all predictors in the final model.

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

<table>
<thead>
<tr>
<th>Predictor</th>
<th>B</th>
<th>SE</th>
<th>β</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Concerns about waste</td>
<td>-0.46</td>
<td>0.20</td>
<td>-0.18</td>
<td>0.02</td>
</tr>
<tr>
<td>Concerns about tantrums</td>
<td>-0.71</td>
<td>0.24</td>
<td>-0.19</td>
<td>0.00</td>
</tr>
<tr>
<td>Mothers’ daily vegetable consumption</td>
<td>0.39</td>
<td>0.16</td>
<td>0.16</td>
<td>0.01</td>
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</table>

**Discussion**

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

Examination of the factors significantly related to maternal reoffering found that mothers’ concern about the economic factors of time, waste and cost were all significantly associated with lower maternal reoffering of rejected vegetables. This is in line with both previous research and the study hypotheses. Research by Drewnowski et al. (2004) asserts that a diet
high in fruits and vegetables can indeed cost more than a diet higher in fats as well as refined sugars and grains, and it appears that this increased cost can present a barrier to repeated offering among UK families. Previous research also states that time can be a barrier to increasing vegetable consumption (Fulkerson et al., 2011; Holley et al., 2016; Kearney & McElhone, 1999; Kilcast et al., 1996). It is likely that the relative influence of these economic factors varies according to the income and size of the family, as well as the cooking knowledge of the person who prepares the meals, and that these influences are interdependent. However, the evidence presented suggests that providing mothers with time and money saving tips for vegetable preparation, as well as advice on how to minimise food waste, may be viable methods for increasing reoffering of vegetables to children.

Findings from our study also suggest that child factors can play a role in the number of times mothers reoffer rejected vegetables to their child, with mothers who are concerned about their child’s mood and possible tantrums reporting that they reoffered vegetables fewer times. However, contrary to the study hypotheses and previous research (e.g. Tan & Holub, 2012), children’s food fussiness did not significantly correlate with the number of times mothers reoffered disliked vegetables to their child. It is possible that the nature of children’s vegetable rejection (such as whether or not they have tantrums) has a greater impact on mothers’ reoffering of vegetables than how fussy their child is in general. Moreover, although previous research has found an association between higher food fussiness and parents providing a less healthy home environment (Tan & Holub, 2012), it is possible that other factors, such as concerns about food waste, are more important factors in maternal reoffering of disliked vegetables. These findings therefore suggest that mothers’ reoffering may not be a function of children's acceptance of vegetables, which is a promising finding for improving children's consumption of vegetables in future.
Maternal factors were also associated with maternal reoffering previously rejected vegetables. Mothers’ own vegetable consumption was positively associated with reoffering of vegetables to their children. This supports the study hypotheses and previous research suggesting an association between maternal and child vegetable consumption (Cooke et al., 2004; Hanson et al., 2005; Palfreyman et al., 2014), where maternal intake and reoffering can be seen as the gateway to children’s consumption of vegetables.

As several factors were significantly related to maternal reoffering of previously rejected vegetables, we explored the strongest statistical predictors of reoffering. Mothers’ concerns about food waste and child tantrums, and mothers’ own vegetable consumption, were all found to be significant predictors of maternal reoffering of vegetables to their children, with concern about child tantrums the strongest predictor. While the data presented in this study are cross-sectional and cannot determine causality, it is plausible that there is a cyclical relationship between reoffering of vegetables, and tantrums and waste. Here, reoffering a previously rejected vegetable may result in tantrums in some children, as well as food waste of the reoffered vegetable (or indeed the meal which may be seen by the child as contaminated). Concern about tantrums and food waste may then serve to dissuade mothers from continuing to reoffer rejected vegetables to their child. With this in mind, there is a need to educate mothers that with repeated exposure known to be successful (e.g., Cooke, 2007), waste is a short term issue which can be minimised with preparation, cooking and storage methods; practices which mothers of children with higher vegetable consumption demonstrate (Kilcast et al., 1996). Moreover, mothers should be informed about the ways in which tantrums with food can be overcome, and evidence for the best ways to continue offering without risking creating a 'big issue' should be shared with them. For example,
Reoffering of vegetables

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

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

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

References


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