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Parental modelling and prompting effects on acceptance of a novel fruit in 2-4 year old children are dependent on children's food responsiveness.

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Abstract

Few children consume the recommended portions of fruit or vegetables (FV). This study examined effects of parental physical prompting and parental modelling in children's acceptance of a novel fruit (NF) and examined the role of children's food approach and avoidance traits on NF engagement and consumption. 120 caregiver-child dyads (54 girls, 66 boys) participated in this study. Dyads were allocated to one of three conditions: physical prompting but no modelling, physical prompting and modelling, or a modelling only control condition. Dyads ate a standardised meal containing a portion of a fruit new to the child. Parents completed measures of children's food approach and avoidance. Willingness to try the NF was observed and the amount of the NF consumed was measured. Physical prompting but no modelling resulted in greater physical refusal of the NF. There were main effects of enjoyment of food and food fussiness on acceptance. Food responsiveness interacted with condition such that children who were more food responsive had greater NF acceptance in the prompting and modelling condition in comparison to the modelling only condition. In contrast, children low in food responsiveness had greater acceptance in the modelling control condition than in the prompting but no modelling condition. Physical prompting in the absence of modelling is likely to be detrimental to NF acceptance. Parental use of physical prompting strategies, in combination with modelling of NF intake, may facilitate acceptance of NF, but only in food responsive children. Modelling consumption best promotes acceptance in children low in food responsiveness.

Introduction

A balanced and varied diet is crucial to a child's optimal health and development[1]. The rise in the number of overweight and obese children and the associated rise in non-communicable diseases such as diabetes mellitus, cardio-vascular disease and some cancers over the past decades highlights the fact that the diet consumed by many children is not favourable to their weight or health status[2]. The introduction of healthy foods into a child's diet at an early age is crucial[3,4]. Food preferences developed during childhood are stable and enduring, influencing food choices in adulthood[5]. Nevertheless, many parents find it difficult to successfully introduce healthy foods, especially fruits and vegetables, into their children's diets during infancy, and only 21.5% of 5-15-year-olds in England consume the recommended five or more portions of fruits and vegetables a day[6].

A variety of factors play an important role in whether or not children will consume fruits and vegetables[7,8]. These include parental feeding practices during infancy and childhood[9, 10], parental preferences, the accessibility and availability of fruits and vegetables, the child's social eating environment, as well as genetically determined taste perception, and appetite[7,8]. Of these parental fruit and vegetable consumption is one of the strongest predictors of fruit and vegetable consumption in children[8, 11]. Observing familiar others, especially parents, consume different foods and model their intake leads to the social facilitation of eating behaviour[12,13,14]. Furthermore, in households in which fruits and vegetables are consumed by parents, they are more readily available and accessible, leading to a child's greater exposure to fruits and vegetables[,12.15,16]. A further predictor of children's eating behaviour is not what, but how parents feed their children[17]. Pressure, typically measured by the degree of verbal instruction to consume or try foods, is one of the most investigated controlling feeding strategies employed by parents. It is often used to encourage children, especially pre-school children, to eat new foods, more food in general or to eat foods deemed to be healthy[18,19]. However, despite parents' intentions to increase the intake of healthy foods, pressure to eat is negatively associated with children's fruit and vegetable consumption[8,11,20-21].

Nevertheless, it is likely that a certain degree of less intrusive prompting or negotiating is necessary to encourage children to taste novel foods, leading to the exposure which will facilitate novel food acceptance[23]. In line with this suggestion, Blissett et al.[18]found that the number of parental physical prompts used during a mealtime, which included a new fruit (NF), was significantly correlated with the number of taste experiences children had with the new fruit (measured by counting the number of times the child licked the NF, bit into it, or put some of the NF into the mouth). The physical prompts parents used included passing the food into the child's hand, holding the food up to the child's face, or replacing the rejected food back on to the child's

plate, and were independent of any verbal prompts. These results suggest that parental physical prompting may have a positive effect on dietary intake, promoting fruit and vegetable consumption under some circumstances. However, due to the cross-sectional nature of this study, it is unclear whether physical prompting facilitated acceptance, or whether parents of children who were more willing to taste such foods, used the practice more readily.

It is also the case that there are individual differences in children's appetite, enjoyment of food, and willingness to try new foods[3,24-27]. Children tend to show relatively stable and continuous eating behaviour traits from early through to later childhood[28]. These traits include those which are associated with food approach, and a tendency to overeat, such as food responsiveness (the tendency to want to eat when food cues are present) and enjoyment of food (gaining great pleasure from eating behaviour) and those which are associated with greater satiety and food avoidance, such as satiety responsiveness (stopping eating when internal cues of fullness are noticed) and food fussiness (selectivity about food type and range)[28]. These food approach and food avoidance traits have also been shown to be systematically correlated with child weight[29] and actual eating behaviour[30].In the context of this study, it is likely that children who show stronger 'food approach' tendencies will accept new foods more readily and may both elicit, and respond differently to, different parental feeding practices than children with high levels of food avoidance.

As previous research has indicated that the use of parental physical prompts during a mealtime is positively correlated with a child's willingness to try a NF[18], this study aimed to establish whether caregivers who had been instructed on how to use physical prompting would be more successful in introducing the NF than caregivers who had not been instructed in prompting. We also examined whether a combination of modelling and prompting would be more successful than prompting or modelling alone. Finally, we aimed to examine whether children's food approach or food avoidance tendencies interacted with modelling and prompting conditions to determine their effects on child NF acceptance.

We assessed engagement with the NF, measured by behaviours indicating willingness to approach/interact with the NF as well as the actual consumption of the NF to allow us a more sensitive measure of acceptance than consumption and rejection alone. Based on previous research we hypothesized that children of caregivers who received instructions on how to prompt would be more likely to engage with, and consume more of, a NF than children of caregivers who received no instructions on prompting. Additionally, we hypothesized that children of caregivers who received instructions on how to prompt would be more likely to engage with, and consume more of, a NF if their caregivers also consumed the NF compared to if their caregivers had been instructed not to eat the NF themselves. In accordance with the literature we hypothesised that those children higher in

food approach behaviours (food responsiveness, enjoyment of food) and those children lower in food avoidant behaviours (food fussiness, satiety responsiveness) would show greater acceptance of the NF and that the effectiveness of parental prompting would be greater in those children with higher levels of food approach behaviours and children with lower food avoidance behaviours.

Materials and Method

Participants

One hundred and twenty caregiver-child dyads were recruited to this experimental study. Caregivers and their children were recruited through the Infant and Child Laboratory database, which contains information on families in which caregivers have indicated an interest in research participation at the University of Birmingham. The caregivers who participated in this study were the primary caregivers of their children; where fathers (*n*=2) or grandmothers (*n*=4) participated, these were primary or equal caregivers. Before caregiver-child dyads visited the university pre-screening questions were asked, to ascertain whether children had eaten all of the lunch foods and any of the three NFs (dried date, tinned lychee or fresh fig) before. Inclusion criteria for children included the absence of known food allergies or disorders affecting eating, current or recent major illness or diagnosed intellectual disabilities. Caregiver-child dyads were assigned at random to one of three conditions and received different instructions on the mealtime behaviours they were asked to exhibit during the mealtime. Block randomisation was used to allocate to groups in blocks of 10 participants with conditions changing each week, allocated in order of recruitment. However, due to failure to attend sessions and/or data loss, group sizes were unequal at the end of data collection (see below).Caregivers in all three conditions received identical information on changes in children's willingness to try new foods between the age of 2 and 6 years. Specific instruction given to caregivers in each of the three conditions can be seen below. Caregivers were classed as prompting if they used any of the prompting behaviours described, for a minimum of three times during the mealtime. While most caregivers were compliant with the instructions given about mealtime behaviours they were asked to exhibit or omit, a few caregivers failed to follow them, resulting in some caregivers eating the NF when they were asked not to eat it, or not eating the NF when they were asked to eat it, or failing to use the instructed prompting behaviours for a minimum of three times. To address these issues, caregivers-child dyads who were not compliant with instructions were removed from the analysis (n sizes given below). In addition to the instructions given, all caregivers were asked to keep the mealtime as natural as possible, and to respond as they would normally do to any aspects of the mealtime.

Condition 1: *Parental use of physical prompts to eat the NF without eating the NF (Prompting No Modelling; PNM)*

Caregivers were asked to use physical prompts to eat the NF (including passing the food to the child, moving the food towards the child, holding the NF up to the child's face, encouraging the child to touch the NF). To avoid this prompting behaviour developing into pressure to eat, the parent was instructed to only encourage trying of the food (not to force consumption). The caregivers assigned to this condition were asked not to taste the NF themselves. Of an original sample of 50, 15 were classed as non-compliant; 10 caregivers failed to prompt a minimum of 3 times, and 5 caregivers were removed from the group because they ate the NF. This left a sample of 35 parents who physically prompted but did not model eating the fruit.

Condition 2: *Parental use of physical prompts to eat the NF and eating the NF (Prompting and Modelling; PM)*

Caregivers were asked to use physical prompts to eat the NF as described above. The caregivers assigned to this condition were also asked to try the NF themselves. Caregivers were not instructed on how to react to the NF. Of an original sample of 43 dyads, 6 were non-compliant because the parent failed to prompt 3 times or more, leaving a sample of 37 parents who prompted and modeled eating the fruit.

Condition 3: *Parental eating of the NF but no training in physical prompts (Modelling 'Control' group: MC)*

Caregivers in this condition were not given any information about prompting, but were simply asked to taste the NF themselves. There were 27 dyads in this condition, in which the parent modeled eating of the fruit; all were compliant with this request.

Questionnaire measures

Demographic information. Caregivers provided information on their age, number of persons in their household, ethnicity, household income and level of education. Caregivers also reported their child's age, gender, breastfeeding duration, age at introduction of complementary foods, and their daytime care arrangements because these factors are frequently associated with children's eating behaviour and parental feeding practices.

Child Eating Behaviour. The Children's Eating Behaviour Questionnaire (CEBQ[31]) was used to measure children's Food Approach and Food Avoidance Behaviours. The 35-item scale consists of eight subscales, four of which assess Food Approach Behaviours (Food Responsiveness, Enjoyment of Food, Desire to Drink, and Emotional Overeating) and four, which assess Food Avoidance Behaviours (Satiety Responsiveness, Slowness in Eating, Emotional Undereating and

Food Fussiness). In this study we focussed on two food approach and two food avoidance subscales: Food responsiveness, enjoyment of food, satiety responsiveness and food fussiness, because these subscales have been associated with behavioural measures of child eating behaviour[30,32]. The Cronbach's alphas for each subscale were: Food responsiveness: 0.70, enjoyment of food: 0.40, satiety responsiveness: 0.73 and food fussiness: 0.87; indicating good reliability for all subscales with the exception of enjoyment of food.

Child Neophobia. To ensure our groups of children did not differ in neophobia we administered the Child Food Neophobia Scale[33]. This measure assesses parental perceptions of children's willingness to try new foods. Analysis of Cronbach's alphas indicated best internal consistency (alpha = .88) from inclusion of only 3 items: 'My child doesn't trust new foods', 'If my child doesn't know what is in a food, s/he won't try it' and 'My child is afraid to eat things s/he has never eaten before'. A sum of these three items was calculated as an index of child neophobia.

Apparatus

Recording Equipment. The mealtimes were recorded using two remotely adjustable cameras, which were located in two opposite corners of the observation room. Recordings were processed using a Picture-in-Picture Processor which ensured that the caregiver's and child's faces could be seen on the screen at the same time.

Food Preparation. The caregivers' and children's foods were presented on identical white, round porcelain plates (Ø=18cm). Water was presented in identical glasses.

Mealtime Foods. Caregivers and children each received a standardised meal with a novel fruit presented on the same plate. All meal items were weighed on scientific scales prior to and after consumption. Depending on the caregivers' pre-indicated preference, the children's lunch consisted of half a ham or cheese sandwich made with white bread with added wheatgerm (Hovis Best of Both) (approximately 120kcal or 125kcal respectively, J. Sainsbury Plc.), 10g ready salted potato crisps (approximately 53kcal, Walkers Snack Food Ltd.), two chocolate-chip cookies (approximately 114 kcal, Burtons Foods Ltd.), five milk-chocolate buttons (approximately 35kcal, Cadbury Plc.) and five green grapes (approximately 18kcal). Caregivers received a lunch identical to that of their children's, except that they were given a whole ham or cheese sandwich depending on their pre-indicated preference (approximately 240kcal or 250kcal respectively, J. Sainsbury Plc.). Meal foods were chosen to reflect typical lunchtime meals eaten by children in the UK. Because the novel fruit presented as part of the meal needed to be novel to all children, it was not possible to use the same fruit in all conditions. A whole dried date without the stone (approximately 23kcal), a tinned lychee without the stone (approximately 21kcal), or a quarter of a fresh fig

(approximately 12kcal) were presented as NFs. These fruits were selected as they have unusual characteristics and at least one was novel to all children within the sample. In cases where children had not consumed any of the NFs before, NFs were presented evenly across participants and sessions through randomization. However, because of prior consumption of the NFs by several children, dried date was used in 24 mealtimes, tinned lychee in 44 mealtimes and fresh fig in 31 mealtimes. However, importantly, there were no effects of type of fruit on outcome nor any interaction between fruit and condition (see results). Because of differences in weights of the different NFs offered it was not possible to compare conditions based in simple weight of consumption. Therefore, we calculated consumption of the NF based on the percentage consumed of the whole portion offered.

Procedure

This study was conducted according to the guidelines laid down in the Declaration of Helsinki and all procedures were approved by the Ethical Review Committee of the University of Birmingham (ERN 10-0010). All caregivers gave written informed consent prior to participation. Caregivers and children attended the Infant and Child Laboratory's observation room for one session, during which, after a period of familiarisation, they sat in specific seats at the table in order to ensure optimal capture of parent and child behaviours displayed during the mealtime. Each parent-child dyad was tested separately. Lunch was presented and the researcher left the room and followed the session on a monitor in the adjacent room, from which discreet wall mounted cameras were controlled by the researcher. After caregivers and children had finished their lunch, taking as long as they needed, caregivers completed the questionnaire. Children and caregivers were then measured and weighed by a trained researcher at the laboratory in order to determine their height and weight and subsequently BMIs for caregivers and BMI z-scores (BMI adjusted for age and gender) for children.

Analysis

Video Analysis. An adaptation of the Family Mealtime Coding Scale[34]was used to code the parental feeding strategies observed during the mealtimes. Parental feeding strategies were grouped into 12 categories. Nine of the categories addressed feeding strategies that were specific to the NF, including Physical Prompting of the NF to the child's plate, hand or face/body, Verbal Prompting of the NF, Modelling of NF consumption, Role-play including the NF, Comparison of the NF, Teaching about the NF and Rewarding/Bargaining NF consumption. Three categories additionally addressed parental feeding strategies specific to the other constituents of the meal, including

Physical Prompting of mealtime foods, Verbal Prompting of mealtime intake and General Comments about the mealtime. Detailed descriptions and corresponding examples for each category of strategies within the video-coding schedule can be seen in Table 1.

Table 1 about here

Children's 'engagement' behaviours towards the NF and the mealtime foods were grouped into eight categories: physical refusal, verbal refusal, smelling the NF, licking the NF, placing the NF in the mouth, swallowing the NF, physical refusal of the mealtime foods, and verbal refusal of the mealtime foods. Detailed descriptions and corresponding examples for each category of child behaviours can be seen in Table 2.

Table 2 about here

Children's engagement behaviours were not mutually exclusive; a range of behaviours towards the NF were displayed and recorded during mealtimes, and a child that licked the NF initially could have swallowed and enjoyed it subsequently, or vice versa. As well as recording the frequency of the different engagement behaviours, we also recorded the child's greatest observed engagement with the NF, with higher engagement scores indicated greater willingness to try the NF. These scores ranged from physical refusal (1) to swallowing the NF (6). E.g. if a child only displayed physical refusal (1) and verbal refusal (2), but no further interaction with the NF, then verbal refusal (2) was noted as the greatest observed engagement. If a child, however, smelled the NF (3) but later swallowed it (6), swallowed (6) was noted as the most successful outcome of the mealtime. The behavioural coding software ObsWin[35] was used to code the occurrence of our predetermined parental feeding strategies and child behaviours. Raters could not be fully blinded to condition because of the occurrence of explicit behaviours coded for each category. However, two researchers second-coded the data without knowledge of the study subgroups, from which inter-rater reliability was calculated for 26% of the mealtimes. Two way mixed effects model intraclass correlation coefficients were calculated, yielding a mean intraclass coefficient of 0.56, indicating adequate inter-rater reliability.

Statistical Analysis

The criterion alpha for significance was .05. Stem-and-leaf plots were inspected and indicated that the majority of data were normally distributed; parametric tests were therefore conducted on all

variables. Initially, sample characteristics were inspected and possible differences between groups, and gender differences, were identified using one-way ANOVAs with post hoc bonferroni corrections. A per protocol analysis was undertaken; results of participants who did not adhere to the protocol were eliminated from the analyses. After this, as a manipulation check, the frequency of the strategies and differences in the use of the strategies were assessed and differences based on the condition caregiver-child dyads were in were examined using MANCOVA controlling for child age effects, or chi-square where necessary. Next, differences in a child's engagement with and consumption of a NF based on the condition the parent-child dyad was in and the child's eating characteristics (based on median splits of food responsiveness, enjoyment of food, food fussiness and satiety responsiveness) were examined. A series of 3 (condition) x 2 (high vs. low eating behaviour tendencies) ANCOVAs controlling for child age were calculated to examine main and interaction effects on children's engagement with and consumption of the NF. Interaction effects were examined using simple main effects analyses controlling for child age.

Results

Sample characteristics

The sample characteristics and differences between the three conditions were analysed and are summarised in Table 3.

Table 3 about here

There were no significant group differences in mothers' age and BMI, children's BMI z-score, weaning age, length of being exclusively breastfed or number of hours per week spent in day care. There was a significant difference in children's age, where children in the PNM condition were significantly younger than children in the MC condition, so child's age was controlled for in the subsequent analyses. None of the other factors were considered in the subsequent analyses given the lack of the group differences. Overall, 47 girls and 52 boys participated in the study, and the distribution of children's gender was balanced across the three conditions (χ^2 (2, N = 99) = 2.501, p=0.286), and there were no gender differences in acceptance. There was no effect of fruit type used on intake (F(2,98)=.55, p=.57) or the child's willingness to try the fruit (F(2,95)=2.10, p=.13), nor any interaction between fruit and condition on intake (F(4,98)=1.45, p=.23) or willingness to try the fruit (F(4,95)=1.81, p=.13). There was a small difference in parental reports of fussiness between the conditions; children in the PNM condition were rated as slightly less fussy than children in the MC condition. Controlling for fussiness (in analyses where fussiness was not the basis of the

median split) made no difference to the pattern of results. Child neophobia did not significantly differ between the conditions (F (2,93)=.07,p=.93).

Manipulation check: Feeding Strategies by Condition

To check that the manipulation had the desired effect on feeding practice, a MANCOVA controlling for child age confirmed that there was a significant effect of condition on feeding practices (Pillai's trace F(24, 164)= 3.93, p<.0001). Tests of between-subjects effects showed that there were significant differences between the conditions in the frequency of modelling, physical prompts to the plate, physical prompts to the child's hand, and total number of physical prompts, consistent with condition manipulation. Table 4 shows the profile of feeding strategies used by caregivers in the different conditions. No differences in the frequency with which any other feeding practices were used, were observed.

Children's Behaviour with the NF by Condition

To examine whether children of caregivers who received instructions on how to prompt would be more likely to engage with, and consume more of, a NF than children of caregivers who received no instructions on prompting, and whether children of caregivers who received instructions on how to prompt would be more likely to engage with, and consume more of, a NF if their caregivers also consumed the NF, a MANCOVA controlling for child age was conducted. This suggested that there was no significant effect of condition on children's mealtime and eating behaviour (Pillai's trace F(16, 164)= .814, p=.67). However tests of between-subjects effects showed that there was a significant difference between the conditions in the frequency of physical refusal of the NF, with children in the PNM condition physically refusing the NF more frequently than children in the MC condition. Table 5 shows the profile of children's mealtime and eating behaviours in the different conditions. Neither was there a significant effect of condition on whether children had any taste of the NF or not ($\chi 2$=4.24, df=2, p=.12) although only just over half of the children in the PNM group tasted the NF, in contrast to over 70% of children in the PM and MC groups.

Food approach and Avoidance and NF acceptance

To examine whether those children higher in food approach behaviours and those children lower in food avoidant behaviours would show greater acceptance of the NF and whether the effectiveness of parental prompting would be greater in those children with higher levels of food approach behaviours and children with lower food avoidance behaviours, a series of ANCOVAs controlling

for child age were conducted. These were calculated first for percentage of the NF consumed, and second, for the greatest observed engagement with the NF.

Percentage of NF consumed

ANCOVAs controlling for child age were carried out to assess differences in children's consumption of the NF, measured by the percentage of the offered NF consumed by the child during the mealtime, based on condition and median splits of food approach/avoidance traits. There were no significant main effects of satiety responsiveness (p=.36), food responsiveness (p=.87), or enjoyment of food (p=.46) on the percentage of the NF consumed by the child. There was a main effect of fussiness on percentage of NF consumed ($F(1, 84)=7.39$, p=.008). Pairwise comparisons showed that more fussy children consumed less of the NF (p<.008; low food fussiness mean percentage consumed=39.5, SD=40.3; high food fussiness mean percentage consumed=18.4, SD=32.8). There was no interaction with condition (p=.55).

Greatest observed engagement

ANCOVAs controlling for child age were carried out to assess differences in children's willingness to try the NF, measured by the 'best outcome' observed from the child during the mealtime, based on condition and median splits of food approach/avoidance traits.

Food fussiness &greatest observed engagement

There was a main effect of fussiness ($F(1,87)=8.75$, p=.004) and no significant interaction between condition and food fussiness on acceptance of the NF. Pairwise comparisons showed that fussy children showed least engagement with the NF (p=.004; low food fussiness mean engagement=5.0, SD=1.6; high food fussiness mean engagement=3.9, SD=1.8).

Satiety responsiveness and greatest observed engagement

There was no significant main effect of satiety responsiveness on engagement with the NF. There was no interaction between condition and satiety responsiveness (p=.53).

Food responsiveness and greatest observed engagement

There was a significant interaction between food responsiveness and condition ($F(2,86)=4.50$, $p=.014$). Post hoc simple main effects analyses for high and low food responsiveness adjusted for child age revealed that children low in food responsiveness in the PNM condition showed significantly lower engagement with the NF than children low in food responsiveness in the MC condition ($p=.012$). There was no significant difference between the PNM and PM, or the PM and MC conditions in children low in food responsiveness. In contrast, in children high in food responsiveness, there was greater engagement with the NF in the PM condition than in the MC condition ($p=.044$). There was no significant difference between the PNM and PM, or the PNM and MC conditions in children high in food responsiveness. (Figure 1).

Insert Figure 1 about here

Enjoyment of food and greatest observed engagement

There was a significant main effect of enjoyment of food on engagement ($F(1,86)=5.21$, $p=.025$), with pairwise comparisons demonstrating that those children who were reported to enjoy food more, had greatest observed engagement with the NF ($p=.025$; low enjoyment Mean engagement=4.3, SD=1.8; high enjoyment Mean engagement=4.9, SD=1.5). There was no significant interaction between condition and enjoyment of food ($p= .66$).

Discussion

This study examined the relative efficacy of physical prompting techniques with and without parental modelling in the facilitation of acceptance of a NF by their children in comparison to parental modelling alone. We also examined how child food approach/avoidance characteristics would interact with these feeding practices to determine acceptance. We did not find evidence to support the hypothesis that children of caregivers who received instructions on how to physically prompt would be more likely to accept a novel fruit than children of caregivers who received no instructions on prompting. Indeed, overall, children who were in the physical prompting but not modelling group showed higher rates of NF refusal than children whose parents were not instructed to use physical prompting. This may suggest that physical prompting in the absence of modelling has similar effects to the use of verbal pressure to eat[8, 19-22]. Importantly, this study also showed that there was no effect of physical prompting on rates of verbal pressure to eat used by parents, so we can be confident that the differences seen between conditions are effects of physical prompting and not a general increase in pressure to eat.

We found some support for our hypothesis that children of caregivers who received instructions on how to prompt would be more likely to engage with a novel fruit if their caregivers also consumed the novel fruit compared to those whose caregivers had been instructed not to eat the NF. Children who were high in food responsiveness were more accepting of the NF in the prompting and modelling condition than in the modelling control condition. However, this effect did not hold true for children low in food responsiveness, who showed greater acceptance of the NF in the condition where parents modelled intake but were not instructed to prompt, and least acceptance in the prompting but no modelling condition. Because of its potentially detrimental effect on acceptance, particularly in children who are low in food responsiveness, it is not feasible to recommend physical prompts as a method of increasing the likelihood of success of introduction of novel fruits to children. This study's results are further evidence that parental modelling is a crucial determinant of the successful introduction of a NF, and are consistent with previous studies which have shown the effectiveness of adult modelling for encouraging new food intake[12-13]. Modelling without tangible overt physical pressure appears to be the most effective strategy for facilitating NF acceptance in children low in food responsiveness.

We also found some support for our hypotheses that children showing higher food approach (enjoyment of food) and lower food avoidance (food fussiness) behaviours would be more accepting of the NF. This is consistent with previous work that showed that these traits are predictive of children's food intake and weight trajectories[29-30]. That the effectiveness of parental prompting depended upon children's food responsiveness but did not interact with children's enjoyment of food, food fussiness or satiety responsiveness requires further investigation. Previous work has demonstrated that children's food responsiveness is significantly related to faster eating and greater total energy intake[30], more rapid growth and greater weight gain[36], suggesting that it is a good indicator of a child's food approach tendencies and appetite. Food responsiveness has also been associated with greater parental use of restrictive feeding practices, whereas enjoyment of food has been associated with lower parental pressure to eat, and both satiety responsiveness and fussiness are associated with greater pressure to eat, irrespective of child weight[29]. Therefore, further work could examine how a child's experience of typically restrictive feeding practices might interact with parental prompting to eat in determining the acceptance of new foods. The interaction of parental feeding practices with children's individual differences has received scant attention in the literature, although a small number of studies have called for attention to be paid to this when evaluating the effectiveness of interventions focussing on parental feeding practices. For example, Gubbels et al. [37] demonstrated that parenting practices had a much stronger relationship with children's diet quality when the child had a favourable behavioural style, favourable eating style or

lower BMI. Together with the current study, this emphasises the need to examine children's individual differences when evaluating potential intervention strategies. This study suggests that food responsiveness may be a particularly important characteristic to examine in such contexts.

Blissett et al. showed that the number of parental physical prompts used during a mealtime which included a NF was associated with NF acceptance[18]. Because of the naturalistic observational methodology used in this prior study, it was unclear whether parental physical prompting facilitated intake, or whether parents of children who were more willing to taste such foods, used the practice more readily. In light of the findings of the current study, it appears that children who are willing to taste new foods elicit or reinforce the use of parental physical prompting. Whilst we did not find evidence in the current study that physical prompts are a useful mechanism for those children who are low in food responsiveness, it may be that prompting facilitates acceptance in those children higher in food acceptance. This is consistent with other studies examining children's compliance with maternal verbal prompts to eat. For example, girls who show greater compliance with maternal prompts to eat are more likely to become overweight or obese and gain relatively more weight across time than their less compliant peers[38]. Furthermore, children of obese mothers are more compliant with prompts to eat than the children of non-obese mothers[39].

There are a number of limitations of this study. The participants who sign up to the Infant and Child Laboratory database tend to be well educated, relatively affluent and therefore not particularly representative of families where fruit and vegetable consumption is very poor. Therefore the findings may not replicate in lower SES contexts. Whilst we gave much information to parents about how we wanted them to behave during the feeding session we needed to exclude several parents from analysis on the basis of non-compliance. We used a per-protocol analysis rather than an intention to treat analysis which yielded a smaller sample size and resultant loss of power. Another concern is that parents completed the questionnaire measures after they had eaten the meal with their child, so their ratings of general traits of their child's food approach and avoidance may have been more reflective of the child's eating behaviour in that session than would be typically reported. Furthermore, some parents in the modelling 'control group' condition spontaneously used physical prompts to eat. We did not exclude these individuals from the analysis but when making comparisons between the prompting groups and the control group we were mindful that a small amount of physical prompting also took place in this group. A fourth condition, with caregivers who used no prompting or modelling, would have provided a potentially useful comparison, albeit one that lacked ecological validity. Because the NF we used differed between groups, to ensure the novelty of the fruit to all participants, it was not possible to compare the grams consumed by the children in each condition. Therefore we had to calculate the percentage of the fruit that was

consumed. Although there were no significant differences in children's eating behaviours based on the fruits used, it is possible that variability in the taste, texture, or amount of the NF presented may have had a small effect on the amount of the food consumed. This potentially explains why the effects that were significant were predominantly for the degree of engagement with the NF rather than the measure of consumption. Furthermore, the longer term effects of physical prompting on food acceptance in children high in food responsiveness are unknown.

In conclusion, whilst some parents can be taught to use physical prompting strategies which, in combination with modelling of NF intake, may facilitate acceptance of NF in food responsive children, physical prompting in the absence of modelling is likely to be detrimental to NF acceptance for many children. In children who are low in food responsiveness, modelling consumption best promotes acceptance. These findings emphasise the need to examine children's individual differences in food approach and avoidance when recommending intervention strategies designed to improve the range of foods accepted by children with poorer diets.

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Conflict of Interest

The authors have no conflict of interest to declare.

Authorship

JB, GH & SH formulated the research questions and designed the study

CB & AF collected all data, coded observations, entered data and carried out elements of data analysis.

JB took primary responsibility for supervision of the study and carried out the majority of data analysis.

All authors contributed to the writing of the manuscript and have approved the final version.

Figure Legends

Figure 1.

Estimated Marginal Means of the engagement with the NF by children, by condition and food responsiveness. Child age as covariate. PNM= Prompting no modelling; PM= Prompting and modelling; MC= Modelling 'Control' group.

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585 Table 1

586 *Descriptions of Parental Feeding Strategies and Examples.*

Behaviour Category	Description of the Behaviour	Example
Physical Prompt to Plate (NF)	The parent passes NF from table or own plate onto child's plate.	After the child takes the NF off his/her plate and puts it on the table the mother places it back on his/her plate.
Physical Prompt to Hand (NF)	The parent places NF into child's hand.	The mother takes the child's hand and puts the NF into the palm of his/her hand.
Physical Prompt to Face (NF)	The parent brings the NF closer to the child's face.	The mother picks up the NF and holds it up in front of the child's face/mouth.
Verbal Prompt (NF)	Parental comments that aim to increase Verbal prompting of NF consumption. Any comment to encourage the child to consume the NF.	"Try it", "Eat it", "Try a little bit".
Modelling (NF)	Parent models the actual or pretended ingestion of the NF/eats it. Parent comments on ingesting the NF. Parent makes noises during NF ingestion or pretended ingestion. Distant modelling – parent uses a non-present other to model the NF consumption.	"Look, mummy is eating it", "Mmmmh", "Yummy", "Daddy/grandma really likes these".
Role Play (NF)	Pretending a puppet/toy is eating the	"I think Thomas the tank

	NF. Pretending that the NF is alive and can speak.	engine would love to try some date", mother pretends to feed Thomas the tank engine, "Hello, my name is Mr. lychee, would you like to try me?".
Comparison (NF)	Parent compares the NF to something that looks or tastes similar.	"Dates are like big raisins, don't they", "Look, the lychee looks like an egg". "Dates are really sticky",
Teaching (NF)	Parent teaches the child about the NF's sensory properties (taste, texture, colour, smell) or other aspects such as history and eating context	"Figs smell like cucumber", "Lychees are really sweet", "People eat dates around Christmas time", "Figs are good for your bowels", "Inside, there's a big stone", "It's a fruit"
Rewarding/ Bargaining (NF)	Parent rewards the child for eating the NF with another food or different non-edible incentives.	"If you try some of your fig you can have another cookie/ you can go and play"
Physical prompting (Mealtime)	Physical prompting of any of the mealtime foods, but not of the NF	Placing the food on the child's plate, placing it in the child's hand, bringing it closer to the child's face/body.
Verbal Prompting (Mealtime)	Verbal prompting of lunch food consumption but not of NF	"Eat your grapes", "Have some more sandwich".

	consumption. Any comment to encourage the child to consume the meal foods.	
General Comments (Mealtime)	General comments about the mealtime, but not specific attempts to encourage food consumption	"What have you got on your plate", "Mummy has sandwiches too", "Are the grapes your favourite?".

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589 Table 2

590 *Descriptions of Children's Behaviours Toward the NF and Mealtime Foods and Examples.*

Child behaviour	Description	Examples
(1) Physical refusal	Any occurrence of the child physically refusing the NF in response to the parent offering the NF or due to the general presence of the NF on the child's plate.	E.g. leaving the table, covering the mouth, turning the head away, blocking the parent's hand or pushing it away if the parent tries to offer the NF, removing the NF from the plate, throwing the NF onto the table/floor.
(2) Verbal refusal	Any occurrence of the child verbally refusing the NF.	E.g. "I don't like this", "I don't want to eat this", screaming, crying.
(3) Smelled	Any occurrence of the child smelling the NF, either by picking it up and bringing it to the nose or through parental offering, but no further interaction with it.	E.g. smelling the NF after picking it up or in response to the parent bringing it closer to the child's face.
(4) Licked	Any occurrence of the child licking the NF, either by picking it up and bringing it to the mouth or through parental offering, but no further interaction with it.	E.g. licking the NF after picking it up or in response to the parent bringing it closer to the child's face.
(5) Placed in mouth	Any occurrence of the child placing the NF inside the mouth, but no further interaction or its consumption.	E.g. putting the NF into the mouth without biting it, holding it inside the mouth and then taking/spitting in

		back out.
(6) Swallowed	Any occurrence of the child chewing and swallowing a piece of the NF.	E.g. biting off a piece of the NF, chewing and swallowing it.

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Table 3

Sample Characteristics for Participants in Each Condition and Differences in Characteristics Based on Condition. Mean (SD) Values per Group and Associated F-values of ANOVA.

	Prompting No Modelling (PNM) (*n*=35)	**Prompting and Modelling (PM) (*n* =37)**	**Modelling control group (MC) (*n* =27)**	*F*
Mother's age (years)	33.97 (6.04)	35.97 (4.18)	35.00 (4.52)	1.35
Mother's BMI	25.70 (4.69)	25.94 (5.60)	24.70 (5.26)	.45
Child's age (months)	27.45 (4.26)	29.22 (4.93)	31.30 (4.01)	5.52** PNM< MC
Child's weight (z-score)	.82 (2.29)	.69 (2.29)	.33 (1.84)	.40
Weaning age (months)	5.93 (2.99)	5.45 (1.27)	5.71 (1.16)	.42
Exclusively breastfed (months)	4.66 (1.81)	5.64 (3.68)	4.59 (2.35)	1.22
Daycarecategory†	2.09 (1.03)	2.42 (1.12)	2.58 (1.07)	1.57
CEBQ Food responsiveness	2.39 (.98)	2.05 (.91)	2.44 (.57)	.89
CEBQ Enjoyment of food	3.71 (1.29)	3.43 (1.29)	3.78 (.64)	1.99
CEBQ Satiety responsiveness	2.82 (1.00)	2.81 (1.03)	2.96 (.50)	.22
CEBQ Food fussiness	2.36 (1.05)	2.71 (1.09)	3.00 (.79)	3.15* PNM< MC
Neophobia	9.78 (2.59)	9.89 (2.71)	9.63 (2.62)	.07

**p<.05 **p<.01*

†1= 0 hours per week; 2=1-10 hours per week; 3=11-25 hours per week; 4 = 26-40 hours per week; 5=40+ hours per week.

Table 4

Minimum, Maximum, Mean and SD of the Feeding Strategies Used by Caregivers During Mealtimes. Differences in the use of Different Feeding Strategies by Condition as Indicated by MANCOVA controlling for child age.

	Condition			
Variable	Prompting No Modelling (*n* =35)	Prompting and Modelling (PM) (*n* =37)	Modelling control group (MC) (*n* =27)	*F* value and results of pairwise post hoc tests
		Novel Fruit		
Physical prompting				
Face	0-26	0-12	0-7	2.12
	4.23 (5.36)	3.70 (3.45)	1.85 (2.16)	
Hand	0-11	0-2	0-1	5.77*
	1.06 (2.06)	.43 (.69)	.04 (.19)	MC<PM=PNM
Plate	0-19	0-13	0-5	6.66*
	3.91 (3.70)	3.65 (2.71)	1.30 (1.56)	MC<PM=PNM
Total Physical	1-44	1-18	0-10	8.46*
Prompts	9.20 (8.30)	7.78 (4.64)	3.19 (2.66)	MC<PM=PNM
Verbal Prompt	1-21	0-29	0-24	2.79
	5.06 (4.84)	6.95 (6.01)	7.96 (6.22)	
Modelling	0-7	0-11	0-11	29.45**
	.54 (1.56)	4.46 (2.63)	4.11 (3.11)	PNM<PM=MC
Role-Play	0-5	0-5	0-11	1.48
	.49 (1.20)	.59 (1.34)	1.15 (2.85)	
Comparison	0-8	0-5	0-6	1.52
	.97 (1.79)	.62 (1.04)	1.52 (2.06)	
Rewarding/Bargaining	0-8	0-7	0-9	1.88
	.63 (1.73)	.54 (1.32)	1.41 (2.41)	
Teaching	0-16	0-10	0-9	.12
	2.43 (3.58)	2.14 (2.32)	2.59 (2.50)	
		Other mealtime foods		
General Comments	0-34	0-32	0-42	2.60

	6.60 (7.96)	7.76 (7.24)	12.03 (11.85)	
Physical Prompt	0-30	0-36	0-10	.74
	4.03 (6.55)	4.22 (6.85)	1.96 (2.68)	
Verbal Prompt	0-24	0-37	1-31	1.21
	7.40 (6.25)	9.81 (9.33)	9.56 (6.77)	

*p<.01 **p<.0001

Table 5

Minimum, Maximum, Mean and SD of the Observed Children's Mealtime and Eating Behaviours. Differences by Condition as Indicated by MANCOVA controlling for child age; and frequency of at least one taste exposure to the NF by condition.

	Condition			
Variable	Prompting No Modelling (*n* =35)	Prompting and Modelling (PM) (*n* =37)	Modelling control group (MC) (*n* =27)	*F* value and results of pairwise post hoc tests
Frequency of physical refusal of the NF	0-18 4.54 (4.47)	0-11 3.91 (2.93)	0-8 2.48 (2.28)	3.12* PNM>MC
Frequency of verbal refusal of the NF	0-16 3.97 (3.65)	0-10 3.76 (2.77)	0-12 3.67 (3.05)	.05
Frequency of smelling but refusing the NF	0-2 .29 (.62)	0-3 .24 (.64)	0-4 .26 (.81)	.20
Frequency of licking but refusing the NF	0-4 .31 (.80)	0-3 .54 (.93)	0-1 .30 (.47)	.92
Frequency of holding in mouth but refusing the NF	0-3 .32 (.73)	0-4 .43 (.93)	0-4 .48 (1.01)	.50
Frequency of swallowing the NF	0-5 .74 (1.44)	0-8 1.84 (2.17)	0-12 2.11 (2.83)	3.08
Greatest observed engagement	1-6 3.77 (1.78)	2-6 4.72 (1.73)	1-6 4.88 (1.64)	2.88
Percentage of NF consumed	0-100 21.51 (32.74)	0-100 34.0 (41.15)	0-100 31.88 (39.90)	.82
Total taste exposures	0-7 1.35 (1.88)	0-8 2.81 (2.45)	0-16 2.88 (3.70)	2.95
Number of children who had at least 1 taste of the NF	18 (51.4%)	26 (70.3%)	20 (74.1%)	$\chi 2$=4.24

*p<.05

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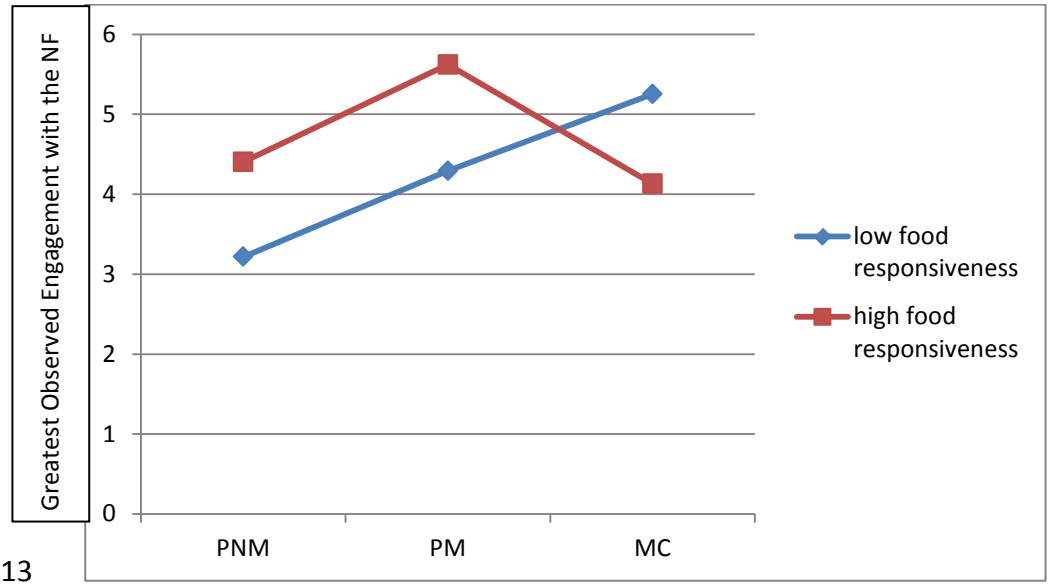

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614 Figure 1. Estimated Marginal Means of the engagement with the NF by children, by condition and
615 food responsiveness. Child age as covariate. PNM= Prompting no modelling; PM= Prompting and
616 modelling; MC= Modelling 'Control' group.

617