Rejection of Known and Previously Accepted Foods During Early Childhood: An Extension of the Neophobic Response?

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Abstract: Children begin to reject new foods (food neophobia) at around 18 to 30 months. At this time parents also report the rejection of known and previously accepted foods. The studies presented here are the first to examine this rejection of previously accepted foods in isolation and presents a number of significant findings. Using a parental questionnaire, it was found that the rejection of known and previously accepted food begins towards the end of infancy, commonly occurs during nursery age, reduces in frequency after 30 months and most often involves the rejection of vegetables, mixed foods and fruit.

It is hypothesised that some known and previously accepted foods are rejected due to an extension of the neophobic response. When neophobia begins, infants become hyper-vigilant to the visual perceptual features of food in order to recognise the food given. Foods not matching learnt expectations, due to perceptual changes between servings, may be categorised as 'new' or 'different' and rejected in a neophobic response. A second study offers some support for this hypothesis, showing that those children who are reported as having rejected a known and previously accepted food score higher on neophobia and 'picky' eating scales. Implications are discussed.

Keywords: Food neophobia, picky/fussy eating, categorisation of food, questionnaire, infant's eating.

INTRODUCTION

Food neophobia, the avoidance of new foods, begins around 18 to 30 months of age [1-4] and at this time many new foods are rejected on sight. It is thought that this is an evolutionary defence against the possibility of ingesting poisons by consuming unknown substances [2] and is observed in both humans [3, 5, 6] and other omnivores [7-10].

Few food preferences are innate. Beyond a preference for sweet tastes [11] and aversion towards sour and bitter tastes [12] our food choices are learnt *via* exposure. When solids were first introduced, Birch, Gunder and Grimm-Thomas [13] found that infants' preference for a food can be influenced with just one exposure, with intake increasing from 35- to around 72-grams, while there was no increase shown in consumption of a control food. Furthermore, this increase in preference is shown to extend to similar foods within the same category but not to foods from other categories. Taken together, this suggests a learning process is taking place.

As the child ages, the number of exposures required to form a learnt preference tends to increase, requiring up to 15 or more tastes [14, 15], but the evidence that this learning still occurs is extensive [16-19]. As well as increasing the appeal of a target

food [14] and foods similar to the target [15], exposure also reduces food neophobia [15, 18]. Therefore, while the rejection of a new, unknown food is accounted for by the neophobic response, if children begin rejecting known and previously accepted foods (KPAF), i.e. those that are established in the diet, there is no clear explanation in the existing literature.

Around the time that food neophobia appears, however, parental reports do suggest that children are not only rejecting new foods but also beginning to refuse some KPAF. This phenomenon has not been directly examined, however, research that addresses 'picky' eating in children does tend to incorporate both the avoidance of new food and the rejection of some familiar foods [5, 20, 21].

This rejection of food is usually done *on sight* and Carruth *et al.* [21] report parental experiences such as, "in some cases a familiar food prepared differently was viewed as novel" (p.185). This suggests that when an infant rejects a KPAF it may be due to the visual perceptual qualities of that food. The beginning of neophobia increases anxiety about food stimuli [5, 22-24] and, therefore, the perceptual features of the food become more salient as the child wishes to recognise the foods he or she is given. If the child has developed a prototypical expectation of the given food, based on their previous experiences, and the meal offered provides a perceptual mismatch to that expectation, the food may be categorised as 'new' or 'different' and rejected in a neophobic response.

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Evidence exists to suggest that toddlers do have a preference for easily identifiable foods, eaten one at a time, more so than mixed foods, or foods in a sauce [2]. This may be because children want to recognise the foods they consume to aid food learning, or so that they are able to identify the consequences of ingesting specific foods. The foods that are being reported as rejected by 'picky' children, are vegetables [21, 25], fruit [3] and mixed foods [2] which are all prone to changes in their appearance between servings, more so than processed foods.

Furthermore, infants who are sensory sensitive and highly visually hyper-sensitive, such as those on the autistic spectrum, show a desire for food to be prepared in a certain way, have a higher tendency to want the same food presentation than do control group children, and even show some desire for food to be presented in the same bowl [26, 27]. Although children with autism do have a more general desire for 'sameness' than normally developing children, this selective eating begins at around 18 months [27], around the same age at which food neophobia begins. These observed general food preferences, such as low intake of vegetables and this desire for similar food preparation, seem to be an extreme expression of the neophobic or 'picky' response described elsewhere [20, 21, 27].

Most research into 'picky' eating has been conducted with children aged 2-years and over [5, 20, 21, 28-32]. Two studies have measured 'picky' eating in infancy [33, 34] and these studies suggest that, by 19 months, up to 50% of infants are categorised as 'picky' by their parents [33].

The survey studies presented in this paper are the first to explicitly investigate the rejection of KPAF in isolation. The aim is to quantify the prevalence of children reported as having rejected a KPAF and to assess any initial patterns of this type of rejection, such as the age of onset and the type of food being rejected. Furthermore, the paper aims to determine whether these initial patterns support the idea that the onset of food neophobia, and problems with visually categorising foods, could explain any increase in the rejection of KPAF during early childhood. Finally, in support of this, it will be assessed as to whether children who reject a KPAF are also considered to be more neophobic and/or 'picky' than those who have not.

Based on previous research examining 'picky' eating [5, 20, 21] it is hypothesised that the rejection of KPAF will be common among nursery-aged children (study one & study two). Furthermore, it is expected that the rejection of KPAF will begin to occur at around the age of 18- to 30- months, a time when current literature suggests up to 50% of parents consider their child to be 'picky' [33, 34] and food neophobia begins (study one).

In line with the proposal that the reason for this type of rejection is that foods do not match visual perceptual expectation, it is hypothesised that the rejection of KPAF will reduce with age as the child experiences wider food exposure [15], gains greater understanding of foods [2], develops more in depth knowledge of food categories [35] and as neophobia reduces; resulting in less visual perceptual focus on the presentation of food (study one). Based on previous research showing that vegetables [21, 25], fruit [3] and mixed foods [2] are the most highly rejected, it is expected these are often rejected KPAF (study one). Those children who are reported as having rejected a KPAF are predicted to score higher on the 4-item food neophobia measure [36] and on a 3-item 'picky' eating scale [5] (study two). Finally, infants who are reported to have had early food difficulties will be more likely to subsequently reject KPAF than those who are not reported to have had early feeding problems (study two).

STUDY ONE; METHOD

This phenomenon of children rejecting KPAF has not been explicitly researched in isolation before; therefore survey questions were specifically designed for this study. The questionnaire asks parents whether their child has ever rejected a KAPF (yes/no response), and those who report that this has occurred respond to a further eight question enquiring as to when they last noticed this type of rejection, what the food was and the perceptual features of the food (such as colour and how it was presented).

A total of 10, 700 questionnaires were printed and distributed to 202 day nurseries across England, which cater for pre-school children up to the age of around 5 years, so they could be distributed to the parents of children attending these nurseries. The questionnaires were sent via the National Day Nurseries Association (NDNA), the numbers for each nursery were over-estimated to ensure enough would be given to each nursery. Furthermore, we relied on the willingness of the nursery managers to hand out the questionnaires once they received them (a letter explaining the study was included in the individual nursery packs). As a

result of the method of distribution, we have no information for how many of the questionnaires actually reached the intended parents. In an attempt to increase the response rate, pre-paid envelopes were given with the questionnaires and an incentive, in the form of a prize draw for gift vouchers (1st prize £150, 2nd prize £75, 3rd prize £25) was also offered.

A total of 347 questionnaires were returned. After removing the data for children who did not fit the required criteria (see data input section below), 312 responses remained. The ages of the children in the sample ranged from 6 to 57 months (mean = 32 months) and the gender mix was 156 females and 153 males (3 not reported). The children's ethnicity consisted of 165 (53%) White - British, 56 (18%) British, not specified, 39 (12.5%) White, not specified, 17 (5%) Asian - British, with the remaining origins 35 (11.5%) unknown or making up <5% of the sample.

Data Input

Those children who were reported as ill at the time of rejecting a KPAF were removed from the data set (N=27), as were the data for children over 5 years of age (N=6) and 2 participants whose parents reported 'milk' as the rejected food, as opposed to a solid. In order to record the textures of the rejected foods reported by parents two researchers independently inferred, from descriptions of the food and method of preparation, which one of 7 pre-determined texture categories it was likely to fall into; smooth puree, soft mash, bite and dissolve finger food, bite and melt finger food, bite and soft chew, bite and splinter, bite and lump [37]. An eighth texture category was added to this list to cover any foods with a mixture of textures. Cohen's Kappa showed a good inter-rater reliability score of .81 (N = 230) for agreement on inferred textural properties of the foods. For the foods where disagreement occurred, the principal investigator and a second researcher reviewed each item together and agreed on the most likely textural category.

To compare any differences in the age of children who have been reported to have rejected a KPAF in the last week, month or 6 months, an ANOVA was conducted. As it was predicted that the rejection of KPAF would be more likely to occur during late infancy, i.e. the children reported to have rejected a KPAF in the last week were expected to be younger than those who had done so only in the last month or 6 months (across the age range of 6 to 57 months). As such, a one-tailed hypothesis was used as were planned comparisons. All data were analysed using SPSS version 18.

STUDY ONE; RESULTS

Prevalence

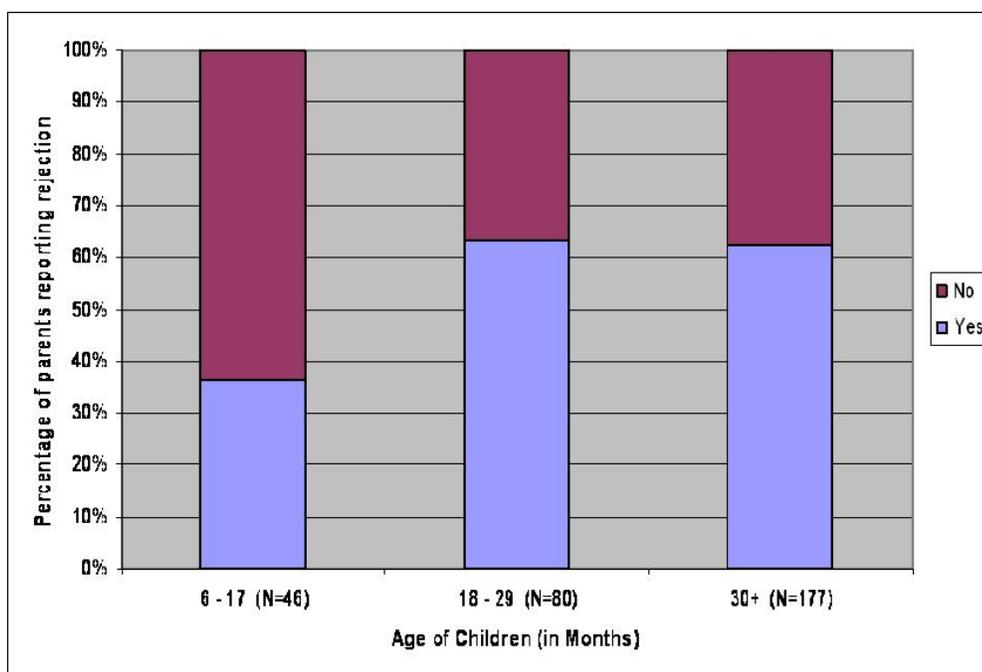The data show that the majority of parents reported that their child had rejected a KPAF (yes = 230

Figure 1: Percentage of children reported to have rejected a known and previously accepted food.
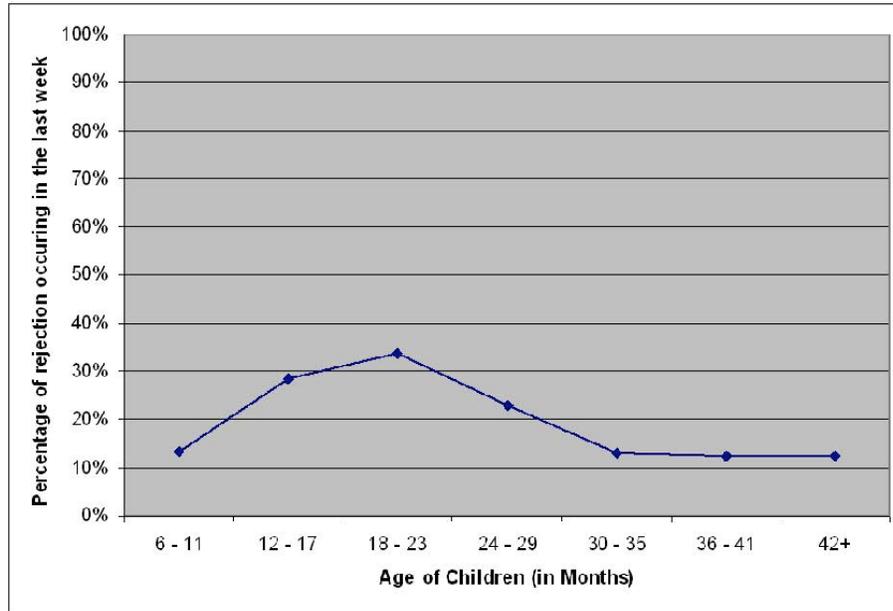
Figure 2: Percentage of children reported to have rejected a previously known and accepted food within the last week.

(73.7%), No = 82 (26.3%)). Although a slightly higher proportion of males were reported as having rejected a KPAF (Female 69.9%, Males 77.1%), the difference was not significant (X^2 (1, N = 312) = 2.08, p > .05).

Age of Onset

In order to examine whether there was a particular time period when the rejection of KPAF was more likely to occur, three measures were considered. Firstly, Figure **1** shows an increase in the proportion of reported rejection between the 6-17 month age group and the 18-29 month group. The reported prevalence

of rejection then remains almost identical between the 18-29 months and the 30+ month age groups.

The frequency of rejection of KPAF also increases around the beginning of the neophobic period (18- to 30- months) [1-4], and reduces thereafter (see Figure **2**).

This pattern is further supported by the data examining whether rejection of a KPAF has occurred within the within the last week, month or 6 months. An ANOVA showed that there was an overall effect on age and when parents reported the most recent time that
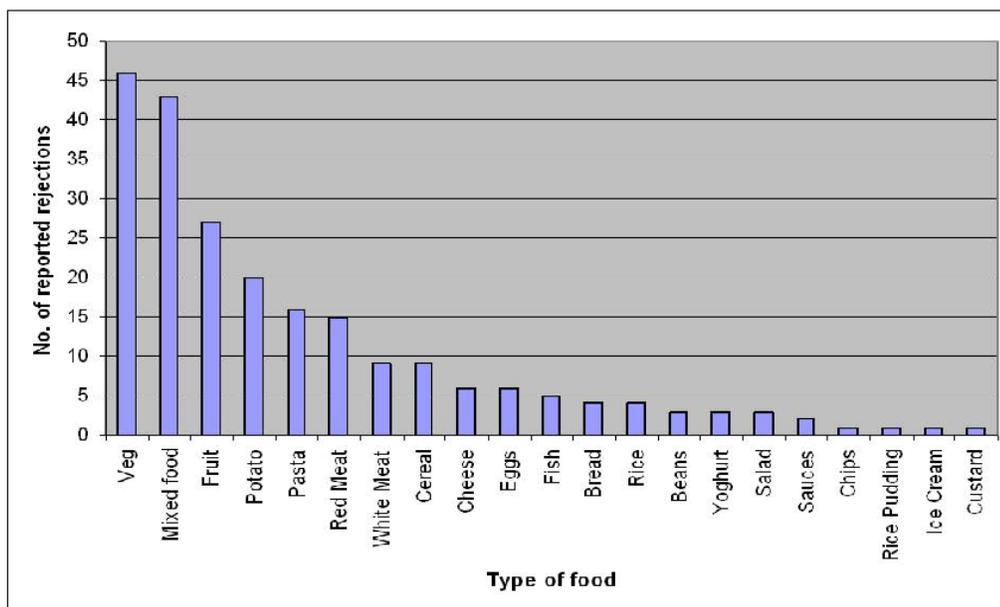

Figure 3: Known and previously accepted foods reported to have been rejected (in categories).
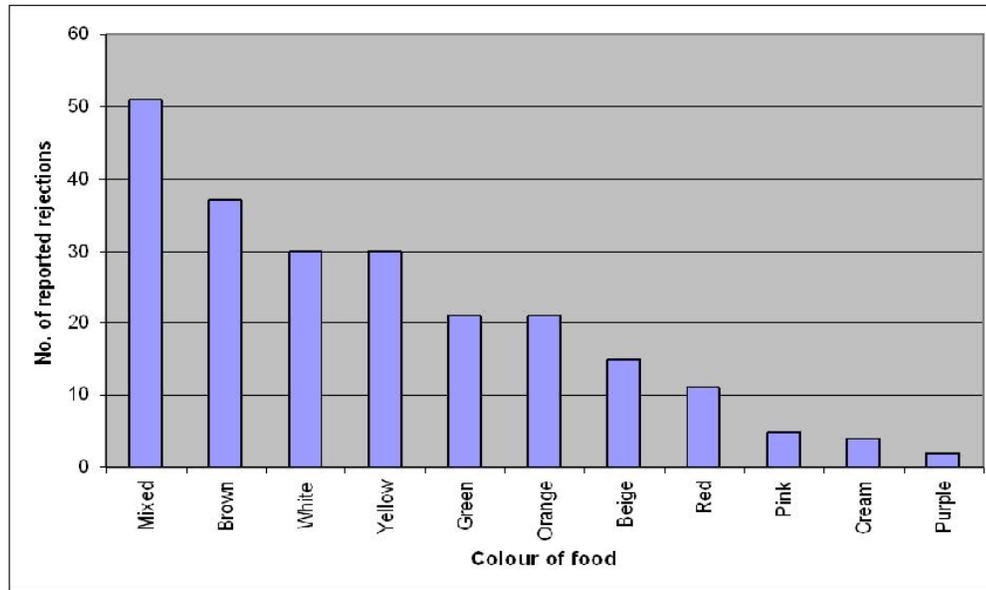
Figure 4: The colours of the rejected foods, as reported by parents.

their child had rejected a previously accepted food ($F_{(2, 212)} = 3.80$, $p < 0.05$, one-tailed). Planned comparisons revealed that the 'within the last week' group was significantly younger than the 'within the last month' and "within the last 6 months" groups ($t(212) = 2.73$, $p < 0.01$, one-tailed) and that the 'one month' and '6 months' groups did not differ ($t(212) = -.009$, $p > 0.05$).

General Trends

The data below shows the categories of foods that have been reported as being KPAF. The three foods reported to be most frequently rejected were

vegetables, mixed foods (e.g. lasagna) and fruit (Figure **3**). Furthermore, the highest frequency of colour reported as being rejected was "mixed" (see Figure **4**).

The texture data showed a trend in relation to the children's ages, with infants from the younger group (6-17 months) rejecting more of the easier textures (bite and soft chew) than the children in the other two groups (18-29 months and 30+ months). However, this age difference is likely to only demonstrate the difference in the texture of age appropriate foods. Overall, the most frequently rejected food by texture
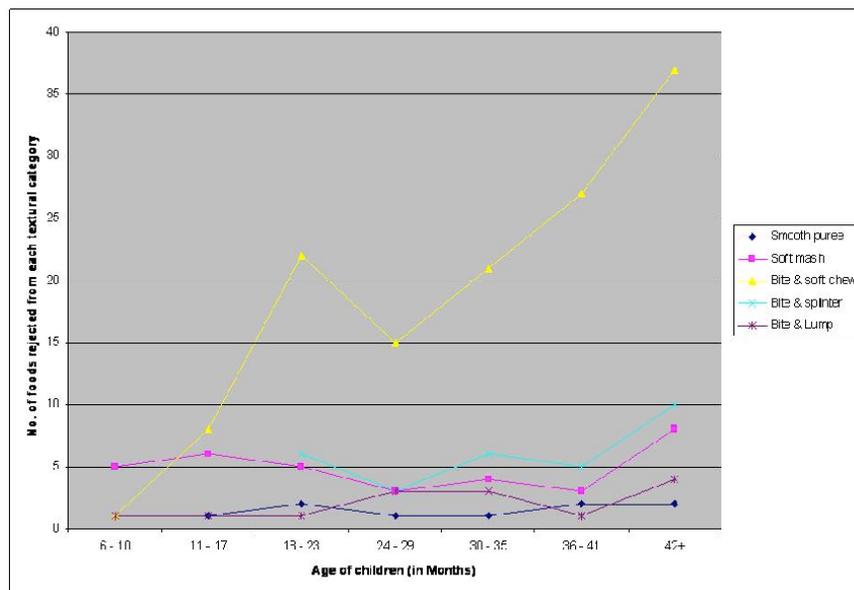

Figure 5: The texture of the rejected foods, as determined by the researchers from parental report of cooking method.

was "bite and soft chew", e.g. fruit and cooked vegetables (summary data are presented in Figure **5**).

DISCUSSION

Based on these data, the rejection of previously accepted food, as reported by parents, commonly occurs in young children. Almost 75% of the parents who participated (N=312) reported that their child had rejected a previously accepted food and the data showed that there was no gender difference. It is important, however, to acknowledge the problem with using a self selected sample for this study and the possibility of those parents who have experienced their child rejecting KPAF replying in a higher ratio than those who have not. This is an obvious concern and the prevalence must be interpreted with caution, especially given the very low response rate. As a result, study two aims to investigate the prevalence of the rejection of KPAF further by obtaining a higher response rate from a single nursery.

Despite the low response rate and likelihood of a bias sample, the data do allow us some insight into the patterns of this type of rejection. While some rejection of KPAF occurs throughout early childhood, the parental reports increase sharply between early and late infancy and then plateau after 30 months (see Figure **2**). Furthermore, the frequency of rejection, as demonstrated by reports that a child has rejected a previously accepted food within the last week, peaks between 18 to 23 months and falls to its lowest levels after 30 months (see Figure **3**). An ANOVA provided further support for this late infancy onset showing that the children reported as having rejected a previously accepted food "within the last week" were significantly younger than those reported to have rejected a previously accepted food in the last month or last six months. Overall, the trends support our hypotheses that the rejection of previously accepted food will happen most often during the beginning of the neophobic period and will then reduce in frequency as the child ages.

Finally, these data show that the foods most frequently reported as rejected are vegetables, mixed foods and fruits, and that the colour reported most frequently was "mixed". This finding offers support for the hypothesis that the most frequently rejected foods would be similar to those previously reported in food rejection literature [2, 3, 21, 25]. These findings are considered further in the overall discussion.

STUDY TWO; METHOD

Once it had been confirmed in study one that rejection of KPAF was occurring, a further set of questionnaires were sent to a single nursery in Preston (UK). The prevalence questionnaire asked parents whether their child had rejected a previously accepted food but this time a definition was included which stated 'the rejection of a food you considered your child to readily accept as part of his or her diet'.

Along with the question regarding the rejection of KPAF, parents were also given a 3-item 'Picky' eating measure [5] and a 4-item food neophobia measure [36]. The aims of these questionnaires were to investigate whether children who are reported as having rejected a previously accepted food also have higher 'picky' and/or food neophobia ratings. Parents were also asked 'did your child encounter any problems with the transition to solids? (Difficulty with unfamiliar textures, reflux etc)'.

Sample

Data for a total of 104 children were returned (72.2% response rate). Two participants were removed because they were over the age of 5 years and a further 13 were removed due to giving too few responses (N= 3), or giving inconsistent responses (N= 10). This resulted in a sample of 89 and a final response rate of 62.5%. The ages of the children whose parents responded ranged from 1 year to 4 years 8 months (mean = 35.7 months; N= 89) with 49 males. The children's ethnicity consisted of 53 Asian - British, 22 White - British, 10 Mixed race (White/Asian), 2 Black - British and 2 Unknown.

Data Input

Parental reports of 'picky' eating were recorded using a 3-item questionnaire (See 5) (α = .87). The scores for children's pickiness were compared using a t-test to see if those children reported as having rejected a KPAF are also reported as having higher levels of 'pickiness'. This same analysis was used to examine rejection of KPAF and food neophobia on the 4-item food neophobia scale (α = .88). Finally, a chi^2 analysis was used to look at the relationship between difficulties in the transition from milk to solids and the rejection of KPAF. As early food difficulties, increased 'picky' ratings, and increased levels of food neophobia are likely to result in increased food rejection, the tests for study two used one-tailed hypotheses.

STUDY TWO; RESULTS

Data from study two suggests a lower prevalence rate of 49.4% for KPAF. Parents who reported that their child had rejected a KPAF in this study considered them to be more 'picky' than parents of children who had not rejected a KPAF. The difference was significant (t(87) = 4.961, p< .001) and is representative of a medium-large effect size (r = .47). Those children who have rejected a KPAF were also considered to be more neophobic than those who have not rejected a KPAF. Again, the difference was significant (t(87) = 4.345, p< .001) and the effect size was medium-large (r = .42) (see Table **1**).

Table 1:   Table Showing the Mean (SD) Food Neophobia and Picky Eating Scores, separately, for those Children who have or have not Rejected a Known and Previously Accepted Food

Rejected a KPAF?	Food neophobia score	Picky eating score
Yes	2.45(.85)*	2.9(1.26)*
No	1.73(.72)	1.75(.9)

*Difference is significant at the 0.001 level (one-tailed).

Fifteen children in the sample were reported to have had some trouble with the transition from milk to solid foods. Of those children 14 (93%) were reported to have rejected a KPAF later in childhood. For the children whose parents reported no problems with the transition to solids, 27 out of 40 (40%) were reported to have subsequently rejected a KPAF. This difference was significant (X^2 (1, N = 82) = 13.79, p< .001) and represents a medium-large effect (phi = .41).

DISCUSSION

The prevalence rate of around 50% for the rejection of KPAF reported in study two is likely to offer a more realistic estimate than in study one. This figure is in line with reported prevalence for behaviours such as 'picky' eating [33, 34] and is drawn from a far higher response rate. Even with this lower estimate the experience of a child rejecting a KPAF is quite common during early childhood.

Study two also offers support for the hypotheses that those children who are reported to have rejected a KPAF will be rated as more neophobic and more 'picky' than those who have not rejected a KPAF. Finally, those children who were reported as having had a difficulty with the transition to solid foods were more likely to have gone on to reject a KPAF.

OVERALL DISCUSSION

This paper is the first to explicitly examine the rejection of KPAF and the results offer some support for the hypotheses presented. The rejection of KPAF seems to be a fairly common occurrence during early childhood, with around 50% of parents reporting that their child has rejected a food that was previously considered to be readily accepted. The data suggest that, while this food-related behaviour occurs across the 6 month to 5 year age range, there is likely to be an increase in reports between the first and second years of life, that it is most likely to have happened 'within the last week' towards the end of infancy, and that the frequency of this occurrence is lower after 30 months. The foods reported as being rejected most often were vegetables, fruits and mixed foods, and the most common colour was 'mixed'. Those children who were reported to have had difficulty with the transition from milk to solid foods were more likely to go on to reject KPAF later in their development. And finally, the data show that those children who have are reported to have rejected a KPAF are considered more neophobic and more 'picky' than those children who have not rejected a KAPF. The proposal being offered here as to why children begin rejecting KPAF is that this behaviour is an extension of the neophobic response.

Food neophobia begins around 18 to 30 months [1-4]. This results in a period of anxiety over food stimuli [5, 22-24], with its foundation in the worry over the intake of noxious substances [2]. The anxiety is likely to result in a period of hyper-vigilance about the visual appearance of all foods, not just those that are new. Infants begin to pay close attention to what they are eating; accepting foods that have little or no changes between servings, while having a higher propensity to reject foods that are prone to visual perceptual changes between servings such as vegetables, fruits and mixed foods.

Previous literature supports the idea that vegetables, fruits and mixed foods are commonly rejected foods during early childhood [2, 21, 25]. While it could be argued that low vegetable intake is due to the bitter taste [12], or low fruit intake explained by the low energy provided [38], neither of these arguments can be applied to the rejection of 'mixed' foods, and together the findings show a pattern of rejection of foods prone to perceptual changes between servings. The rejection of foods during infancy is likely to be done *on sight* [21] further supporting the suggestion that visual aspects are important in the decision to

reject or accept the foods being offered.

It could be that during late infancy, many new foods are being offered to the infant and the foods rejected may be not be fully exposed and, therefore, potentially prone to easy rejection. However, the data do not support this. Firstly the category applied to most of the rejected foods was "bite and soft chew" examples of which are fruit and cooked vegetables [37]. Foods that are well established by late infancy and which are likely to change in appearance between subsequent presentations. Secondly, there are many reasons why a food could be accepted on one occasion and rejected on another, such as satiation [39], illness [40] or lack of exposure [14, 41]. However, these reasons do not account for the rise in the rejection of previously accepted foods during late infancy, the increased frequency of this occurrence around this age and then the plateau and reduction in frequency after 30 months. Thirdly, parents were asked whether their child had rejected a food that they considered to be readily accept, therefore, these should have been fully exposed.

When food neophobia begins, children start to favour eating foods one at a time so they can clearly see what they are eating [2]. Parents also report that children decide whether they like a food prior to tasting and even the same food presented in a different format can be rejected [21]. The rejection of the foods that, on close inspection, differ from the child's prototypical expectation has the effect of reducing the anxiety brought about by the fear of new foods. Those foods that do not match perceptual expectations are categorised by the infant as 'new' or 'different' and rejected in a neophobic response. If there has been an interruption to the child's food learning, due to difficulties in the transition to solids [42, 43], or if the child is sensory sensitive [44] and, therefore, more visually hyper-sensitive, there is likely to be an increase in 'picky' eating behaviours, such as the rejection of KPAF, in the second year.

The reported reduction in frequency of infants rejecting previously accepted foods after 30 months fits the idea that these rejections are based on the infant being unable to integrate perceptual mismatches into their prototypical expectation of certain foods at an earlier age. By the time the child is 30-months-old he or she will have a better understanding that the same food can have visual perceptual feature changes between servings. Furthermore, while effects of increased consumption due to exposure to a target food in the first year of life seems to widen to acceptance of foods within the same category [13], when more finite taste and visual categories have developed, less extension of the exposure response occurs to foods other than the target [45]. Birch *et al.* [15] report 69% of 2 year olds rejected a new food, declining to 29% in 3-year-olds and 0% in 5-year-olds, providing data that also fits with the idea that the rejection of KPAF may have a similar developmental pattern as, and be related to, food neophobia.

APPLICATIONS/IMPLICATIONS

Terms such as 'picky' in literature on infant feeding suggest that certain children are different to the 'norm' or what is expected from a child of that age. Although there is little research into normative food rejection in infancy, it seems that from around 18 months to 30 months of age many children have trouble consolidating the variety within their diet, especially within categories that parents would hope that their child would consume (fruit and vegetables) [2, 21, 25]. Carruth *et al.* [33] report that up to 50% of parents perceive their child to be 'picky' while the paper presented here shows up to 74% of parents report their child as rejecting a previously accepted food. The paper presented here offers the proposal that some of the infant rejections are to be expected and are the result of the foods perceptual qualities and infants sensitivity to visual perceptual changes in food during the beginning of food neophobia. Such research is aimed at reducing the potential for parents to be concerned and anxious that their child is abnormally 'picky' and to begin accounting for some infant food rejections as normal developmental behaviours.

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