THE REJECTION OF KNOWN AND PREVIOUSLY ACCEPTED FOODS IN EARLY CHILDHOOD

By

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Thesis Abstract

To date, no studies have directly examined the rejection of known and previously accepted foods. However, studies investigating 'picky' eating, including the rejection of new *and known foods*, have shown that children labelled 'picky' are likely to have a more unhealthy diet. As a result, increased understanding as to why known and previously accepted foods are rejected may allow for interventions and improved health via increased dietary variety.

The current thesis considered the prevalence of the rejection of previously accepted food in pre-school children and sought to test two hypotheses; (i) that previously accepted food may be categorised as 'new', due to perceptual changes between servings, and rejected in a neophobic response. And (ii) that a perceptual, food based disgust may be a motivation for the rejection of previously accepted foods. It was further proposed that food neophobia would be the catalyst for these rejections.

The data presented suggests that the rejection of previously accepted food is a common occurrence in pre-school children and provides some evidence that the categorisation of food and disgust may influence these rejections. The thesis provides the theoretical arguments for the hypotheses, questionnaire data, and experimental data from methodologies developed for the studies presented.

Dedicated to my parents; Margaret and Dennis Brown who I cannot thank enough.

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THE REJECTION OF KNOWN AND PREVIOUSLY ACCEPTED FOODS IN EARLY CHILDHOOD: CATEGORISATION OF FOOD AND DISGUST.

CHAPTER 1

INTRODUCTION

1.1 **Background to the thesis**

The first year of life is a period of easy acceptance of new foods (Birch, Gunder, Grimm-Thomas & Laing, 1998), and infants' transition from milk to a solid diet is generally achieved with few problems (Birch, 1998), although the timing of the introduction may play a role (Harris, 1993). During the first year children evaluate food based on the taste properties (Birch et al., 1998) and there is an innate preference for sweet tastes (Desor, Maller & Turner, 1973) and aversion towards sour and bitter tastes (Rosentein & Oster, 1988). Beyond this our preferences are learnt via exposure.

The evidence that food preferences are learnt is extensive (Birch et al., 1998; Birch & Marlin, 1982; Birch, Mcphee, Shoba, Pirok & Steinberg, 1987; Nicklaus, Boggio, Chabanet & Issanchou, 2005; Pliner, 1982; Wardle et al., 2003a; Wardle, Herrera, Cooke & Gibson, 2003b). During infancy exposure has been shown to increase the appeal of a target food (Birch & Marlin, 1982), foods similar to the target (Birch et al., 1998) and reduce food neophobia (Birch et al., 1987).

Food neophobia, the avoidance of new foods, begins between the ages of 18 and 30 months (Addessi, Galloway, Visalberghi, & Birch, 2005; Cashdan, 1998; Cooke, Wardle & Gibson, 2003; Harper & Sanders, 1975) and marks a period of reduced dietary variety. Food neophobia is believed to be the onset of an evolutionary

defence against the possibility of ingesting poisons (Cashdan, 1998; Rozin, 1979) and is observed in both humans (Cooke et al., 2003; Galloway, Lee & Birch, 2003; Falciglia, Couch, Gribble, Pabst & Frank, 2000) and other omnivores (Galef, 1993; Johnson, 2000; Marples & Kelly, 1999; Roper, 1993). Food neophobia peaks in these early years and reduces thereafter (Birch et al., 1987; Koivisto & Sjödén, 1996; Pelchat & Pliner, 1995) and is connected to increases in anxiety over food (Galloway et al., 2003; Pliner, Eng & Krishnan, 1995; Pliner & Hobden, 1992; Pliner, Pelchat & Grabski, 1993).

When food neophobia begins, new foods are often rejected, but parents also report *the rejection of known and previously accepted foods* (Carruth et al., 1998). As shown above, food preferences are learnt via exposure, therefore, while the avoidance of new food is explained by food neophobia, the rejection of known foods is unexpected. At this stage foods are usually evaluated visually (Harris, Blisset & Johnson, 2000), prior to being tasted, and as a result rejections often occur *on sight* (Carruth et al., 1998; Cashdan, 1998).

Skinner, Carruth, Bounds and Ziegler (2002) conducted a longitudinal study of children's food preferences and found that two factors were important in predicting food preferences at 8 years of age; children's food neophobia score and children's food preferences at 4 years. The study found that, although the number of foods tried between the ages of 2- to 8- years increased, these foods were more likely to be categorised as disliked than liked. The findings suggest that in order for children to have a long term preference for a food during childhood, the food usually has to become an established preference prior to 4 years of age.

Although the children in this study were reported to enjoy a relatively high number of foods, the sample was of middle-upper class, white children. This socio-

economic group is usually reported to have higher consumption of fruit and vegetables, a key factor in a healthy diet, compared to those from lower socio-economic groups (Rasmussen et al., 2006; Cooke et al., 2004). Furthermore, they were reported to be low in food neophobia, again, typifying a group of children that would be expected to have higher fruit and vegetable intake than those with higher food neophobia (Cooke, Carnell & Wardle, 2006; Cooke et al., 2003; Falciglia et al., 2000; Galloway et al., 2003). Children from lower socio-economic backgrounds, and those that have higher levels of food neophobia, are likely to be more prone to establishing a restricted range of food preferences in their early years. As this usually results in the rejection of fruit and vegetables (Carruth et al., 1998; Cooke et al., 2003; Jacobi et al., 2003), it is a cause for concern and justifies the need for greater understanding of the antecedents for the dietary narrowing, around the time neophobia begins, to inform interventions and increase healthy eating during childhood.

Neophobia has been widely researched (Addessi et al., 2005; Birch et al., 1987; Birch et al., 1998; Cooke et al., 2003; 2004; Falciglia et al., 2000; Hobden & Pliner, 1995; Pliner, 1994; Pliner & Loewen, 1997; Wardle et al., 2003a; 2003b) and 'picky' eating, also discussed as food fussiness (Harris et al., 2000; Pliner & Loewen, 1997) and food refusal (Johnson & Harris, 2004), which considers the rejection of new *and* known foods, has also been looked at a number of times (Carruth et al., 1998; Carruth & Skinner, 2000; Carruth, Ziegler, Gordon & Barr, 2004; Kim et al., 2006). However, the rejection of previously accepted foods is yet to be examined directly.

1.2 Overview of present thesis

The thesis presented here comprises a further five chapters; beginning with a review of current literature (Chapter two) relevant to the acceptance and rejection of

food in early childhood. The review is split into two sections; firstly a review of feeding within the first year, and the ways in which different early experiences may influence later food acceptance and rejection. This section discusses innate preferences, the relative ease with which new foods can be introduced in the first year and the potential benefit of wider food exposure during this time. The second part of the review covers food neophobia, other factors that may lead to a child rejecting food, such as disgust, and the increased difficulty of introducing new foods, in comparison to the first year. The review concludes with a summary outlining the factors that may contribute to the rejection of previously accepted food during early childhood and future research directions.

Chapter three provides an overview of methods and measures used in the empirical phase of the thesis and an outline of the overall research strategy. As a number of different methodologies are covered within the empirical phase of this thesis, the methodology chapter only offers an overview of the questionnaire measures used and each write-up, therefore, includes its own method section. Chapters four and five are then presented as papers written in journal format. Chapter four comprises of three studies and chapter five has two studies and a review. A brief introduction and overall discussion are provided for each chapter; however, due to the paper format used, each of the studies has a separate introduction, method section, results section and discussion relevant to that study.

Chapter four provides some data collected to assess the prevalence and initial patterns of the rejection of previously accepted food, as well as the theoretical basis for the first hypotheses proposed within this thesis; that previously accepted foods may be rejected due to a categorisation error. A further two experimental studies are then presented which examine categorisation of foods in early childhood, and how

this may affect a child's acceptance and rejection of food, in an attempt to provide some support for this hypothesis.

Chapter five begins with a theoretical review arguing the second hypothesis presented within this thesis; that the onset of disgust may result in increased food rejections. This is followed by two empirical studies providing some support for this hypothesis. A study with a sample of 4 to 6 year old children is presented, followed by a sample of infants using an adapted methodology. Some of the potential mediating factors are also examined.

Finally, a sixth chapter gives an overview and discussion of the thesis as a whole, including a summary of the main findings and the contribution of the empirical chapters to current understanding about children's early food rejection. This chapter also considers the general limitations of the thesis and provides overall implications, applications and conclusions.

CHAPTER 2

LITERATURE REVIEW

2.1 Aims of the literature review

The following literature review will be split into two parts. Firstly, the acceptance of food in the first year of life will be considered with a view to examining the possible antecedents of later acceptance and rejection. Part two will focus on the second year of life and, in particular, food neophobia and its correlates, including research on the various reasons proposed to explain human food rejection.

The aim of the review is to propose the possible ways in which current theory and research findings could begin to explain why children reportedly start rejecting previously known and accepted foods. Furthermore, the literature review will be used to inform further research suggestions and hypotheses that can be used for the empirical component of this thesis.

2.2 Part one – Food in the first year and influences on later acceptance and rejection

Many factors interact in order to develop a child's food preference. Innate predispositions (Cowart, 1981; Desor, Maller & Greene, 1977; Steiner, 1977), genetics (Breen, Plomin & Wardle, 2006; Cooke, Haworth & Wardle, 2007), parental feeding methods (Galloway, Lee & Birch, 2003; Gerrish & Mennella, 2001; Mennella & Beauchamp, 1996; Mennella, Jagnow & Beauchamp, 2001), including when parents decide to introduce solids (Coulthard, Harris & Emmett, 2008; Mason, Harris

& Blissett, 2005; Northstone, Emmett, Nethersole & the ALSPAC Study Team., 2001), exposure (Birch, Gunder, Grimm-Thomas & Laing, 1998; Birch & Marlin, 1982; Birch, Mcphee, Shoba, Pirok & Steinberg, 1987) and the variety of that exposure (Blossfeld, Collins, Kiely & Delahunty, 2007; Pelchat & Pliner, 1986), can all have an impact on food acceptance as infants enter their second year of life. As food choices are difficult to explain at an isolated point in time, it is important to first consider how dispositions and previous experience may affect later consumption.

2.2.1 Innate preferences

Few food preferences or aversions are innate; the majority of our food choices are learnt via differing degrees of exposure to foods (Birch et al., 1998; Birch & Marlin, 1982; Birch et al., 1987; Nicklaus, Boggio, Chabanet & Issanchou, 2005; Pliner, 1982; Wardle et al., 2003a; Wardle, Herrera, Cooke & Gibson, 2003b). However, in early infancy the acceptability of a food is based on its *taste properties* and infants show a preference for sweet tastes (Cowart, 1981; Desor et al., 1977; Desor, Maller & Turner, 1973; Steiner, 1977), an aversion towards sour and bitter tastes (Cowart, 1981; Rosentein & Oster, 1988) and find salt either neutral (Desor et al., 1975) or aversive (Crook, 1978) dependent on experience (Crystal & Bernstein, 1998; Harris & Booth, 1987; Harris, Thomas & Booth, 1990). While these elements are not the focus of the thesis, and are heavily influenced by environmental factors (Birch, 1999), it is important to consider genetic predispositions when examining how acceptance and rejection of food develops in the first year of life and, therefore, these will be briefly reviewed (See Cowart, 1981 for a detailed review).

2.2.1.1 Sweet tastes

From birth, there is an increase in acceptance of sweet flavours based on measures of increased intake (See Cowart, 1981) and more positive facial response (Steiner, 1979; Steiner, Glaser, Hawilo & Berridge, 2001). This preference is also shown in infancy (Rosentein & Oster, 1988) and later childhood (Desor, Green & Maller, 1975; Enns & Itallie, 1979) and, while sweet tastes remain desirable, the preference seems to lower and become adult-like from around 15- to 19- years of age (Desor & Beauchamp, 1987).

2.2.1.2 Sour & Bitter tastes

Studies that have included both measures of intake (Desor, Maller, & Andrews, 1975) and facial expressions (Steiner, 1977, 1979; Rosenstein & Oster, 1988) have shown that newborns can perceive, and will reject, sour tastes at birth. However, during middle-childhood a significant number of children (35 - 58%) have an increased preference for sour tastes, and this has an inverse relationship with the child's level of food neophobia (Liem & Menella, 2003; Liem, Westerbeek, Wolterink, Kok & Graaf, 2004).

The data on bitter sensitivity are mixed. A strong, negative, facial expression has been shown, from birth, to bitter tastes (Ganchrow, Steiner, & Munif, 1983; Kajiura, Cowart & Beauchamp, 1992; Steiner, 1977, 1979; Rosenstein & Oster, 1988); however, intake is not reduced (Desor et al., 1975; Kajiura et al., 1992). Infants do not seem to actually reject bitter solutions until around two weeks of life, based on both reports of negative facial/body expressions *and* intake of a bitter solution, compared to a sweetened version (Kajiura et al., 1992). The finding that bitter tastes

are not rejected in newborns may, however, be due to an inability to modulate intake (Birch, 1999).

Research also shows that there is a genetic element to the degree in which children, aged 5 to 10 years, will show sensitivity to bitter (6-n-Propylthiouracil, PROP) tastes (Anliker, Bartoshuk, Ferris & Hooks, 1991; Mennella, Pepino & Reed, 2005). When participants are divided up into non-tasters, regular tasters and supertasters (PROP), research shows that the reported disliking for bitter tastes increases with bitter taste sensitivity (Drewnowski, Henderson & Shore, 1997). Those who are sensitive to bitter flavours can also have an increased number of food dislikes (Anliker et al., 1991; Drewnowski & Rock, 1995).

2.2.1.3 Salt

Newborn infants can appear indifferent to (Desor et al., 1975), or rejecting of, salt solutions (Crook, 1978). However, at around four months there is an increase in preference for salted solutions (Beauchamp, Cowart, & Moran, 1986; Beuchamp & Moran, 1984). This was initially thought to be due to changes in perception of salt (Beauchamp et al., 1986), though later studies suggest that this increase in preference is the result of recent dietary experience (Harris & Booth, 1987; Harris et al., 1990). This idea is further supported by the differing response infants have to salt dependent on whether their mother reports no-mild or moderate-severe morning sickness (Crystal & Bernstein, 1998). Prolonged vomiting has been shown to lead to dehydration and electrolyte imbalance (Hawthorn, 1994) reducing salt levels. Children of mothers who experienced increased vomiting during pregnancy show an increased preference for salt solutions.

2.2.1.4 Summary

The research shows that children's main, innate predispositions are to favour sweet flavours (Steiner, 1979; Steiner et al., 2001), and avoid bitter tastes (Ganchrow et al., 1983; Kajiura et al., 1992; Steiner, 1977, 1979; Rosenstein & Oster, 1988), with some genetic variance in the latter (Anliker et al., 1991; Mennella et al., 2005). Why would we prefer sucrose and avoid bitter tastes? Our innate food preferences and aversions are likely to be of evolutionary benefit. Sweet flavours are usually high in sugar, and therefore calorie dense, while bitter tastes can signal the presence of toxins (Rozin, 1986) and avoidance can lower the chance of ingestion of poisons. However, this once beneficial mechanism for increased calorie intake and avoidance of potential toxins, within an environment scarce of food, has become maladaptive in an environment with ready access to high calorie dense, sweet foods (Birch, 1999; Glendinning, 1994).

Fortunately, as children age, the ways in which genes and environment interact determine the development of a particular phenotype (Birch, 1999). Therefore, while these genetic elements can influence a child's food preferences, the environment plays an equally, if not more important, role via adapting preference through exposure to new foods (Birch et al., 1998; Birch & Marlin, 1982; Birch et al., 1987; Nicklaus et al., 2005; Pliner, 1982; Wardle et al., 2003a; Wardle et al., 2003b).

2.2.2 Introduction to solids

The term weaning is used by the WHO to mean the complete cessation of breast feeding, however in the UK 'complementary feeding' and 'weaning' are often used interchangeably (Foote & Marriott, 2003). This review considers the introduction of solids, regardless of breastfeeding cessation or continuation.

Many factors contribute to the timing of introduction of solids, such as, cultural beliefs, medical advice, idiosyncratic beliefs, maternal perceptions of the infant's needs and opinions of friends or relatives (Dettwyler & Fishman, 1992). Once introduction begins, the process is relatively gradual, with new tastes and textures requiring familiarisation over around a 6 month period, beginning with pureed foods and continuing with more texture from around 7-8 months of age, including some softer finger foods (Foote & Marriott, 2003).

2.2.2.1 Timing of first solids/lumpy textures

There seems to be a potential for feeding difficulties if solids are introduced to infants late (Clark & Laing, 1990; Harris, 1993; Mason, Harris & Blisset, 2005). It is, therefore, important to consider when to introduce foods and also, when to introduce solids with different textures. While it has been shown that delaying solids until 6 months of age has no detrimental effect on acceptance (Cohen, Landa Rivera, Canahuati, Brown & Dewey, 1995), a study by Lindberg (2007), including data from two separate samples in Sweden, showed that introduction to solids at around 4 months results in increased positive reactions and the later introduction is related to more negative reactions to the foods (Lindberg, 2007). Furthermore, in the second sample of this study, later introduction was related to increased time taken for solids to be accepted (Lindberg, 2007). While more research is required, it seems that infants have the oral motor skills to allow for acceptance of solids from 4 months of age (Lindberg, 2007). Furthermore, the earlier that fruit and vegetables are introduced to the diet, the greater the intake at 2 to 6 years (Cooke et al., 2004) and early introduction to solids can encourage wider intake across the lifespan (Cashdan, 1994).

As well as the importance of timing for the introduction of solids in general, research suggests that the timing of introduction to *lumpy* solids is also important (Blossfeld et al., 2007; Coulthard, Harris & Emmett, 2009; Northstone et al., 2001). The Department of Health (2008) recommend that the introduction of solids take place around 6 months, finger foods (such as fruit) should be encouraged around 6 to 9 months and a more mature diet should be introduced around 9 to 12 months of age. When these stages are missed, feeding difficulties can occur (Clark & Laing, 1990; Northstone et al., 2001).

A study by Lundy et al. (1998) demonstrated that children aged 6-12 months had more difficulty with complex textures than children in their second year, based on child behaviours during eating. However, their second study showed that, after a period of exposure to either puree, lumps, or both, infants with experience of more complex textures favoured the more complex novel textures suggesting experience facilitates acceptance of a range of complexities. This study was supported by Blossfeld et al. (2007) who compared the acceptance of pureed and chopped carrots in 12-month-old children. The study found that those infants who began eating mashed foods earlier, and those who had greater experience of chopped foods, consumed more chopped carrots.

Northstone et al. (2001) compared the presence of feeding problems in infants at 6 and 15 months, dependent on when lumpy solids were introduced. The study found that children who received lumpy solids prior to 6 months had the least feeding difficulties and those who were introduced to lumpy solids after 10 months had the most feeding difficulties, at both time points. Furthermore, the children who were introduced to lumpy solids after 10 months developed stronger likes and dislikes at 15 months and were considered more ‘choosy’ in their food selection. Coulthard et al.

(2009) report similar findings based on self report questionnaires which show even longer term effects. In a sample of 7821, those children who were introduced to solids after 9 months were found to consume fewer food groups at *seven years*, including all categories of fruit and vegetables. While the children in these studies could have had underlying feeding difficulties that contributed to their late introduction to lumpy solids, these findings combined with those from other studies (Blossfeld et al., 2007; Clark & Laing, 1990; Lundy et al., 1998) suggest that the appropriate timing for introducing solids of varying textures may facilitate the acceptance of foods at a later stage.

Further research supporting the idea that interruptions to a fluent transition from milk to solid foods results in food related problems at a later stage comes from studies about the effects of illness. Johnson and Harris (2004) looked at the correlates of food neophobia and food refusal at around 18 months of age. The results show that, when comparing the influence of poor oral motor function, illness and mealtime negativity; increased reports of illness (in particular, vomiting) during early childhood was predictive of food neophobia at 18 months. While this was a small, retrospective study, the findings are supported Dahl (1987) who found that, of 42 children with early feeding difficulties, 21 still had problems at a 2 year follow-up and recurrent infections were an influential factor contributing to these problems.

2.2.2.2 Summary

Late introduction of solids can have detrimental effects on later food acceptance (Clark & Laing, 1990; Harris, 1993; Mason, Harris & Blisset, 2005) and 4-6 months may be more appropriate for children in Western countries, in terms of aiding ease of transition to solids (Harris, 1993; Lindberg, 2007).

The timing of the infants' introduction to lumpy solids is also important (Blossfeld et al., 2007; Northstone et al., 2001), with more difficult textures requiring introduction by around 10 months (Clark & Laing, 1990; Coulthard et al., 2009; Northstone et al., 2001). Furthermore, interruptions to the weaning process due to illness in the first year may have a detrimental effect on food acceptance, well into the second year (Johnson & Harris, 2004; Dahl, 1987).

2.2.3 Exposure to tastes in breast milk and solid foods

Humans prefer breast milk (Marlier & Schaal, 2005); amniotic fluids prepare infants for the odours and flavours present in breast milk (Schaal, Marlier & Soussignan, 2000) and the variation of flavours in a mother's diet are transferred via breast milk (Mennella & Beuchamp, 1999; Mennella & Beuchamp, 1996; Mennella, Jagnow & Beauchamp, 2001). This may prepare the child for easier transition to solid foods (Harris, 2008). Furthermore, research shows that whether or not a child was breast fed has an influence on later food acceptance (Forestell & Mennella; Galoway et al., 2003; Galloway et al., 2003; Sullivan & Birch, 1994).

Sullivan and Birch (1994) compared the effects of exposing a novel vegetable, with or without added salt, on the resulting acceptance of that vegetable. They also examined whether there was an influence of initial feeding method (breast milk or formula-fed) on the impact of the food exposure. They found that infants who had been given breast milk showed a significant increase increase in their liking of the exposed vegetable, relative to the infants who had been exclusively formula-fed. This finding suggests that the consumption of breast milk has an impact on later consumption of solids, with the mediating effect thought to be the transition of a

wider variety of flavours transmitted through this milk (Mennella & Beauchamp, 1999; Mennella & Beuchamp, 1996; Mennella et al., 2001).

While studies have yet to show a direct increase in *consumption* of the food thought to have been exposed during breast feeding in humans, a study using rats does seem to show increased acceptance of foods exposed via milk, and the findings show this may not always be advantageous (Bayol, Farrington & Stickland, 2007). Bayol et al. (2007) showed that the offspring of mothers fed 'junk food' during pregnancy and lactation showed a preference for a 'junk food' diet; in comparison to control offspring whose mother's were fed rat chow. Therefore, while flavours are transmitted via breast milk (Mennella & Beuchamp, 1999; Mennella & Beuchamp, 1996; Mennella et al., 2001) and this may be a factor in increased fruit and vegetables intake (Cooke et al., 2004; Rasmussen et al., 2006) and lower levels of 'picky' eating as the child ages (Galloway et al., 2003), if mothers who breast feed have a poor diet, these habits may be transmitted to the child, increasing the chances of preference for high fat, salt or sugar foods (Bayol et al., 2007).

Once solids have been introduced to the diet there is comprehensive evidence to suggest that food preferences are learnt (Birch et al., 1998; Birch & Marlin, 1982; Birch et al., 1987; Nicklaus et al., 2005; Pliner, 1982; Wardle et al., 2003a; Wardle et al., 2003b). During infancy, exposure has shown to increase the appeal of a target food (Birch & Marlin, 1982), foods in similar categories to the target (Birch et al., 1998) and to reduce neophobia (Birch et al., 1987), which is the avoidance or fear of new foods (Rozin, 1976). However, these foods need to be tasted by the children themselves (Birch & Marlin, 1982; Pliner, 1982; Sullivan & Birch, 1994), or to be seen being eaten by others (Birch, 1980; Hobden & Pliner, 1995). Just being in the

presence of the food, and looking at it without tasting, does not have the same effect (Birch et al., 1987).

Infants tested between 4 to 7 months showed that, as little as one exposure to a new food, can result in an increased preference for that food (Birch et al., 1998), with acceptance, in grams, almost doubling for the target food (banana or peas). The same study also looked at the effect the exposure to a target food had on the acceptance of a similar (a different fruit or a different vegetable) or a different food (fruit, vegetable or meat, depending on the target food used). The results showed that there was an increase in consumption for a similar but not for a different food. Together, these findings suggest that, during infancy, preference for a food via exposure occurs very quickly, and can extend to foods within the same category, with the likely mediator being similarity in taste (Birch et al., 1998). Furthermore, the initial feeding method may influence the overall effect of exposure, with breastfed infants showing a larger effect of exposure to vegetables than those that are bottle-fed (Sullivan & Birch, 1994).

As children age, the number of exposures required to produce a preference for a food increases (Birch et al., 1987; Birch & Marlin, 1982; Sullivan & Birch, 1990, 1994). When examining the effects of exposure on preference for fruit, Birch et al. (1987) found that there was a significant preference for the exposed fruit after 5-10 tastes in children aged between 23 and 64 months. These findings mirror those from an earlier study, that used cheese as the new food (Birch & Marlin, 1982), where children aged 2 and a half to 3 years showed significant increases in preference from around 5-10 exposures. Finally, Sullivan and Birch (1990) showed that children aged 4 to 5 years showed a preference for sweet, salted or plain tofu, dependent on the flavour exposed, after 8 exposures, and a further increase in preference after 15

exposures, similar findings were later reported for vegetables (Sullivan & Birch, 1994). Also, those in the sweet and salted groups, showed a decrease in preference, from baseline, for the plain tofu. This suggests that the generalisation to other variants within the same food category, shown in exposure at 4 to 7 months (Birch et al., 1998), does not occur when the child is older and an increase in preference for one particular taste can actually reduce the desire for variants, possibly because the child is learning food-flavour appropriateness (Sullivan & Birch, 1990).

Even as adults, the effects of exposure continue to influence our food preferences. Foods within cultures are generally similar, but can vary widely between cultures (Cashdan, 1998). This is likely to be the effect of greater exposure to the available foods. A study by Zellner, Garriga-Trillo, Rohm, Centeno and Parker (1999), using a questionnaire and hedonic rating scale, compared American and Spanish college students on their liking and craving for various food and drinks. The data showed that Spanish participants favoured coffee and white chocolate significantly more than the American participants, while the American participants rated liking tea significantly more than the Spanish sample. Both samples showed an equal liking for milk chocolate, non-chocolate sweets and Cola. These findings map on to the cultural variants in exposure.

While, almost universally, exposure has been shown to increase acceptance of a target food, two possible complications can occur. Sensory specific satiation, the reduction of hedonic value of food after consumption (Temple, Chappela, Shalika, Volcya & Epstein, 2008; Rolls, 1986), can cause foods to be rejected in infancy (Mennella & Beauchamp, 1999), early childhood (Birch & Deysher, 1986) and affect both wanting, the desire to eat (liking) and the pleasure obtained from consuming the food, in adulthood (Havermans, Janssen, Giesen, Roefs & Jansen, 2008).

Furthermore, consumption is not necessarily required to produce the reduction in reported liking (Rolls & Rolls, 1997).

The likelihood is that the reduction in hedonic value will only last for a short period of time, except where there are extreme periods of repeated exposure (Rolls & de Waal, 1985). This is referred to as monotony (Rozin & Vollmecke, 1986) and has been examined in relation to the rations given to military personal (Schutz & Pilgrim, 1958) and University students (Seigal & Pilgrim, 1958). In these studies, prolonged access to a small number of unchanging foods consequently produced lowered ratings of liking, in comparison to different foods, and this reduced liking was still present at a four month follow-up (Seigal & Pilgrim, 1958). Therefore, while exposure is beneficial, over-exposure can be problematic and lack of variety can also produce negative consequences.

2.2.3.1 Effect of wider early dietary experience on later rejection/acceptance

Birch et al's. (1998) study on the influence of exposure to a target food showed that, during the first year of life, children show an increased consumption of a target food, and a food similar to the target, but not to different foods. One further post-exposure condition was the child's response to a home prepared version of the target food. The exposure effect was shown to not transfer in this condition. The explanation for this was the variation in texture, compared to the pre-prepared, purchased food given in the exposure phase of the study. This suggests that a mere taste of new foods can have beneficial effects on intake, but the same food may have to be given in *different format*s at different periods of exposure in order to produce wider acceptance, furthermore, this variety may not be found in all manufactured foods.

A study by Maier, Chabanet, Schaal, Leathwood and Issanchou (2008) showed that infants who were breastfed and given a variety of exposure to vegetables at around 5 months of age, accepted significantly more new foods than those who were bottle fed and given low variety, for up to two months. A longitudinal study assessed the impact of variety of exposure to fruit and vegetables in the first two years on subsequent consumption 6, 7 and 8 years (Skinner et al., 2002). Early fruit/vegetable variety was measured as the number of different fruits given over a 24hr period and early fruit/vegetable exposure was measured by the number of individual servings of fruit or vegetables recorded, both calculated using 24hr parental recall, 7 or 8 times over the child's first two years. Although early variety and exposure did not predict vegetable intake at school age, the model was weak and suggests a number of other factors, not measured in the study, contribute to vegetable intake. The results did show, however, that fruit intake, followed up at 6, 7 and 8 years, was predicted by fruit exposure in two models; breast feeding duration and *early fruit variety* in one, and breast feeding duration and *early fruit exposures* in model two. Again, however, there was considerable unexplained variance (approx. 75%), so a number of other factors are likely to be involved.

As well as variety in exposure per se, the age at which variety is given may be of importance (Cashdan, 1994). Capretta, Petersik & Stewart (1975) found that when young rats were exposed to a varied diet of 3 to 4 flavours, they were more likely to accept a novel food 24 hours later, than rats fed a less varied diet. However, this was not the case with adult rats suggesting there may be an opportunity in early life to widen food acceptability that is not as easy later on. In human studies this is shown by Birch et al. (1998) where infants in the first year showed greater acceptability for foods similar to those they were exposed to, whereas this extension to similar foods

did not occur in 4 to 5 year olds (Sullivan & Birch, 1990). Furthermore, Cashdan (1994) argues that there is a 'sensitive period' of food exposure within the first 2 to 3 years of life and missing this opportunity can lead to continued reduced dietary variety.

2.2.3.2 Summary

Together the exposure data show that there is a period of easy acceptance during weaning, where foods can be introduced with as little as one taste and can facilitate the acceptance of similar flavours (Birch et al., 1998). The period between the first and second year and how/when the transition from easy acceptance, to the need for more persistent exposure, occurs has not been researched but, by the end of the second year, children's required exposures increase dramatically to between 8 and 15 tastes before a significant preference is shown (Birch & Marlin, 1982; Sullivan & Birch, 1990). Furthermore, and the extension of a preference to other similar foods no longer occurs (Sullivan & Birch, 1990). This may be the result of an increase in food neophobia and suggests that there may be a 'sensitive period' for introducing new flavours and increasing the likelihood of later dietary variety (Cashdan, 1994) which may have the effect of reducing the impact of food neophobia.

2.3 Part two – Food Neophobia and the narrowing of dietary variety

Up to the second year it is likely that foods are evaluated based on their taste. Exposure can increase the preference for a target food and to foods similar to the target, if they also share textural properties (Birch et al., 1998). However, it seems

that during the second year this taste based evaluation *becomes visual*, i.e. foods are evaluated based on how they look, prior to being tasted.

Food neophobia is the fear of new foods and is thought to provide a protective function in that it prevents newly mobile infants consuming toxins (Cashdan, 1998; Rozin, 1976). This avoidance is observed in both humans (Cooke et al., 2003; Galloway et al., 2003; Falciglia, Couch, Gribble, Pabst & Frank, 2000) and other omnivores (Galef, 1993; Johnson, 2000; Marples & Kelly, 1999; Roper, 1993) and begins in children at around 18 to 30 months (Addessi et al., 2005; Cashdan, 1998; Cooke et al., 2003; Harper & Sanders, 1975).

When neophobia begins, new foods are often rejected, but parents also report the rejection of known and previously accepted foods (Carruth et al., 1998). Both of these rejections seem to occur *on-sight* (Carruth et al., 1998; Cashdan, 1998) as children need to recognise the food they are about to eat before they will do so. As a result of the rejection of new and previously accepted foods children can be labelled 'picky' eaters with Carruth et al. (2004) reporting that, by 19 months, 50% of parents considered their child to be picky. The result of this is increased food rejections and sometimes a narrowing of dietary variety.

The following sections of this review will consider the reasons for the rejection of foods. The review will cover neophobia (Rozin, 1976) and the possible influence of genetics (Cooke, Haworth & Wardle, 2007), sensory sensitivity (Dunn, 1999) and gender (Koivisto & Sjödén, 1996). Furthermore, the four main types of human food aversions, distaste, disgust, inappropriateness and danger (Fallon & Rozin, 1983), will be considered, with a focus on disgust and its corresponding contamination sensitivity (Rozin & Fallon, 1987). Finally, the way in which children categorise foods will be examined.

2.3.1 Reasons for rejection

2.3.1.1 Food Neophobia

The neophobic response results in food being rejected on-sight and, while it seems to be connected to enduring, dispositional factors (Galloway et al., 2003); exposure to the new food has been shown to reduce the neophobic response and the response also reduces with age (Birch et al., 1987). When examining the effects of exposure on neophobia Birch et al. (1987) found that 11 out of 16 children aged 2 years rejected the first taste of a new food, this declined to 3 out of 16 by the age of 3 and none of the 5 years olds rejected a taste of the new food. Furthermore, this study showed that preference for the new food increased with taste exposure, just looking at the food did not increase preference for the target food. This fits the theory that food neophobia is an avoidance of toxins and that the absence of any negative effects, post ingestion, alleviates the fear of the new food (Birch, 1999), the theory of 'learned safety' (Kalat & Rozin, 1973).

An important issue when considering food neophobia is whether or not it is a *true* phobia, as this has consequences for the affective response children have upon being given new foods when their neophobia is high. The evidence suggests food neophobia and anxiety are related and that food neophobia is indeed a genuine fear of new foods. Galloway et al. (2003) looked at the causes of food neophobia and pickiness in 7-year-old girls using an adapted food neophobia scale (C-FNS, Pliner, 1994) and a revised version of the Manifest Anxiety Scale (1997). The study found that neophobia was significantly related to an increase in children's anxiety. A study by Pliner, Pelchat and Grabski (1993) also relates food neophobia and anxiety, showing participants who scored above the median in state anxiety, were willing to

taste fewer novel foods than those scoring below the median. This was later extended to show that even an increase in anxiety that is unrelated to food, has the potential to increase the neophobic response (Pliner, Eng & Krishnan, 1995). Finally, Pliner and Hobden (1992) reported several studies that obtained small, but significant, relationships between the food neophobia scale (FNS) and trait anxiety.

Additionally, when being treated for food neophobia, behavioural techniques, similar to those used in the treatment of other phobias, are used to help both children and adults (Singer et al. 1992; Marcontell, Laster & Johnson, 2003; also see Nicholls, Christie, Randall & Lask, 2001). Taken together, the findings that relate anxiety and neophobia, along with the methods used to treat food neophobia, suggest the fear of new foods is indeed a true phobia.

In terms of the effects of food neophobia on children's diets; children aged 4 to 5 years who scored higher on an adapted version of the C-FNS (Pliner, 1994) consumed considerably less fruit and vegetables than the less neophobic children, while still consuming many sweet, fatty, and starchy foods (Cooke, Carnell & Wardle, 2006). A study by Falciglia et al. (2000) showed that, while the diet of children with high and low food neophobia were relatively comparable for energy and nutrient intake at ages 9 to 11, children high in food neophobia consumed less vitamin E, had lower dietary variety and consumed increased amounts of saturated fat. Finally, in a population based study by Russell and Worsley (2008) it was found that increased food neophobia resulted in a reduction in preferences for all food groups, though vegetables in particular were avoided, and a less healthy diet. Many studies have related food neophobia to the consumption of fewer foods, in particular vegetables, fruits and meats (Cooke et al., 2004; Cooke et al., 2004; Falciglia, Pabst, Couch & Goody, 2004; Carruth et al., 1998; Pliner & Pelchat, 1991) neophobia, therefore,

limits dietary variety and leads to unhealthy food intake patterns (Cooke et al., 2006; Falciglia et al., 2000; Russell & Worsley, 2008).

2.3.1.1.2 Heritability of neophobia

It is difficult to measure the degree to which neophobia is genetically heritable, and what variance is due to environment. Generally, there are small but consistent similarities in the food choices of parents and their children and, while this could be due to an inherited propensity to avoid certain foods, these children are less likely to be offered food that is not liked by their mother (Skinner et al., 2002), therefore, the similarities may be due to environment. Furthermore, a twin study found that the strength of food preference similarities varied between food categories (Breen, Plomin & Wardle, 2006) so there may be a lack of consistency in family preferences or a difference in the heritability of dislike for/rejection of certain food types, i.e. heritability for dessert liking was low (.20) while heritability for acceptance/rejection of protein foods was high (.78).

A number of studies have examined familial similarity in neophobia. Research shows a low to moderate heritability, based on correlations between parents and children or comparison of siblings (Falciglia et al., 2004; Galloway et al., 2003; Koivisto & Sjoden, Pliner, 1994; Pliner & Lowen, 1997). Plomin and Rowe (1977) report no difference between MZ and DZ twins in terms of temperament and food choice; however, their study did not use a standard measure of food neophobia. To date, only two twin studies have examined the heritability of food neophobia one looking at children (Cooke, Haworth & Wardle, 2007) and one investigating the trait heritability within adults (Knaapila et al., 2007). Cooke, Haworth and Wardle (2007) compared reports of food neophobia, using a 4-item version of the FNS (Pliner, 1994)

with children aged 8- to 11- years (N= 5390 pairs). This study found that genetic influences accounted for 78% of the variance in neophobia with the further 22% accounted for by *non*-shared environmental factors. Cooke et al. (2007) suggest that the non-shared environmental factors may be the result of parents responding differently to siblings and/or different children respond differently to the same situation.

Knaapila et al. (2007) conducted a smaller study with both a Finnish family sample and British twin sample of adults. Using both the original 10-item FNS (Pliner, 1994) and a revised, validated 6-item version of the FNS (Ritchey, Frank, Hursti & Tuorila, 2003) the study provided similar estimates to Cooke et al. (2007) with approximately two-thirds of the variance explained by genetics and no shared environmental influence. Together, these findings show that, despite the need for further research, neophobia should be considered largely determined by genetic influences.

2.3.1.1.4 Reduction of neophobia via modelling

Exposure, as discussed earlier (see section 2.2.5), has been shown to reduce the effect of food neophobia, via the consumption of novel food (Birch et al., 1987; Wardle et al., 2003b) but not by just looking at the food (Birch et al., 1987). Therefore, in order to reduce food neophobia via consumption, a person has to be encouraged to *try* the food. One way in which this facilitated is by watching, and then copying, others eating a novel food; this is known as modelling (Birch, 1980).

Modelling has been shown to have the effect of increasing consumption in a number of studies and children have been shown to accept a novel food more readily when modelling parents (more so than unknown adults) (Harper & Sanders, 1975),

peers (Birch, 1980; Hendy, 2002) and teachers who enthusiastically show their liking of the novel food (Hendy & Raudenbush, 2000). However, the food being modelled has to be the same as the one offered and has to be eaten, not just offered (Addessi et al., 2005).

There are suggestions that, if people have positive experiences with novel food, such as they taste good or positive social reinforcement occurs, this may help develop script knowledge that 'new foods can taste good' and increase children's willingness to try them (Pliner, 2008). However, while this has been shown in adults (Pliner et al. 1993) and older children (Loewen & Pliner, 1999) this cognitive extension to willingness to try different novel foods has not yet been shown in children younger than 10 to 12 years (Loewen & Pliner, 1999).

The gender differences reported for the effect of modelling on consumption are mixed. Hendy and Raudenbush (2000) found that 4 to 5 year old girls were more influenced by peer models than boys, whereas Harper and Sanders (1975) and Birch (1980) found no gender effects, though the ages of the samples differed. In terms of age, the findings are equally inconsistent with Harper and Sanders reporting no age differences between 14 to 20 month and 42 to 48 month old children when modelling parents and other adults, and Birch (1980) showing how 3 year olds were more influenced than 4 year olds, though peer models were used in this study.

The effect of modelling has been consistently supported; however, the potential for other factors to influence modelling requires research. Addessi et al. (2005) showed how colour is an important factor in the acceptance of a modelled food and a recent study by Coulthard and Blissett (2009) has shown how fruit and vegetable consumption by mothers is correlated with consumption of their children

unless the child has high taste/smell sensory sensitivity. Therefore, individual factors may influence the effects of modelling.

2.3.1.1.5 Neophobia and its possible correlates

Pliner (unpublished as cited in Pliner & Salvy, 2006) found that disgust correlates highly with neophobia, as measured using the FNS, while Nordin, Broman, Garvill and Nyroos (2004) found a small correlation between disgust sensitivity and neophobia. Food neophobia seems to be a "true" phobia resulting in increased anxiety towards food (Galloway et al. 2003; Pliner et al. 1995; Pliner & Hobden, 1992; Pliner et al. 1993) and in severe cases requiring behavioural treatments (Singer et al. 1992; Marcontell, Laster & Johnson, 2003; also see Nicholls, Christie, Randall & Lask, 2001). When something becomes the source of a phobia the feelings of disgust towards those stimuli may become inflated (Thorpe and Salkovskis, 1998) and as a result there may be increased potential for a disgust and contamination response in relation to food, when neophobia begins

Sensory sensitivity, an increase in sensitivity in one or more of the senses (Dunn, 1997), could also be related to neophobia. Children on the autistic spectrum, who are often sensory sensitive, can become very selective eaters (Timimi et al. 1997), have less dietary variety (Nicholls et al. 2001) and have more problems with textures (Schreck, Williams and Smith, 2004). Furthermore, there is an increased desire for specific food presentation when compared to controls (Schreck et al. 2004; Timimi et al. 1997; Williams et al. 2005). Though these children often suffer physiological problems from an early age, their selective eating patterns generally begin around 18 months (Nicholls et al. 2001; Schreck, Williams and Smith, 2004; Timimi et al. 1997; Williams, Gibbons & Schreck, 2005), around the onset of

neophobia (Addessi, Galloway, Visalberghi, & Birch, 2005; Cashdan, 1998; Cooke, Wardle & Gibson, 2003; Harper & Sanders, 1975).

Eating involves vision, touch, taste and smell, and differences in the processing of this information have been found with regards to bitter sensitivity (Drewnowski et al., 1997) and a recent study shows that the relationship between mother/child fruit and vegetable intake is moderated by taste/smell sensitivity (Coulthard & Blisset, 2009). Carter et al. (2000) also showed that ratings of bitterness sensitivity were higher for participants who were classed as 'neophobic' when compared to 'neophiliacs', people with an overt willingness to try new foods. Furthermore, early experiences seem to result in differing sensitivity, within the mouth, during the second year and, as a result, some textures can be rejected (Blossfeld et al., 2007; Northstone et al., 2001; Smith, et al., 2005). As explained above, the second year of life also sees a change from a taste evaluation of food to a visual evaluation, prior to tasting. Therefore, those children with increased visual sensitivity may have in an increase in on-sight food rejections.

A final element of a person's sensory profile that is negatively related to food neophobia (Loewen & Pliner, 2000; Pliner & Hobden, 1992; Raudenbush et al, 1995) and related to the reluctance to approach novel stimuli generally (Pliner and Hobden, 1992; Raudenbush et al, 1995) is sensation seeking. Sensation seeking is "a trait defined by the seeking of varied, novel, complex, and intense sensations and experiences" (Zuckerman, 1994) and if people are low in sensation seeking then they may be avoidant of unknown sensations that could be provided by a new food.

2.3.1.2 ‘Picky’ eating

‘Picky’ eating, as defined within this thesis, is the rejection of *both* new and some known foods and textures (Carruth & Skinner, 2000; Carruth et al., 1998, Galloway, Fiorito, Lee & Birch, 2005; Li, Shi, Wan, Hotta & Ushijima, 2001; Potts & Wardle, 1998; Rydell, Dahl & Sundelin, 1995; Smith, Roux, Naidoo, & Venter, 2005). The literature that addresses the issue of children becoming ‘picky’ suffers, however, from a lack of consistency in regards to the terminology used. While seemingly investigating very similar themes, ‘picky’ eating has also been called food fussiness (Harris et al., 2000; Pliner & Loewen, 1997), food refusal (Johnson & Harris, 2004), food avoidance (Marchi & Cohen, 1990), food selectivity (Kedesdy & Budd, 1998) and food fussiness/‘picky’ have been used interchangeably (Smith et al., 2005). Furthermore, measures of picky eating differ, with some studies developing ‘picky’ eating sections within their questionnaires (Birch et al., 2001; Blossfeld et al., 2007; Carruth et al., 1998; Galloway et al., 2005; Galloway et al., 2003), some developing their own questionnaire (Smith et al., 2005), and other just asking caregivers whether they consider their child ‘picky’ (Carruth et al., 2004). Finally, the age ranges for studies that investigate ‘picky’ eating vary considerably from infants and toddlers (Blossfeld et al., 2007; Carruth et al., 1998) to pre-school children (Jacobi et al., 2003) and school aged children (Birch et al., 2001; Galloway et al., 2005; Galloway et al., 2003) and it may be that the motivation for these behaviours is different during these developmental periods.

Moreover, while there are distinctions between the working definitions of neophobia and ‘picky’ eating, it is not yet clear as to whether these aspects of children’s food rejection are actually behaviourally distinct (Galloway et al., 2003; Jacobi et al., 2003; Pelchat & Pliner, 1986; Pliner & Hobden, 1992) or not (Potts &

Wardle, 1998; Raudenbush, Van Der Klaauw & Frank, 1995). To date only one study has examined the determinants of picky eating and neophobia in which it was concluded that, while they are related, they have different behavioural predictors (Galloway et al., 2003). Neophobia was predicted by mothers' neophobia and girls' anxiety score while 'picky' eating was predicted by mother's vegetable variety, the number of months the child was breastfed (inverse relationship) and reports of less time to prepare healthy food. However, the sample was relatively unrepresentative, consisting of girls in middle childhood, and 85% of the variance remained unexplained, therefore, no clear conclusions can be made at this time. Despite the lack of clear evidence that the concepts of food neophobia and 'pickiness' are distinct, they have been treated as such in the majority of research and, therefore, the literature presented here also treats them as separate concepts.

Most research into picky eating has been carried out on children aged 2 years and over (Carruth & Skinner, 2000; Carruth et al., 1998; Galloway et al., 2003; Galloway, Fiorito, Lee & Birch, 2005; Li, Shi, Wan, Hotta & Ushijima, 2001; Potts & Wardle, 1998; Rydell, Dahl & Sundelin, 1995; Smith, Roux, Naidoo, & Venter, 2005). The research shows that infants and toddlers who are categorised as 'picky' have less dietary variety, with vegetables reported as a highly rejected food group (Carruth et al., 1998; Jacobi, Agras, Bryson, Hammer, 2003), along with fruit (Cooke et al., 2003) and "mixed" foods (Cashdan, 1998).

When accounting for why children become picky Carruth et al. (1998) offer two explanations. Firstly, parents of picky eaters do not offer their children enough exposures to the target foods. Research shows foods need to be given 10-15 times to increase liking significantly (Birch & Marlin, 1982; Loewen & Pliner, 1999), but reports suggest that parents of children who are deemed picky do not expose their

children to new foods this often (Carruth et al., 1998; Carruth et al., 2004). However, this study reported no significant difference between the exposures provided by the parents of children deemed 'picky' eaters and those that were not. The second explanation given is that toddlers' desire for independence contributes to the picky eating. Carruth et al. (1998; p.185) give two quotes from mothers to describe the frustration felt, "he will visually decide he doesn't like something" and "one time she'll eat it the next time she won't even touch it – yukky! Gross!" (p.185). Beyond these examples, no clear evidence is presented to support the idea that the pursuit of autonomy is a key factor in children's food rejections.

Two studies have measured picky eating in infancy (Carruth, Zeigler, Gordon & Barr, 2004; Kim et al., 2006). Carruth et al's. (2004) study reported that, by 19 months, up to 50% of infants were categorized as picky by their parents. The aim of the paper was to report prevalence and offers little explanation as to why there may be a rise in 'picky' eating, beyond the observation that parents do not seem to offer enough opportunities for children to try new foods. The study by Kim et al. (2006) examined reports of 'picky' eater status and measures of maternal feeding behaviour, maternal feeding practice and infants' temperament. From a sample of 83 children (aged 12 to 24 months) 39% were considered to be 'picky' and it was reported that maternal disinhibition and infant temperament scores were significantly higher in the 'picky' group, compared to those not considered to be 'picky'.

2.3.1.3 Distaste, Inappropriate & Danger based rejections

A negative facial response, consisting of turning away, mouth gaping, nose wrinkling, eye squinch and sometimes a gag reflex (Rosenstein & Oster, 1988; Rozin & Fallon, 1987; Rozin, Lowery & Ebert, 1994; Steiner et al., 2001; Vrana, 1993), is

shown from birth to some distasteful substances (Bennett, Bendersky, Lewis, 2005; Rosenstein & Oster, 1988; Rozin & Fallon, 1987; Sullivan & Lewis, 2003). This response remains almost identical in presentation from birth to adulthood (Sullivan & Lewis, 2003). The extent of the reaction induced by a distasteful substance is related to the intensity of the elicitor, e.g. if only a mildly distasteful substance is tasted, then less extreme facial signaling will be shown (Rosenstein & Oster, 1988).

Fallon and Rozin (1983) identified four main motivations for human food rejection; distaste, disgust, inappropriateness and danger. These are fairly self explanatory, with distaste referring to sensory qualities of food items, inappropriate and danger rejections due to the avoidance of non-food substances that may cause harm if consumed, and disgust is the rejection of items based on their nature and origin (Rozin & Fallon, 1987).

Using a story formation method and a hedonic rating scale, Fallon, Rozin & Pliner (1984) tested the response of children aged 3.5 to 12 years, and an adult comparison group, to various items "contaminating" a glass of juice at different stages, e.g. 'poison' falling into the glass to represent danger. While children across the age range rejected at least one item from each of the four categories, the study concluded that the youngest children would reject the drink based mainly on the sensory qualities, i.e. taste. Later, rejections based on anticipated dangers were shown and finally, the older children would reject the items in similar ways to the adults, with disgust appearing to be a motivation from around 7 years of age. However, it is difficult to demonstrate the motivations for the rejection of food in children younger than those in Fallon et al's. (1984) study, e.g. what 'poison' is and the negative consequences of consumption, as sufficient learning and cognitive function is

required for this to be represented by a child (Rozin & Fallon, 1987; Rozin, Haidt & McCauley, 2000). This does not necessarily mean that the motivations do not exist.

While, based on the adult-like cognitive criterion described by Fallon et al. (1987), food rejections due to *danger* do not occur in young children, i.e. young children are not motivated to reject substances containing poison, unless they infer distaste. However, it is proposed that neophobic rejections of new foods are the result of omnivores trying to avoid poisoning from ingesting unknown substances (Cashdan, 1998; Rozin, 1976). Therefore, children do begin to reject foods due to *danger* from around 18 months to 2 years of age.

2.3.1.4 Overview of disgust

Rozin and Fallon (1987, p. 23) defined disgust as the "revulsion at the prospect of (oral) incorporation of an offensive substance. The offensive objects are contaminants; that is, if they even briefly contact an acceptable food, they tend to render that food unacceptable". Human diets can vary from person to person due to exposure (Logue & Smith, 1986; Pliner, 1982; Wardle et al., 2003; Wardle et al., 2003b), ideology (Rozin, 1990) and culture (Cashdan, 1998; Logue & Smith, 1986). As a result, what is viewed as disgusting also varies from person to person. Some fairly universal disgust items have been identified, such as faeces and rotting flesh (Angyal, 1941; Curtis & Biran, 2001; Rozin & Fallon, 1987), but apart from these, while there are similarities, what is seen as disgusting seems to be a learnt, socially and culturally mediated, response (Curtis & Biran, 2001).

Disgust is generally viewed as a basic human emotion (Darwin, 1965) and, as such, the feeling of disgust is usually accompanied by a characteristic facial response similar to that produced by distaste. Furthermore, as with distaste, the facial response

to disgust varies, dependent on the stimuli (Rozin & Fallon, 1987). The similarities between distaste and disgust have led some researchers to suggest that disgust could have developed from distaste (Fallon et al., 1987; Rozin, Haidt & McCauley, 1999; Torochuk & Ellis, 2007).

2.3.1.4.1 Properties of "Disgusting" items

When describing substances that can cause a disgust response, Rozin and Fallon (1987) suggest that a number of elements are present; the main reason for a person's revulsion is the nature or origin of the item and, though not generally considered harmful, there are sensory objections to the substances, for example; taste, appearance or odour. The substances could be disgusting on ideational grounds, they may result in an adverse affect, and eating such substances might produce nausea. Furthermore, the fundamental feature of a disgusting substance, as described by Rozin and Fallon is that it has contaminating effects, that is, if it touches a liked food, it is likely to render that food inedible. This effect can occur through trace contamination, where physical contact leaves trace amounts of the offensive substance on a liked food, or associational contamination, where there is no physical trace but an association results in the food being undesirable.

2.3.1.4.2 Age of onset for cognitive disgust and contamination

Research into when disgust rejections develop was conducted by Fallon, Rozin and Pliner (1984) who concluded that disgust does not appear as a motivation for rejection until around 7 years of age. However, there are a number of potential problems with this study. Firstly, there was a reliance on story telling to elicit a response. This is both unrealistic and requires verbal ability and memory. Secondly,

the story method was accompanied by pictures which required the children to see each separate image as a sequence of events, whereas they may have just seen them as separate pictures (Fallon et al., 1984). Furthermore, the study used a relatively small sample of upper-middle class participants ranging in age from 3.5 to 12 years which results in limited representations of each group. Overall the methodological problems may have artificially increased the age at which disgust was thought to appear.

Studies have shown that younger children do seem to understand at least the "fundamental feature" (Rozin & Fallon, 1987, p. 567) of disgust; contamination. As adults, we have an understanding that if one item touches another then there has been some exchange of their properties, even if this is invisible to the naked eye. This exchange has the potential to increase or decrease the cognitive value of an item so that if a cockroach touches a drink, even if that cockroach is sterilised, then the drink is rejected, while a shirt worn by a loved one has a magnified value over a washed shirt that was previously worn by a disliked person (Rozin, Millman & Nemeroff, 1986). This follows what is known as the law of contagion, "once in contact, always in contact" (Rozin & Nemeroff, 2002, p. 201).

Children as young as three years often show awareness of the transfer of properties from one item to another, such as sugar dissolving (Rosen & Rozin, 1993), and by four years children show knowledge of the key elements of contamination (Rosen & Rozin 1993; Seigal, 1988; Springer & Belk, 1994; Toyama, 1999; 2000). Children of this age even show a degree of associational contamination; just the proximity of the contaminant is enough to reduce the liking of an accepted substance (Toyama, 1999).

Furthermore, research suggests that the socially mediated element of a disgust rejection may be developing prior to seven years, but is not yet fully ingrained. A

study by Mumme, Gradwohl & Adams-Lariviere (2007) showed that children would often accept a juice drink that clearly had a bug in it when they thought the researcher had not noticed, but they responded with embarrassment when later questioned about why they had been willing to drink the contaminated juice. A study by Toyama (2000) also shows that the response to dropped food may be socially mediated, even by children as young as two years. This suggests that, while children younger than 7 may be *learning* what is "disgusting", the feeling is not yet a true motivation for food rejection.

2.3.1.4.3 Properties of foods can be disgusting

It has been suggested that the rejection of food due to the food's intrinsic properties, as opposed to rejection caused by a disgusting non-food, such as faeces, is due to "animalness/livingness" properties of that food (Rozin & Fallon, 1987). Animals can remind consumers of "livingness", can decay or may have come into contact with other decaying animals or food, and therefore, can evoke a contamination effect. However, "animalness" may not be the only factor. Martins and Pliner (2006) conducted a study to evaluate the reasons for disgust towards both animal and non-animal foods and found that foods maybe considered "disgusting" due to aversive texture. Some of the information in this study, used to elicit participants' responses, required the inference of textural and other qualities from verbal descriptions of the foods visual properties. It was found that knowledge of origin did not affect how disgusting the foods were rated and that inferred aversive texture accounted for more variance in disgust responses than knowledge of "animalness". Furthermore, while novel animal foods, when not controlling for texture, are more likely to be rejected than novel non-animal foods by adults (Martins, Pelchat & Pliner, 1997), this finding

is not replicated in children aged 5-11 years (Pliner, 1994). Therefore, while infants and small children may not find foods disgusting based on knowledge such as "animalness", they may be able to perceive texture based on foods' visual properties and this could be considered "disgusting".

2.3.1.4.4 Sliding scale of disgust

When a negative facial response is elicited by distasteful foods during infancy, research shows that a stronger elicitor will produce a stronger response (Rosenstein & Oster, 1988), that is, the more distasteful the food, the more facial signaling is shown. Disgust responses are also on a continuum from mild to strong (Rozin and Fallon (1987), therefore, a mildly disgusting substance will produce less facial signaling from a person than something that is highly offensive. Martins and Pliner (2006) proposed an account of this by suggesting that the potential to view an item as disgusting could involve *additive effects*. For example, if a food has aversive textural properties, *and* knowledge of origin also causes feelings of disgust, this could result in a more pronounced disgust response than if only one of the factors was present. The findings that fear of a stimulus are related to the level of the disgust induced when that stimulus is presented (de Jong & Merckelbach, 1998; Mulkens, de Jong & Merckelbach, 1996; Tolin, Lohr, Sawchuk & Lee, 1997), could be one such additive variable.

2.3.1.4.5 Fear and Disgust

Previous studies have found that disgust ratings increase in people with a phobia, when the phobia related stimulus is presented (de Jong & Merckelbach, 1998; Mulkens, de Jong & Merckelbach, 1996; Tolin, Lohr, Sawchuk & Lee, 1997), for

example, if a spider is the source of a phobia, the level of disgust reported towards that stimulus increases (Mulkens et al. 1996). As disgust seems to be a food-related emotion, the onset of neophobia could amplify the potential for a disgust response towards food substances.

Food neophobia is considered to be the fear of new foods (Cashdan, 1998; Rozin, 1976). However, there are only a few studies that have investigated whether a correlation exists between food neophobia and disgust. Broman, Nyroos & Nordin (2001) report that there is a correlation between disgust and neophobia in adults and Pliner (unpublished, as cited in Pliner & Salvy, 2006) also found a high correlation between the FNS and a disgust scale. Finally, Martins and Pliner (2005) showed that the willingness to eat *novel* animal and non-animal foods was related to the degree of disgusting properties attributed to the food. Therefore, food neophobia may be related to disgust in the food domain but this has not been investigated in children.

2.3.1.5 Gender differences in propensity for neophobia/disgust

Gender may be important when considering disgust and neophobia. Higher levels of disgust are consistently reported by women than by men (Davey, 1994; Haidt, McCauley & Rozin, 1994; Nordin et al., 2004; Schienle, Schäfer, Stark, Walter, & Vaitl, 2005). However, a gender difference in disgust sensitivity in children has not been sufficiently investigated. The gender pattern for food neophobia is less clear. Higher levels of neophobia scores have been reported in men than in women (Hursti & Sjoden, 1997; Tuorila, Lähteenmäki, Pohjalainen & Lotti, 2001), higher neophobia scores in women than men (Frank & Van der Klaauw, 1994; Alley & Burroughs, 1991) and some studies show no gender differences (Koivisto & Sjoden, 1996; Pliner & Hobden, 1992; Loewen & Pliner, 2000; Nordin et al., 2004). The data

on gender differences in neophobia in children suggests that, while there is a slight increase in reports of neophobia for males, the difference does not reach significance (Cooke, Carnell & Wardle, 2006; Falciglia, Couch, Gribble, Pabst & Frank, 2000).

2.3.1.6 Summary

Food neophobia is thought to be an evolutionary defence against the possibility of ingesting poison (Rozin, 976; Cashdan, 1998). Food neophobia begins to influence dietary intake from around 18 months (Addessi et al., 2005; Cashdan, 1998; Cooke et al., 2003; Harper & Sanders, 1975) when new foods are often rejected and dietary variety can be affected (Cooke et al., 2006; Falciglia et al., 2000; Russell & Worsley, 2008). Neophobia seems to be a true phobia (Galloway et al., 2003; Pliner et al., 1993), children are influenced to varying degrees (Pliner, 1994) and a large part of this variance is explained genetically (Cooke et al., 2007). Finally, it is shown that, via modelling, parents and significant others can influence children's acceptance of food at the neophobic stage (Addessi et al., 2005; Birch, 1980; Hendy, 2002; Hendy & Raudenbush, 2000).

At around the same time as neophobia is beginning to influence intake, parents often report that their child becomes 'picky' rejecting not only new, but also previously accepted foods (Carruth et al., 2004) and dietary variety is also affected (Carruth et al., 1998; Cashdan, 1998; Cooke et al., 2003; Jacobi, Agras, Bryson, Hammer, 2003). As yet, the research is unclear as to whether food neophobia and 'picky' eating are behaviourally distinct (Galloway et al., 2003; Pelchat & Pliner, 1986; Pliner & Hobden, 1992) or not (Potts & Wardle, 1998; Raudenbush, Van Der Klaauw & Frank, 1995).

When examining the motivations for human food rejection Fallon and Rozin (1983) identified distaste, disgust, inappropriateness and danger, all influencing rejection at various points in development up to the age of around 7 years, when 'adult-like' disgust rejections begin to occur. Rozin and Fallon (1987, p. 23) defined disgust as the "revulsion at the prospect of (oral) incorporation of an offensive substance. The offensive objects are contaminants; that is, if they even briefly contact an acceptable food, they tend to render that food unacceptable". However, elements of contamination seem to occur earlier than Rozin and Fallon (1987) propose (Rosen & Rozin 1993; Seigal, 1988; Springer & Belk, 1994; Toyama, 1999; 2000). This, along with the observation that food neophobia is thought to be a *danger* based rejection (Rozin, 1976; Cashdan, 1998) and occurs before "danger" is thought to be a motivation for rejection, suggests that disgust, in a more visual perceptual based form and purely towards food stimuli, may influence food choices earlier than suggested within the literature.

Fear is positively correlated with disgust (de Jong & Merckelbach, 1998; Mulkens et al., 1996; Tolin et al., 1997), therefore, when food neophobia, the fear of new food, begins, there could be a correlating inflation of disgust towards food stimuli, contributing to rejection of food labelled "neophobic" and/or a child being "picky". Furthermore, as described, food neophobia results in the avoidance of new foods; this suggests children have developed a conceptual food category consisting of both known and unknown foods. This could also contribute to food refusal and will be considered in the next section.

2.3.3 Categorisation of food during childhood

The neophobic response results is the rejection of an unknown food on-sight and begins around 18 months to 30 months (Addessi et al., 2005; Cashdan, 1998; Cooke et al., 2003; Harper & Sanders, 1975). Neophobia, therefore, suggests that infants have developed a conceptual food category towards the end of infancy. The rejection of the unknown food is either due to the belief it is a "non-food" or, more likely, the substances are seen as part of the food category, but categorised as "new" or "different" and rejected until fully exposed and the child can be sure of the consequences of ingestion.

A conceptual category is one that does not require a perceptual match between items (Herrnstein, 1990). Assessing whether infants have a conceptual food category is difficult when extrapolating from categorisation studies using data obtained using other stimuli. Mandler and McDonough (1998; 2000) showed that 19-20 month olds have more of a conceptual understanding of artefacts (such as a chair) than natural items (such as an animal or a plant) and this was hypothesised to be due to infants' greater contact with everyday artefacts. However, while food is a natural item, an infant is in contact with various types everyday from birth and, therefore, an early conceptual understanding of food may develop (Nguyen and Murphy, 2003). Furthermore the biological advantages food affords may also contribute to the development of early conceptual food knowledge (Bovet, Vauclair & Blaye, 2005; Rozin, 1990).

Categorisation studies are usually aimed at understanding children's cognitive development and how they form "adult-like" categories (Nguyen and Murphy, 2003), that aim is out of the scope of this thesis. The focus of this thesis is not to consider the debates surrounding children's cognitive categorical development as a whole (see

Mandler, 2000 & Quinn & Eimas, 2000) but whether or not children have developed a conceptual category towards the end of the second year, and what visual elements of food may contribute to whether an infant categorises it as “accepted” or “rejected” (Rozin et al., 1986a).

Studies involving the investigation of food categories have been conducted using pictures of (Bovet et al., 2005; Nguyen & Murphy, 2003), and real, foods (Birch, Billman & Richards, 1984; Rozin et al., 1986b). However, all these categorisation studies were conducted after infancy (barring a small number of children in the study by Rozin et al., 1986b), use differing methodology and report contradicting findings. As explained, theoretically speaking, when infants develop food neophobia during late infancy a conceptual food category has already been established for food. Furthermore, it is likely that food is perceptually evaluated at this age, prior to consumption, in order to categorise it as “accepted” or “rejected”. Food can differ in visually perceived attributes based on changes in its colour, global changes (different shape) or local changes (small colour changes or visually perceived changes in texture). Therefore, it is important to consider if these changes are salient to children around the time of neophobia.

In general categorisation tasks, using sequential touching (a method suitable for categorisation tasks at around 13 to 30 months; around the time neophobia begins), research with toy exemplars e.g. animals, cars, etc, show that infants categorise based on global similarities, e.g. vehicles vs animals, but not on a basic level (see Mareschal & Quinn, 2001 for a review). However, Rakison and Butterworth (1998) found that if non-ecological variants were used, e.g. legs changed for wheels on a car and wheels changed for legs on an animal; infants no longer categorise the items based on global membership but according to these local

changes, i.e. whether the toys had legs or wheels. An extension of this study by Mareschal and Tan (2008) showed that if infants are given a priming task prior to being given hybrid variants, the items will not be categorised by their functional parts. Hybrid tasks conducted in this way lack ecological validity and may confuse the children (as they do adults; Maraschel & Tan, 2008). However, it would be interesting to see if infants categorise foods based on global, local or colour variations where the changes may not be non-valid.

2.3.3.1 Potential influence of global, colour and local changes

Humans and animals often take into account similarities in shape when categorising both animate and inanimate items (Biederman, 1987; Brown 1990; Gelman, 1990; Mandler, 1992). Navon (1977, 1981, 1983) showed that when humans are presented with a series of small letters (local features) that, together, make up a different large letter (global feature) they quickly identify the global feature and are unaffected by the local feature. However, when asked to focus on the local feature, they were slower to respond due to their focus on the global whole. Children are also inclined to show a global shape bias, over colour, when categorising objects. Inferring from reaction times and eye movements it was found that, despite being a slower process, global shape was utilised when categorising known objects (Farnham-Diggory & Gregg, 1975).

A possible exception to this global focus could be ecologically valid stimuli such as food (Addessi et al., 2005; Macario. 1991; Santos, Houser & Spelke, 2001). Santos et al., (2001) found that, rather than attending to the global shape, when approaching new foods, rhesus monkeys attended to colour cues. Santos et al. hypothesise that this is due to the potential for foods to change global shape while

remaining edibile (see also; Macario. 1991). However, changes in the *colour* of foods can give an external indicator of internal goodness. Animals need to quickly develop an understanding of food, and the visual properties of food, for a biological benefit (Bovet et al., 2005; Rozin, 1990). As omnivores, there is a need to eat an array of food but to also understand the potential for edible looking substances to have high levels of toxicity. A study looking at the effects of modelling, a process which has been shown to encourage others to try new foods, and therefore reduce the neophobic response, showed that the modelling effect occurred significantly more often when the food eaten by the model was the same colour as the food offered to the child (Addessi et al., 2005).

Errors when selecting food can easily lead to death (Galef, 1988, 1990; Rozin, 1976, 1990) and this is more likely to occur when the child becomes mobile, hence the predisposition for food neophobia (Rozin, 1976). With the colour offering the potential to indicated foods toxicity (Santos et al., 2001), colour variations may be salient to children, especially when food neophobia develops (from around 18 months).

In terms of local changes to the visual properties of food, e.g. burnt edges; no studies have been conducted with children. However, local changes such as these are likely to result in some sort of change to the textural property of the food and, subsequently, a flavour change (Nijhuis et al., 1998). So, while global categorisation of items is usually favoured, within food sorting tasks, the influence of colour and local changes should be investigated.

2.3.3.2 Summary

The neophobic response, beginning in late infancy, suggests that infants have developed a food category and are rejecting those foods that they do not recognise. However, there is a paucity of research examining the way in which food is categorised in infancy, despite the biological advantages of developing an early understanding of food (Bovet et al., 2005; Rozin, 1990).

Adults, children and animals have been shown to largely rely on global shape features when categorising (Farnham-Diggory & Gregg, 1975; Navon, 1977, 1981, 1983) However, this may not be the case for ecologically valid stimuli, such as food (Addessi et al., 2005; Macario. 1991; Santos, Houser & Spelke, 2001). Local, global and colour changes could all impact on the evaluation and categorisation of food and these feature changes may be relevant to food rejection during the neophobic period when many parents also judge their child to become 'picky' (Carruth et al., 2004; Kim et al., 2006).

2.4 Overall Summary and future directions

Towards the end of the second year of life infants develop food neophobia (Addessi et al., 2005; Brich et al., 1987; Cashdan, 1998; Cooke et al., 2003; Harper & Sanders, 1975) thought to be an innate predisposition to avoid poisoning when becoming more mobile and independent (Cashdan, 1998; Rozin, 1976). At this point new foods are often rejected but parents also report the rejection of known and previously accepted foods (Carruth et al., 2004). In combination, these two types of rejection are usually considered to be the basis of 'picky' eating and by around 20 months up to 50% of infants are deemed 'picky' by their parents (Carruth et al., 1998; Carruth et al., 2004; Galloway et al., 2003; Kim et al., 2006).

The result of food neophobia and 'picky' eating is reduced dietary variety which is characterised by a more unhealthy diet in general (Cooke et al., 2006; Falciglia et al., 2000; Russell & Worsley, 2008). It is, therefore, important to consider the aspects that could result in children's increased rejection of food in late infancy. Based on a review of current literature four factors have been identified that may contribute to this increased rejection and these require further investigation:

1) Early influences on later acceptance/rejection of food

It seems that there are important periods for exposure to new foods (Birch et al's., 1998; Skinner et al., 2002), a potential increase in dietary variety in the second year if wider variety is given in the first year (Birch et al's., 1998; Skinner et al., 2002) and continued feeding problems can occur as a result of interruptions to the weaning process (Johnson & Harris, 2004; Dahl, 1987). Overall, the first year is a sensitive period for infants to learn about food (Cashdan, 1994). It would be valuable to investigate whether these early aspects could influence the impact of food neophobia and 'picky' eating behaviours during infants' second year of life.

2) Onset of food neophobia and 'picky' eating

'Picky eating' incorporates the rejection of both new *and* previously accepted foods (Carruth et al., 1998; Carruth et al., 2004; Galloway et al., 2003). While neophobia is defined as the fear/avoidance of new foods (Cashdan, 1998; Rozin, 1976), the concurrent element of food rejection, rejecting known and previously accepted foods, which is investigated in 'picky' eating literature (Carruth et al., 1998; Carruth et al., 2004; Galloway et al., 2003) has not been isolated and examined as a separate incidence. Only one paper has directly examined whether neophobia and

'picky' eating are even separate constructs (Galloway et al., 2003). However, this paper only included 7 year old girls from high SES backgrounds and only accounted for 15% of the variance in picky eating and neophobia. The conclusion that the constructs are behaviourally distinct (Galloway et al., 2003; Pelchat & Pliner, 1986; Pliner & Hobden, 1992) has not been confirmed (Potts & Wardle, 1998; Raudenbush, Van Der Klaauw & Frank, 1995). Therefore, *the rejection of previously accepted foods,* at a time in which neophobia is thought to begin, and reports of 'picky' eating increase, towards the second year (Addessi et al., 2005; Birch et al., 1987; Cashdan, 1998; Cooke et al., 2003; Harper & Sanders, 1975), should be examined explicitly.

Food neophobia seems to be a true phobia (Galloway et al., 2003; Pliner et al., 1993). As a result, young children are likely to have increased perceptual focus on the food presented in order to identify what they are eating and reduce their anxiety. Due to this, two aspects may be of importance in determining why infants begin to reject previously accepted food at around the same time as they begin to reject new foods; (i) the features of food that are salient when categorising food and (ii) whether an increase in anxiety could increase the potential for disgust towards food.

3) The categorisation of food in the second year of infancy

The categorisation of food during late infancy has not been investigated, despite the inference of food neophobia suggesting the development of a conceptual food category at around this age. Furthermore, Adults and older children, while favouring global shape when categorising most objects (Farnham-Diggory & Gregg, 1975; Navon, 1977, 1981, 1983), may adapt their focus when categorising ecologically valid stimuli, such as food (Addessi et al., 2005; Macario. 1991; Santos et al., 2001). The investigation of whether local, global or colour changes to food

stimuli could be salient to children in late infancy may be worthwhile when considering food rejection during the neophobic period.

4) Disgust as a motivation for rejecting food

Anecdotal reports suggest that food can act as a contaminant during early childhood (Cashdan, 1998; Harris, 2000; Rozin, 1990). However, studies report that disgust is not a motivation for the rejection of food until around 7 years of age (Fallon & Rozin, 1987). The potential to contaminate is key to disgusting stimuli; therefore, while a non-food substance, such as faeces, may not evoke disgust in a child, food may have the potential to do so. This also requires further investigation.

2.5 Broad aims of the present thesis

The aim of this thesis is to examine an area of food rejection that has not been directly investigated before; the rejection of previously accepted food during late infancy. This will be achieved via the stages outlined below:

1) The first step will be to examine the prevalence of the rejection of previously accepted foods and record any initial patterns, e.g. food types rejected, age of onset etc. As up to 50% of parents reported their child as a 'picky' eater during infancy (Carruth et al., 2004) and the rejection of previously accepted foods is part of the 'picky' eating definition, it is hypothesised that a high proportion of parents will report that their child has rejected a previously accepted food. Furthermore, it is hypothesised that the age of onset will be around 18 to 24 months, when neophobia is likely to have begun. The most rejected, previously accepted, foods will be fruit, vegetables and mixed foods, as reported in previous literature to be highly rejected

food categories during childhood (Cashdan, 1998; Carruth et al., 1998; Jacobi et al., 2003). And finally, it is hypothesised that children who are reported to have had interruptions to the introduction of solids in the first year of life, children who are reported to have higher food neophobia and children with higher 'picky' eating scores will be more likely to have rejected a previously accepted food.

2) The two hypotheses presented in this thesis are both based around food neophobia. During the second year of life, visual features of food stimuli are likely to become salient as the child wishes to recognise the food given and lower his/her anxiety prior to consumption. Perceptual mismatches, between the visual properties of the food given and the child's expectations, based on children's previous experience, may lead to (i) the food is categorised as "new" or "different" and rejected in a neophobic response. As a result the way in which young children categorise food will be examined. It is hypothesised that infants will have a conceptual category for food items, i.e. they will be able to sort items that represent foods as different from those representing animals, and that children will be able to visually categorise between those foods that they are reported to like and the foods they are reported to dislike. Furthermore, the ability of infants to categorise foods in a basic form (i.e. fruit as different to biscuits) will be tested. A final set of conditions will test the hypothesis that global, local and colour changes are salient features when categorising foods.

3) Finally, the thesis will examine hypothesis two; (ii) the onset of food neophobia increases the potential for disgust, subsequently, visual mismatches are perceived as aversive and, therefore, result in rejection. It is observed that disliked food can act as a contaminant (Cashdan, 1998; Harris, 2000; Rozin, 1990; Timimi,

Douglas & Tsiftsopoulou, 1997) a key element of disgust (Rozin & Fallon, 1987). The aim of this thesis is to develop methodology with which these observations can be examined in childhood, under experimental conditions. This may offer a proxy measure of the potential for disgust to influence rejection earlier than is currently proposed. It is hypothesised that, during infancy and early childhood, food can act as a contaminant and, therefore, may be characteristic of a disgust stimulus.

The present thesis will be the first to research directly the rejection of previously accepted food during early childhood. Studying this aspect of food rejection has a number of implications and applications for both the understanding of acceptance and rejection of food during early childhood and in helping to widen children's dietary variety and consumption of fruit and vegetables. The hypotheses presented in this review suggest that the rejection of previously accepted food is likely to be a common occurrence and a normal developmental stage. However, current terms that incorporate this type of rejection, such as 'picky' eating, suggest that certain children are different to the 'norm' or what is expected from a child of that age. There is little research into normative food rejection in infancy and research such as the work presented in this thesis 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 development. Furthermore, the aim of the research is to provide a greater understanding of food neophobia and the ways in which it can affect children's acceptance of food beyond just the avoidance of new foods.

CHAPTER 3

GENERAL METHODOLOGY

3.1 Introduction to general methodology chapter

The current thesis has used a number of different research samples and study methodologies, both existing and new techniques, in order to investigate the overall research question. Each individual study write-up will include a method section detailing the samples used, study design and an outline of the data analysis procedure. However, a variety of questionnaires were used in the studies and these will be described here and their use justified in more detail.

3.2 Standardised questionnaires

Several standardised parental report questionnaire measures were used to assess their relevance to data pertaining to the research question addressed within that study. These questionnaires measure children's food neophobia, 'picky' eating, willingness to try new foods and sensory sensitivity. The following section provides detailed descriptions of these questionnaires, where they appear within the thesis and why they were used.

3.2.1 Adapted Children's Food Neophobia Scale (C-FNS; Pliner, 1994)

A measure for the trait of food neophobia was originally developed by Pliner and Hobden (1992) and later adapted to apply to children (Pliner, 1994; C-FNS). The Food Neophobia Scale (FNS) assesses individual differences in the trait of food neophobia. The scale has been shown to have good reliability and validity and can predict people's willingness to try novel foods (Arvola, Lähteenmäki & Tuorila,

1999; Bäckström, Pirttilä-Backman & Tuorila, 2004; Falciglia, Pabst, Couch & Goody, 2004; Flight, Leppard & Cox, 2003; Hobden & Pliner, 1995; Hursti & Sjödén, 1997; Falciglia, Pabst, Couch & Goody, 2004; Hobden & Pliner, 1995; Martins, Pelchat & Pliner, 1997; Pliner & Hobden, 1992; Pliner, 1994; Raudenbush & Frank, 1999). The questionnaire has ten items (half of which are reversed) and are answered on a 7-point likert scale from "very much like my child" to "extremely unlike my child". These scores are summed to give a food neophobia score ranging from 10-70, the higher the score, the higher the reported food neophobia.

In order to make the FNS more appropriate across nationalities and cultures Russell and Worsley (2008) and Flight et al. (2003) removed the use of the word "ethnic" due to the lack of relevance within the Australian culture. Due to the high reliability (Pliner, 1994), its use with similar age groups (Cooke et al., 2003; Russell & Worsely, 2008) and the appropriateness of altering 'ethnic' within samples from Birmingham and North London, two ethnically diverse areas of the UK, this adapted 10-item C-FNS was used for Study Four.

In a study that directly examined the cultural validity of the FNS, Ritchey et al., (2003) advised the removal of at least two items in order to increase the applicability of the questionnaire across nationalities. This study also showed that a 6-item version may be a viable one; this was later used by Knaapila et al. (2007) in one of the first investigations into the heritability of food neophobia in a twin study. A six-item version of the C-FNS is now commonly used with British samples in order to remove items that may lack relevance to younger participants (Cooke et al., 2004; Cooke et al., 2006; Wardle, Carnell & Cooke, 2005). However, while this may have offered a suitable alternative for Study four, the full 10-item version was chosen to

provide a wider measure of food neophobia and in the belief that all 10-items had relevance.

A final alteration of the C-FNS resulted in a four-item questionnaire and was used in the only large scale twin study of food neophobia during childhood (Cooke et al., 2007). The four item version has a high Cronbach's (0.88) and the items were selected on the basis that they represent those most relevant to new foods. The scale is measured by parental response on a 4-point scale from "strongly disagree" to "strongly agree", one of which is reversed. These scores are then used to calculate a mean, and a higher mean score indicates a higher propensity to reject novel foods. Due to the increased cultural and national relevance, the increased focus on items relevant to *new* foods, the practical ease of using a four-item questionnaire to reduce time taken for parents responding to multiple questionnaires and the fact that reliability remains high, the Cooke et al., (2007) 4-item version of the C-FNS (Pliner, 1994) was used to measure food neophobia in the second part of Study one (Appendix B).

3.2.1.1 Other food neophobia measures

While the food neophobia scale (FNS; Pliner & Hobden, 1992) is the most commonly used measure of food neophobia, other measures do exist. The Food Attitude Scale (FAS; Frank & Van der Klaauw, 1994; Raudenbush, Schroth, Reilley, & Frank, 1998) is a list of 455 foods and drinks (some fictitious) on which participants rate their willingness to try, and their like/dislike of the foods, and also includes 20-items asking for information on attitudes towards food. However, while this scale correlates well with the FNS (Raudenbush et al., 1998), the FAS has not been adapted for work with young children.

The only other direct measure of food neophobia commonly used with children is the Food Situations Questionnaire (FSQ; Loewen & Pliner, 2000). This questionnaire measures children's willingness to try novel foods in both stimulating environments, such as away from home and festive occasions, and non-stimulating environments, such as normal, home-based mealtimes, and has been shown to predict willingness to try new foods better than the C-FNS in a laboratory setting (Loewen & Pliner, 2000). However, this measure is a self-report questionnaire for children and, as the use of the C-FNS was for children aged between 12 months and 5 years within this thesis, the parentally reported C-FNS was chosen.

3.2.2 'Pickiness'/willingness to try measure

The picky eating questionnaires used for the second part of Study One was a 3-item 'picky' eating questionnaire (Birch et al., 2001; Galloway et al., 2003, 2005) (Appendix C). This was included because of its previous use with a varied age range and is commonly utilised as a picky eating measure.

The 'picky' eating measure being used for study six is a measure of both 'picky' eating and willingness to try new foods (Appendix D). The measure has been validated (Carruth et al., 1998) and used when assessing both 'pickiness' (Carruth et al., 1998) and the acceptance of different textures (Blossfeld et al., 2007) within an infant sample. The questionnaire has a total of nine statements, rated along a likert scale of 1-7, gives mean scores for 'pickiness' and 'willingness to eat' and is an age appropriate measure for this study. For the purposes of this thesis, 'picky' eating is defined as the increased likelihood of rejecting some *new and previously accepted foods* (Carruth & Skinner, 2000; Carruth et al., 1998, Galloway, Fiorito, Lee & Birch, 2005; Li, Shi, Wan, Hotta & Ushijima, 2001; Potts & Wardle, 1998; Rydell, Dahl &

Sundelin, 1995; Smith, Roux, Naidoo, & Venter, 2005), themes that are measured in each of the picky eating questionnaires used.

3.2.3 Sensory Profile

Individuals vary in their sensitivity to perceived sensations, and respond to sensory information in different ways (Dunn, 1999). These differences may influence the acceptability of food through differing perceptions of taste (Drewnowski et al., 1997), texture (Blossfeld et al., 2007; Northstone et al., 2001; Smith, et al., 2005) or visual sensitivity and/or increased potential for disgust and neophobia (see Chapter 2, section 2.3.1.1.5). Furthermore, sensation seeking has been shown to negatively correlate with food neophobia (Loewen & Pliner, 2000; Pliner & Hobden, 1992; Raudenbush et al, 1995). Due to these potential sensory influences on food acceptance, a measure of sensory sensitivity has been used in a number of the studies presented in the current thesis.

A measure of sensory profile was used in two studies. Firstly, Study Four examined the potential for food to act as a contaminant in children aged 4 to 6 years. In order to examine whether or not a child's sensory profile could have an effect on contamination sensitivity, the short sensory profile was used (SSP; Dunn, 1999) (Appendix E). The questionnaire asks for a 1-5 response ranging from "Always" to "Never" for 38 statements and is filled out by a caregiver. Secondly, Study Six used the Infant/Toddler sensory profile (Dunn, 2002) (Appendix F). This questionnaire is also completed by the caregiver and contains 48 statements relating to children's daily experiences of sensory information, responded to on a 5 point scale from "almost always" to "almost never".

While these sensory profile measures were established for work with clinical groups, they have been used for research with non-clinical samples (Ahn, Miller, Milberger & McIntosh, 2004; Coulthard & Blissett, 2009) and have been shown to relate to food experiences (Coulthard & Blissett, 2009). These measures provide validated, caregiver questionnaires that relate to a number of elements of interest to the current thesis (e.g. taste/smell sensitivity, visual sensitivity and sensation seeking) and are age appropriate.

3.2.3.1 Other Sensory Profile measures

Other caregiver questionnaires relating to sensory profiles are available. The Evaluation of Sensory Processing (ESP; Johnson-Ecker & Parham, 2000) is a 76-item questionnaire and is used with children aged 2 to 12 years. As the infant studies in this current thesis have participants aged 18 to 25 months, this measure was unsuitable. The Sensory Sensitivity Questionnaire-Revised (SSQ-R; Talay-Ongan & Wood, 2000) measure is specifically designed for use with children who have autism and, therefore, may have less generalisability. The SSQ-R scale has also been used with school aged children (4- to 14- years; Talay-Ongan & Wood, 2000) slightly above the mean age used in study five.

Finally, the Sensory Experiences Questionnaire (SEQ; Baranek, David, Poe, Stone & Watson, 2006) offers a similar structure as the infant/toddler sensory profile (Dunn, 2002) and may have provided a suitable alternative. However, this questionnaire was mainly created to screen for autism and developmental delays, therefore, the Dunn measure may be more valid for non-clinical groups. Furthermore, the SEQ is for use with children aged 5 to 80 months so the sensory profile is more age specific.

3.3 New Questionnaires

As this thesis is addressing a question yet to appear within the literature some new questionnaires were required to obtain potentially important data. These consisted of questions relating directly to the rejection of previously accepted foods and a questionnaire created to elicit data about early feeding experiences that may have relevance to later food rejections (see Chapter 2, sections 2.2.3 and 2.2.5). This early experiences questionnaire was used in multiple studies and is detailed below.

3.3.1 Early Experiences Questionnaire

Appendix G is an example of the Early Experiences Questionnaire (EEQ) used in studies one and six of the current thesis. The items were created to elicit information on 10 factors regarding infants' experiences with food in the first year of their life, which may be of importance in later food acceptance/rejection and were decided upon after an extensive review of feeding literature. The questionnaire ascertains whether the infant was breastfed, bottle fed or a mixture of the two (Cooke et al., 2004; Rasmussen et al., 2006), when solids were introduced (APA, 2005; Clark & Laing, 1990; DoH, 2006; European Commission, 2004; Harris, 1993; Mason, Harris & Blisset, 2005; WHO, 2003), whether breastfeeding continued after the introduction of solids (Skinner et al., 2002), whether lumpy solids were introduced before or after 10 months (Blossfeld et al., 2007; Northstone et al., 2001), whether children were predominantly weaned on homemade or pre-purchased foods (Birch et al., 1998), about any interruptions to weaning due to illness (Johnson & Harris, 2004; Dahl, 1987), whether any dietary restrictions were in place, and a general question on the *variety* of exposure the infant had within the first year (Birch et al., 1998;

Capretta, Petersik & Stewart, 1975; Skinner et al., 2002). These factors have all appeared within the literature as potentially influential determinants of dietary variety.

As well as the above literature in support of the individual information sought via this questionnaire, a study by Blossfeld et al. (2007) also collected information on early dietary experiences when investigating 12-month-old infants acceptance of different textures. This study asked about breast and bottle feeding, age of introduction of solids, avoidance of certain foods, familiarity with textures and at what age they were introduced, and also a measure of general variety of exposure.

3.3.2 Surveys for the rejection of previously known and accepted foods during early childhood

The aim of study one (Chapter four) was to establish an estimated prevalence for children rejecting previously accepted foods, and to look at the initial patterns for this type of rejection. In order to do this a survey questionnaire was produced. This was used in part one of the study on a national sample of nurseries (Appendix H). A follow-up (part two of study one) used a slightly altered version of the questionnaire (Appendix I) with a single nursery sample and used a more explicit definition of the rejection of a previously known and accepted food. This was done to determine whether the incidence of this type of rejection was related to food neophobia and/or 'picky' eating.

3.6 Summary

A total of nine questionnaires were used within this thesis. Of these, one was used in multiple studies. The questionnaires were chosen based on age appropriateness and prior use within similar research. As this thesis is the first

research to directly examine the rejection of previously accepted foods, the questionnaires were used to try to ascertain relevant determinants and to help guide future research into the subject.

CHAPTER 4

THE REJECTION OF KNOWN AND PREVIOUSLY ACCEPTED FOOD DURING EARLY CHILDHOOD; INFLUENCE OF CATEGORISATION

This thesis is the first work to directly examine the rejection of known and previously accepted food during early childhood and will examine the potential of two influences; food categorisation and the onset of disgust. The current chapter will address the issue of prevalence and will present categorisation data. Disgust will then be considered (Chapter 5).

This chapter aims to investigate the prevalence, as reported by caregivers via a questionnaire, of *the rejection of known and previously accepted foods* during early childhood and hypothesise why this may begin to occur (study one). The chapter will then present two further studies that address various aspects of food categorisation during childhood. Study two will consider early categorical knowledge of food during infancy to show if infants have a conceptual category of food, examine infants understanding of basic food categories, to see if infants can visually categorise those foods they are reported to like and dislike and the potential influences of local, global and colour changes to food when categorising. Study three will consider the onset of cultural categorisation of food. This will serve two purposes; to try to demonstrate the extent of understanding young children have with food (learnt, implicit food rules) and examine whether there is a benefit of presenting actual foods, as opposed to pictures/toys, when looking at children's understanding of how food is categorised.

STUDY ONE

REJECTION OF PREVIOUSLY ACCEPTED FOODS DURING EARLY CHILDHOOD: AN EXTENSION OF THE NEOPHOBIC RESPONSE?

Abstract

This study was the first to examine the prevalence of the rejection of previously accepted foods in early childhood, and presents a number of significant findings. Using a parental questionnaire specifically designed for this study, it was found that the rejection of previously accepted food commonly occurs among children of nursery age, has an onset of around 21 months, reduces in frequency after 30 months and most often involves the rejection of vegetables, mixed foods or fruit.

It was hypothesised that the reason for the rejection of previously accepted foods is an extension of the neophobic response. When neophobia begins, infants become hyper-vigilant to the visual perceptual features of food in order to recognise what is being given. Foods that do not match learnt, prototypical expectations, due to local or global changes between servings, can be categorised as “new” or “different” and therefore rejected in a neophobic response. Implications of these findings are discussed.

REJECTION OF PREVIOUSLY ACCEPTED FOODS DURING EARLY CHILDHOOD: AN EXTENSION OF THE NEOPHOBIC RESPONSE?

Around the time that food neophobia begins (18- to 24- months) parental reports suggest that children start to reject new foods, and some known and accepted foods, on sight (Carruth & Skinner, 2000; Carruth et al., 1998; Galloway et al., 2003). This phenomenon of rejecting foods that were previously accepted 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 (Carruth & Skinner, 2000; Carruth et al., 1998; Galloway et al., 2003).

Only two studies have measured 'picky' eating in infancy (Carruth, Zeigler, Gordon & Barr, 2004; Kim et al., 2006) and these studies suggest that, by 19 months, up to 50% of infants are categorised as 'picky' by their parents (Carruth et al., 2004). 'Picky' eating research across ages shows that infants and toddlers who are categorised as 'picky' have less dietary variety, with vegetables reported as a highly rejected food group (Carruth et al., 1998; Jacobi, Agras, Bryson, Hammer, 2003), along with fruit (Cooke et al., 2003) and "mixed" foods (Cashdan, 1998).

When accounting for the reason why infants become 'picky' Carruth et al. (1998) offer two explanations. Firstly, it could be that that the parents of 'picky' eaters do not offer their children enough exposures to a target food. Research shows that foods need to be given 10-15 times to increase liking significantly (Birch & Marlin, 1982; Loewen & Pliner, 1999), but reports suggest that parents of children who are deemed 'picky' do not expose their children to new foods this often (Carruth et al., 1998; Carruth et al., 2004). While the provision of only limited exposure to a new food could explain some of the children's subsequent food rejections, there was

no difference in the number of times a new food was offered before parents decided a food was not liked, between the 'picky' group and those who were not categorised as 'picky' (Carruth et al., 2004). Secondly, Carruth at al. (1998) suggest that toddlers have a desire for independence and this contributes to their 'picky' eater status. Carruth et al. (1998) quote mothers descriptions of the frustrations felt by parents of these children, as support for this hypothesis.

As mentioned above, the rejection of food is usually done *on sight*; this suggests that when an infant rejects a previously accepted food it may actually be due to the visual perceptual qualities of that food. Food neophobia increases anxiety about food stimuli (Galloway et al., 2003; Pliner, Eng & Krishnan, 1995; Pliner & Hobden, 1992; Pliner, Pelchat & Grabski, 1993) and, therefore, the perceptual features of the food may become more salient as the child wishes to recognise the foods given. If the child has developed a prototypical expectation of a particular food, based on their learnt experience of food preferences brought about via exposure (Birch et al., 1998; Birch & Marlin, 1982; Birch et al., 1987; Nicklaus et al., 2005; Pliner, 1982; Wardle et al., 2003a; Wardle et al., 2003b), and the meal presented offers a perceptual mismatch to that expectation, the food may be categorised as "new" or "different" and rejected in a neophobic response, rather than in an attempt to establish independence.

Evidence exists to suggest that toddlers do have a preference for easily identifiable foods, eaten one at a time, over mixed foods, or foods in a sauce (Cashdan, 1998). This may be because children want to recognise the foods they consume to aid food learning, or to be able to identify the consequences of ingesting specific foods (Cashdan, 1998). The foods that were being reported as rejected by the infants deemed 'picky', were vegetables (Carruth et al., 1998; Jacobi et al., 2003),

fruit (Cooke et al., 2003) and mixed foods (Cashdan, 1998) which are all prone to local, colour and global changes in appearance between servings.

Furthermore, infants who are highly sensory 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 some even have a desire for same bowl (Schreck, Williams & Smith, 2004; Williams, Gibson & Schreck,. 2005). Although children with autism do have a more general desire for "sameness" than normally developing children, this selective eating begins at around 18 months (Williams et al. 2005), 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 seems to be an extreme expression of the neophobic or 'picky' response (Carruth et al., 1998; Carruth et al., 2004; Williams et al., 2005).

The questionnaire study presented here is the first explicitly to investigate rejection of previously accepted foods. The aim of the study was to quantify the prevalence of children reported as rejecting previously accepted foods and to assess any initial patterns of rejection such as the age of onset, and the type of food being rejected. The final aim was to determine whether these initial patterns support the idea that the onset of neophobia, and problems with visually categorising foods, could explain any increase in the rejection of previously accepted foods during childhood.

Hypotheses

Based on previous research examining 'picky' eating (Carruth & Skinner, 2000; Carruth, et al., 1998; Galloway et al. 2003) it was hypothesised that the rejection of previously accepted foods would be reported to have occurred in a

statistically significant number of nursery age infants in this sample. It was also hypothesised that rejection of previously accepted foods would begin to be reported significantly more often at around the age of 18-24 months, when up to 50% of parents consider their child to be 'picky' (Carruth et al., 2004; Kim et al., 2006). In line with the proposal that the reason for this type of rejection is that foods do not match visual perceptual expectation, it was hypothesised that the rejection of previously accepted foods would reduce with age as the child has more exposure (Birch et al., 1987), and therefore, greater knowledge and understanding of foods (Cashdan, 1998), and more in depth knowledge of food categories (Nguyen and Murphy, 2003). Finally, it was hypothesised that, as previous research has shown, vegetables (Carruth et al., 1998; Jacobi et al., 2003), fruit (Cooke et al., 2003) and mixed foods (Cashdan, 1998) would have the highest reported frequency of rejections.

Method

Nationwide sample

This phenomenon has not been explicitly researched before; therefore a questionnaire was specifically designed for this study (Appendix H). The questionnaire items were selected with the main aim of quantifying the number of parents that report their child as having rejected a previously accepted food. Further questions were produced to record the most recent occasion the child has rejected a previously accepted food, the regularity with which it occurs and to elicit the type of food, colour and texture that was rejected. Finally, a question is asked to see if parents identified a single food rejection or the rejection of an entire meal. An initial pilot draft of the questionnaire was given to the parents of children attending a local

nursery (N = 3), and to parents of nursery aged children at the University of Birmingham (N = 5), to test the questions for *ease of understanding*. In response to some of the feedback received, the questionnaire was altered (three questions were re-worded) and the questionnaire was given out again for the opinions of a further 5 members of University staff. The feedback from this second pilot suggested that the questionnaire was sufficiently clear for its intended purpose.

A total of 10 700 questionnaires were printed and sent to 202 day nurseries across England, which cater for pre-school children up to the age of around 5 years, to 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 and we relied on nursery managers willingness to hand out the questionnaires, therefore, we have no information of how many actually reached parents. If all the questionnaires were received, the response rate would be just 3.2%.

The ages of the children whose parents returned the questionnaires ranged from 6 to 68 months (N = 312; 156 female, 153 male, 3 not reported) and the children's ethnicity consisted of 165 White – British, 56 (British, not specified), 39 (White, not specified), 17 Asian - British, 17 origin not reported, 9 mixed race (White/Black), 4 mixed race (White/Asian), 3 Black – British, 1 East Asian and 1 mixed race (White/East Asian). 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, was also offered.

Single Nursery Sample

Due to the cost and logistics of sending out the questionnaires to 202 nurseries, only a single page questionnaire could be used. After data collection and analysis was conducted on the nationwide sample, a further set of questionnaires were sent to a nursery in Preston (UK). This questionnaire used a slightly refined set of questions for the Rejection of Previously Accepted Foods including a definition of what a previously accepted food consisted of ("The rejection of a food you considered your child to readily accept as part of his/her diet") and also included a 3-item 'Picky' eating measure (Galloway et al., 2003), which had a Cronbach's α of .87, a 4-item food neophobia measure (Cooke, Haworth & Wardle, 2007), which had a Cronbach's α of .88, and some questions relating to the child's early food experiences (Appendix I, F, B & E, respectively). The aim of this questionnaire was to try to increase response rates, to enable more reliable prediction of prevalence, to investigate whether those children who are reported as having rejected a previously accepted food have higher 'picky' and/or food neophobia ratings, and to investigate whether some early food experiences (in particular difficulties in the transition to solids) affect the likelihood of a child rejecting a previously accepted food.

Based on the data collected from the first questionnaire, this new set of questionnaires was offered to the parents of children aged 1 to 5 years. 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.

Nationwide Sample Data input

A total of 347 questionnaires were returned. The data from any parent whose child was reported as ill at the time of rejecting a previously accepted food were removed from the data set (N=27), the data for children over 5 years of age were removed (N=6) as the aim was to investigate this incidence in pre-school children. Finally, 2 participants were removed as 'milk' was reported as the rejected, rather than a solid food. All data were analysed using SPSS version 14.

The sample in this study had a wide age range (6 months to 5 years) of children attending pre-schools, with a mean age of 31.97 months (N = 312). In order to calculate a *likely age of onset* for when rejection of previously accepted foods may begin, the data outside of the 6 to 30 month-old group were omitted as there was no increase in the level of reported rejection of previously accepted food after this time (See fig. 4.1.1). Inclusion of the entire data set was likely to have inflated the age of onset. When calculating a likely age of onset for the rejection of previously accepted foods the data were non normal, therefore a Mann-Whitney test was conducted. Where the data was normal, parametric tests were favoured over non-parametric.

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 (Infant & Toddler Forum, 2008). 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-reliability score of .08 (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 and agreed on the most likely textural category. Missing data was coded as such in SPSS.

Where theory or previous research did not suggest a direction for the hypothesis, two-tailed tests were used. However, as there is an increase in 'picky' eating and food neophobia around 18- to 30 months, which then reduces (Addessi et al., 2005; Cashdan, 1988; Cooke et al., 2003; Harper & Sanders, 1975), age and frequency of rejections used one-tail hypotheses.

Single Nursery Sample Data input

Data for a total of 104 children were returned, with a 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 missing critical data (i.e. gender, date of birth etc) (N=1), giving too few responses (N= 2), or giving inconsistent responses (N= 10). This resulted in 89 responses and a final response rate of 62.5%. The data was non-normal and, therefore, non-parametric tests were used.

Parental reports of 'picky' eating were recorded using a 3-item questionnaire (see Galloway et al., 2003). The scores for children's pickiness were compared using a Mann Whitney test to see if those children reported as having rejected a previously accepted food, are also reported as having higher levels of 'pickiness'. This same analysis was used to examine whether children who have rejected a previously accepted food have higher reported food neophobia. Finally, children who were reported as having a problem with the transition from milk to solid foods were compared to those who had no reported problems, to see if there was a difference in their 'picky' scores, food neophobia scores (both using a Mann Whitney test) and the likelihood of parents reporting that they have rejected a previously accepted food

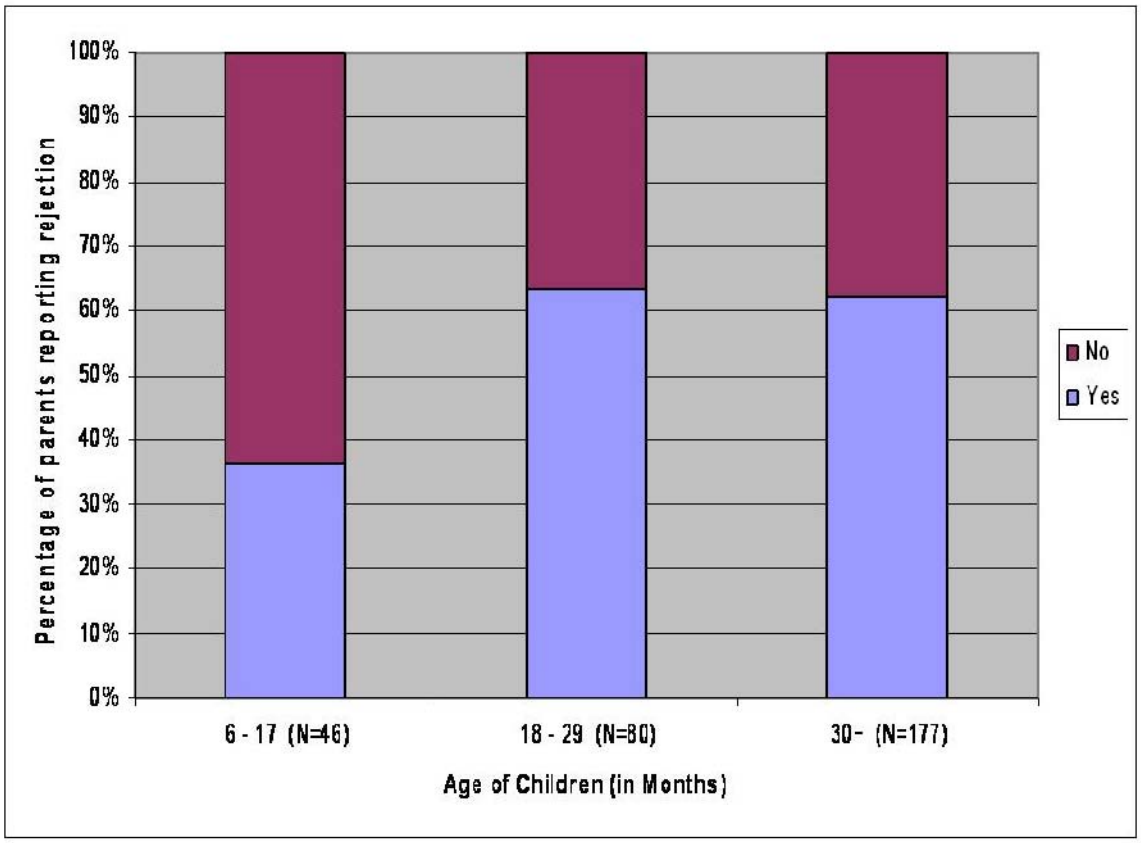
(Chi^2 test). As problems with the transition to solids, and increased 'picky' ratings/food neophobia, are likely to *increase* food rejection, the tests for the single nursery sample used one-tailed hypotheses.

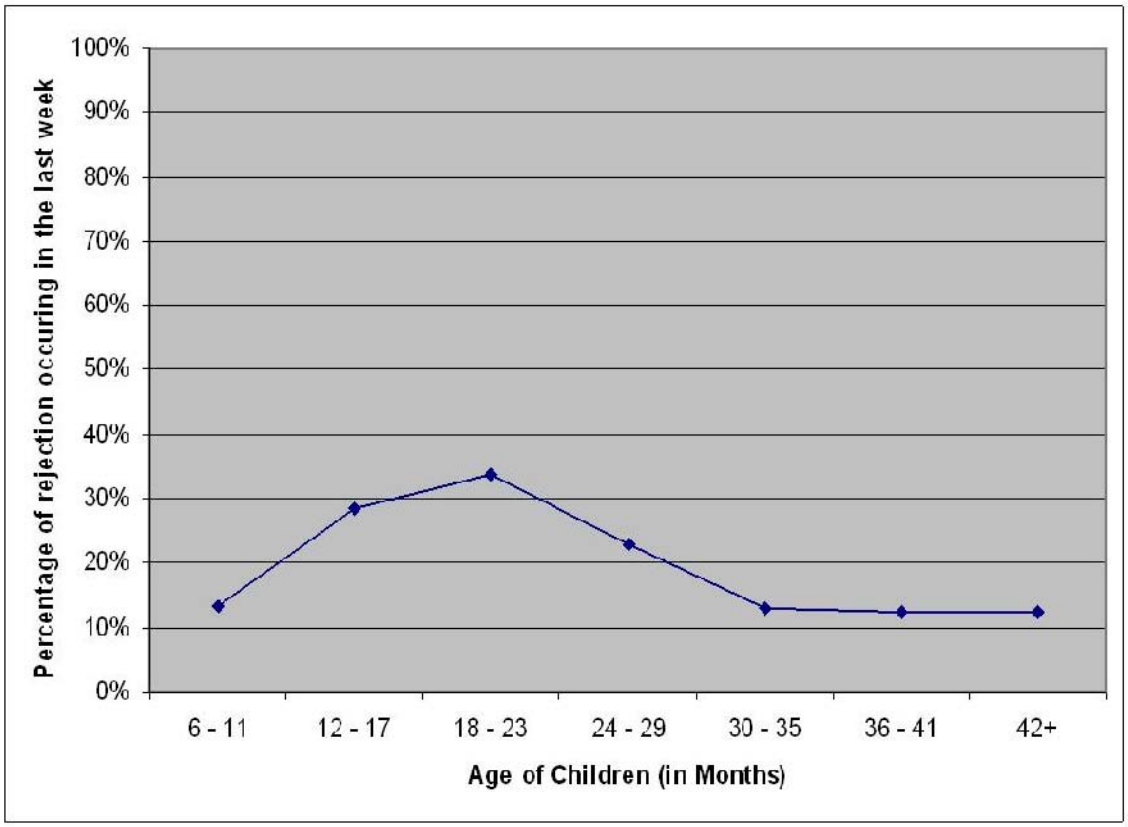
Results

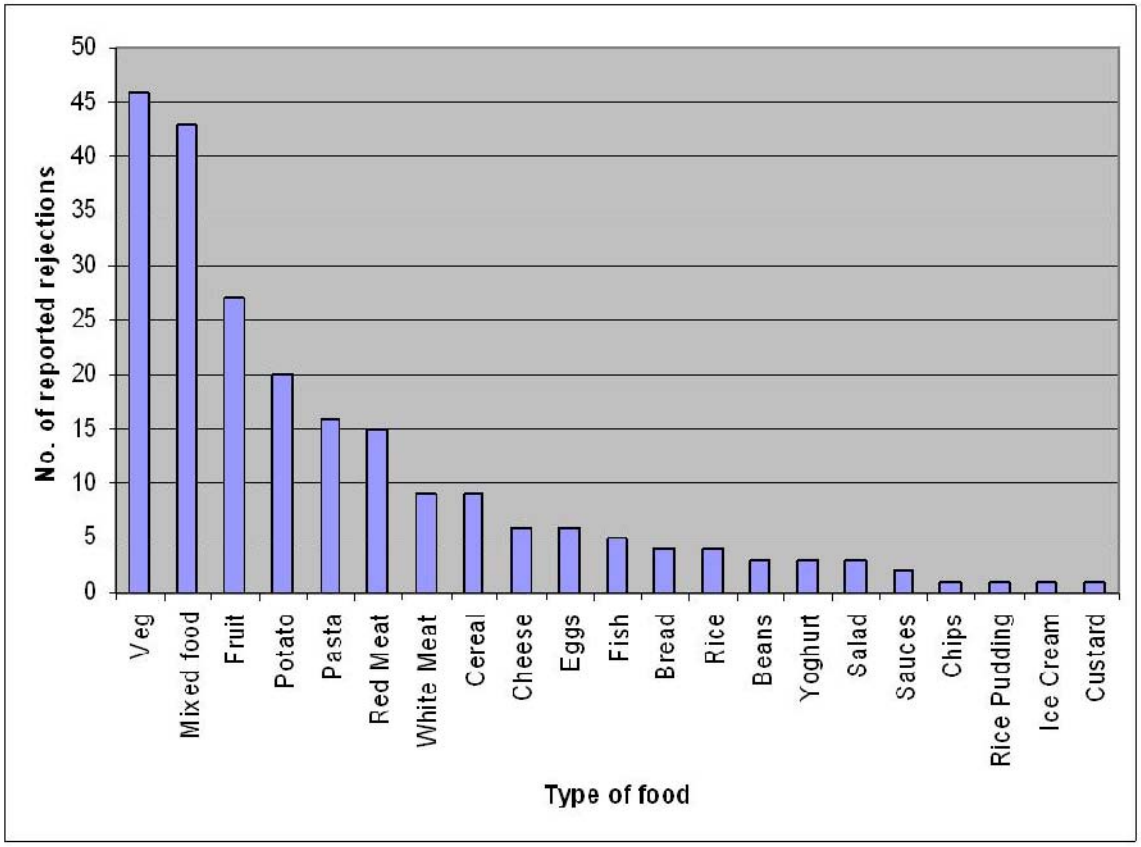
Nationwide sample

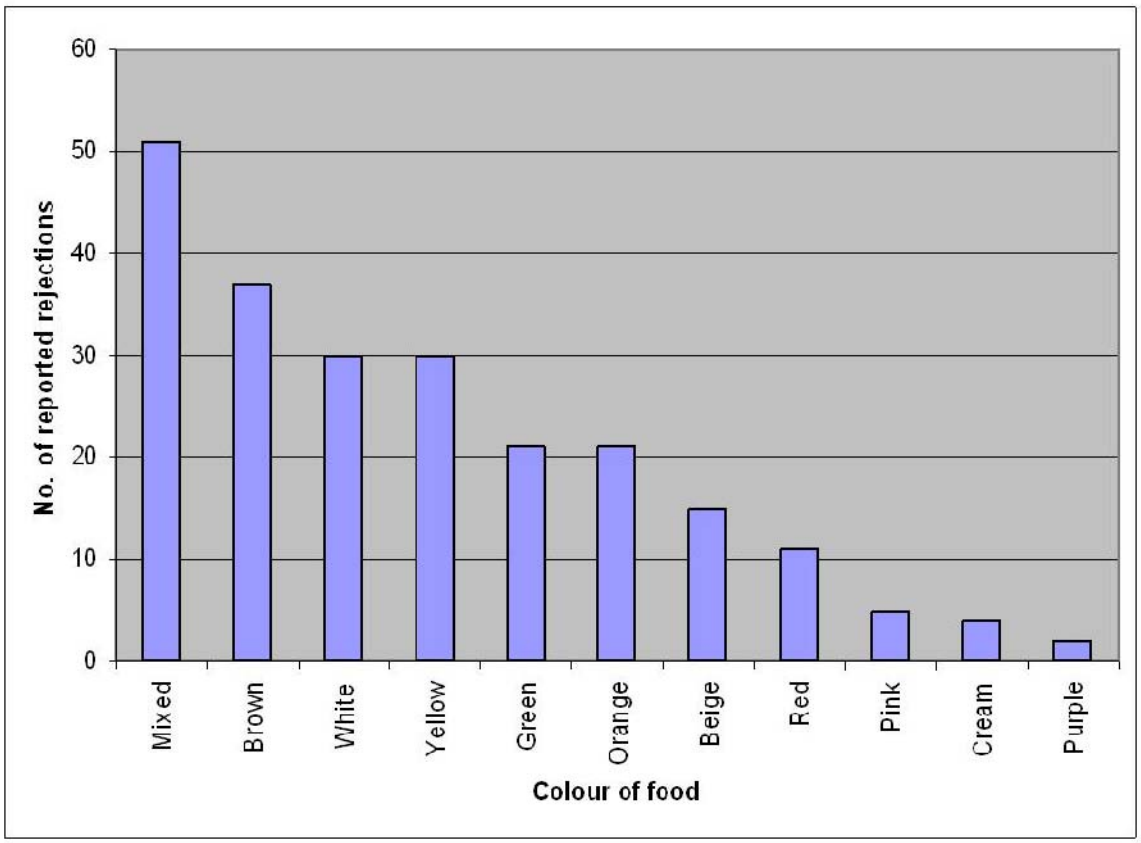
The data showed that the majority of parents reported that their child had rejected a previously accepted food (yes = 230, No = 82). A chi^2 shows that this figure was significant (X^2 (1, N = 312) = 70.21, $p < 0.001$). Although females were reported as rejecting previously accepted foods slightly less than males (Female 109, Males 118), the difference was not significant (X^2 (1, N = 312) = 2.08, $p > .05$).

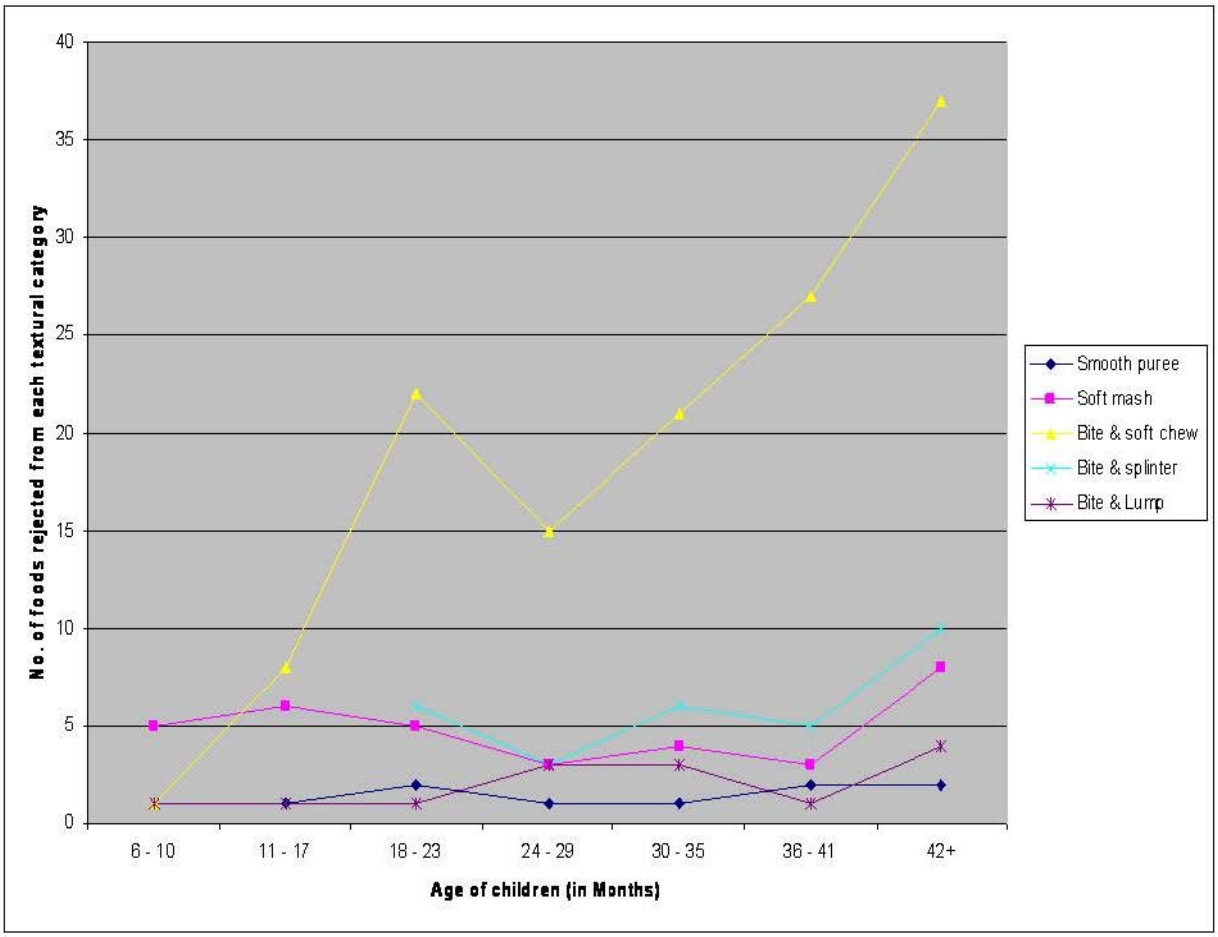
A Mann-Whitney showed there was a significant difference in the ages that toddlers were reported as rejecting previously accepted foods (U=1197.5, N^1=89, N^2=40, $p < 0.01$). Based on parental reports, infants who had not rejected a previously accepted food were significantly younger than the infants who had. The median age for "No, my child has not rejected a previously accepted food", was 17-months and the median age of "Yes, my child has rejected a previously accepted food", was 21-months. Fig. 4.1.1 shows this increase in reported rejection between 6- to 30- months and how there is no increase in reports after 30 months.


100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
Percentage of parents reporting rejection
6 - 17 (N=46)
18 - 29 (N=80)
30- (N=177)
Age of Children (in Months)
No
Yes


Percentage of rejection occuring in the last week
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
6 - 11
12 - 17
18 - 23
24 - 29
30 - 35
36 - 41
42+
Age of Children (in Months)


No. of reported rejections
50
45
40
35
30
25
20
15
10
5
0
Veg
Mixed food
Fruit
Potato
Pasta
Red Meat
White Meat
Cereal
Cheese
Eggs
Fish
Bread
Rice
Beans
Yoghurt
Salad
Sauces
Chips
Rice Pudding
Ice Cream
Custard
Type of food


60
50
40
30
20
10
0
No. of reported rejections
Mixed
Brown
White
Yellow
Green
Orange
Beige
Red
Pink
Cream
Purple
Colour of food


40
35
30
25
20
15
10
5
0
No. of foods rejected from each textural category
6 - 10
11 - 17
18 - 23
24 - 29
30 - 35
36 - 41
42+
Age of children (in Months)
Smooth puree
Soft mash
Bite & soft chew
Bite & splinter
Bite & Lump

one tailed), and had higher 'picky' ($U = 328.000$, $N^1 = 15$, $N^2 = 67$, $p < .05$, one tailed) and higher food neophobia score ($U = 343.500$, $N^1 = 15$, $N^2 = 67$, $p < .05$, one tailed).

Discussion

This study was the first to look at the explicit prevalence for the rejection of previously accepted foods and did so using a questionnaire given to parents of children ranging from 6-months-old to 57 months. The results offer some support for the hypotheses. Firstly, the rejection of previously accepted food, as reported by parents, commonly occurs in young children. Around 50% of parents (N=89) report that their child has rejected a previously accepted food and this figure reached almost 75% of the parents who participated in the nationwide sample (N=312), though the latter figure is from a much reduced reponse rate.

A number of issues need to be considered when interpreting these figures. The problem with using a self selected sample for this study is that parents whose children have rejected a previously accepted food are more likely to respond than those whose children have not, which can inflate the prevalence rate. As a result of the low response rate, the prevalence reported here must be interpreted with caution. Despite this, Carruth et al. (2004) do report that, by 19 months, 50% of parents considered their child to be a "picky" eater and this fits well with the parental reports found in the current study for the rejection of previously accepted foods.

The second set of data collected from a single nursery, with a higher response rate, resulted in a prevalence of around 50%. This used a questionnaire giving a more refined explanation of how a previously accepted food was defined and this may have contributed to the lower reports. However, this also needs to be interpreted with some caution, as it was from a single nursery sample.

The data relating to the 6 to 30 month-old group was used to calculate a likely age of onset (N=129). Analysis of these data showed a significant increase in reported rejections between these ages. The median age of when parents were likely to report "No" their child has not rejected a previously accepted food was 17 months and the median age for when this rejection significantly increased was 21 months of age. This supports the hypothesis that the rejection of previously accepted food begins around the time children develop food neophobia (Addessi et al., 2005; Cashdan, 1988; Cooke et al., 2003; Harper & Sanders, 1975).

Furthermore, the data also show that 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 after 30 months. An ANOVA provided support for this and showed 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. This supports our hypothesis that the rejection of previously accepted food will happen most often during the beginning of the neophobic period and reduces in frequency as the child ages. A study by Birch et al. (1987) showed that around 69% of two year olds were unwilling to try a new food, and that this figure reduced incrementally up to the age of 5 years. If the rejection of previously accepted food is connected to food neophobia then the increased occurrence at around 2 years, and the subsequent reduction in frequency, as reported in this paper, fits well with these data.

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 supports the final hypothesis that the most frequently rejected foods would be similar to those previously reported in food rejection literature (Carruth et

al., 1998; Cashdan, 1998; Cooke et al., 2003; Jacobi, Agras et al., 2003) and that the foods reported as being rejected will be those liable to changes in their local, global and colour features between servings. Fruit and vegetables change in colour, shape and size due to natural variations, and mixed foods, by their very definition, are difficult to recreate identically between servings. Furthermore, based on how foods were reported as being presented, the most common colour was "mixed", again, making repetition of the same visual array between servings difficult to recreate. While variations in other foods do occur, young children demonstrate repetitive behaviours with regard to food (Carruth et al., 1998) and parents seem to learn quickly that sandwiches cannot have crusts or toast has to be a certain shade of brown, variables that are perhaps more difficult to control in naturally changing fruit and vegetables.

The additional questionnaire measures given to the single nursery also show some interesting findings. The data suggest that the rejection of previously accepted foods is related to reports of both food neophobia and 'picky' eating. The measure of central tendency for the food neophobia scale in this sample is similar to those found in other studies, suggesting that it is a relatively representative sample. For example, a study by Cooke et al. (2007) reported that children (8-11 years) in their sample had slightly higher neophobic scores, but, using a 6-item version of the same scale, Cooke et al. (2006) report a slightly lower mean in their sample of 4 to 5 year olds. Futhermore, the 'picky' eating scores for this sample were also comparable to previous research (Galloway et al., 2003) and as the result the findings may be generalisable. Finally, Early dietary problems (in the first year) can affect acceptance of food in the second year.

The proposal offered here to explain why the rejection of previously accepted foods occurs is that it is an extension of the neophobic response. While food neophobia and 'pickiness' are often researched and considered separately (Addessi et al., 2005; Carruth & Skinner, 2000; Carruth et al., 1998; Cashdan, 1988; Cooke et al., 2003; Galloway et al., 2003; Galloway, et al., 2005; Harper & Sanders, 1975; Li et al., 2001; Potts & Wardle, 1998; Rydell et al., 1995; Smith et al., 2005) it may be that elements of infant's 'pickiness' are merely extensions of their neophobic responses to new foods and these types of rejections should not be viewed as behaviourally distinct.

Firstly, neophobia begins around 18 to 24 months (Addessi et al., 2005; Cashdan, 1988; Cooke et al., 2003; Harper & Sanders, 1975). This results in a period of anxiety over food stimuli (Galloway et al., 2003; Pliner et al., 1995; Pliner & Hobden, 1992; Pliner et al., 1993), with its foundation in the worry over the intake of noxious substances (Cashdan, 1998). The anxiety manifests itself as a period of hyper-vigilance about the visual appearance of food in general, not just new foods. 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 potential to reject foods that are prone to local and global changes, in this case vegetables, fruits and mixed foods.

Previous literature supports the idea that vegetables, fruits and mixed foods are commonly rejected foods during early childhood (Cashdan, 1998; Carruth et al., 1998; Jacobi et al., 2003). While it could be argued that low vegetable intake is due to the bitter taste (Rosentein & Oster, 1988), or low fruit intake explained by the low energy provided (Gibson & Wardle, 2003), 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. Furthermore the rejection is likely to be done on sight (Carruth et al., 1998) and the data here shows a sudden onset at around 21 months of age, two observations that make alternative explanations difficult to justify.

It could be that during the period around 21 months 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 hypothesis. Firstly the category applied to most of the rejected foods was "bite and soft chew" examples of which are fruit, cooked potato and carrot (Infant and Toddler Forum, 2008 http://www.infantandtoddlerforum.org/objects/pdf/fact_sheet2.3.pdf) foods that are well established by 21 months of age. Secondly, there are many reasons why a food could be accepted on one occasion and rejected on another, such as satiation (Rolls, 1986), illness (Harris, Blissett & Johnson, 2000) or lack of exposure (Birch & Marlin, 1982; Loewen & Pliner, 1999). However, these reasons do not account for the rise in the rejection of previously accepted foods around the age of 21 months, the increased frequency of this occurrence around this age and then the plateau and reduction in frequency after 30 months.

During the sensitive period, as neophobia begins, children start to favour eating foods one at a time so they can clearly see what they are eating (Cashdan, 1998). 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 (Carruth et al., 1998). 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 (Dahl, 1987; Johnson & Harris, 2004), there is likely to be an increase in 'picky' eating behaviours, such as the rejection of previously accepted foods, in the second year.

Finally, 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. 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 (Birch et al., 1998), when clearer taste and visual categories have developed, around 3 to 4 years of age, less extension of the exposure response occurs to foods other than the target (Sullivan & Birch, 1990). Birch et al. (1987) 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 known and previously accepted foods may have a similar aetiology to that of neophobia. The reports that the rejection of previously accepted foods can still occur monthly, or every 6 months, after the age of 30-months suggests there may still be a desire for uniformity in foods, as is the case with adults preferring prototypical fruit and vegetables (McCarthy, 2006), though the reasons for these later rejections may have different causal explanations.

This paper is the first to examine the prevalence of the rejection of previously accepted foods in early childhood and presents a number of significant findings. This rejection occurs in the majority of infants, has an onset of around 21 months, reduces

in frequency after 30 months and most frequently involves the rejection of vegetables, mixed foods and fruit.

It is hypothesised that the reason for the rejection of previously accepted foods is due to the foods are being categorised as "new" or "different" because of local and global changes that occur between servings and therefore rejected in a neophobic response.

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 2 years of age many children (49% in the single nursery sample & 72% in the nationwide sample) have trouble consolidating the variety within their diet, especially within categories that parents would hope that their child would consume (fruit and vegetables) (Cashdan, 1998; Carruth et al., 1998; Jacobi et al., 2003). Carruth et al. (2004) report that up to 50% of parents perceive their child to be 'picky' while the study presented here shows up to 74% of parents report their child as rejecting a previously accepted food. This write-up 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 during the beginning of 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.

Limitations

The main issue with determining the prevelance of this type of rejection is the sampling used in this study. As addressed above, while over 300 questionnaires were returned from the nationwide study, if all of the questionnaires were distributed the sample could be very self-selected. An attempt to support this finding with a higher response rate from a single nursery showed a much decreased prevelance and both figures are open to criticism.

Also, the figures for food types rejected are only offered here as frequency data and do not take into account how often each food is actually given. Data confirming how often these foods were rejected, in proportion to how often they are given, would offer a stronger idea of whether the specific foods are relevant to the rejection of previously accepted foods. However, the findings for food type reported here do fit with previous research that vegetables, mixed foods and fruits are highly rejected categories of food (Carruth et al., 1998; Jacobi et al., 2003; Pelchat & Pliner, 1986) and therefore may have relevance for this study.

STUDY 2

THE CATEGORISATION OF FOOD DURING LATE INFANCY

Abstract

Two methodologies were used to examine infants' categorisation of food. The first study examined children's (N= 26, Mean Age= 21.3 months) conceptual categorisation using an exhaustive grouping task. Infants were given a period of free play with a group of toy foods and animals. When it was time to 'tidy up' the infants were instructed to put all the animals into one box and all the foods into another. If all items were categorised correctly then the child had shown knowledge of a conceptual category. Fifteen participants were able to exhaustively group the toys and these children were significantly older. However, it was concluded that the age children were able to successfully complete the task may have increased due to the demand characteristics of the task. As a result, other aspects of food categorisation were investigated using sequential touching.

The second study (N= 9, Mean Age= 23 months) also measured infants conceptual understanding of food but this was further extended to examine other elements of categorisation, e.g. basic category (fruits vs biscuits), the effect of local and colour feature changes to the categorisation of food. The Mean Run Lengths (MRL) showed that infants responded to the conceptual category and the basic category systematically. However, Monte Carlo analysis showed that only two infants categorised between the foods and animals, whereas five infants attended to the basic category. The paper discusses the theoretical importance of food categorisation on acceptance, the potential influence of foods feature changes and possible reasons why more infants did not show greater categorisation within this study.

THE CATEGORISATION OF FOOD DURING LATE INFANCY

General Introduction

Rejection of food:

When infants begin to reject new foods it is likely that they have developed a conceptual food category. That is, the rejection of the new food is either due to the belief it is a not food or, more likely, it is part of the food category, but categorised as new and rejected until the child can be sure of the consequences of ingestion. This suggests that during late infancy, children reject foods due to the visual perceptual aspects of that food.

Food preferences are learnt via exposure (Nicklaus, Boggio, Chabanet & Issanchou, 2005; Pliner, 1982; Wardle et al., 2003a; Wardle, Herrera, Cooke & Gibson, 2003b). Initially, during the first year, this learning is done via experience with the taste and texture of the foods, within the mouth, and is achieved with as few as one serving (Birch, Gunder, Grimm-Thomas & Laing, 1998). However, during the second year of life, once food neophobia has began, this process becomes visual, foods are rejected *prior* to tasting, and more exposures are required to induce a preference (Birch & Marlin, 1982; Birch et al., 1987; Sullivan & Birch, 1994). One possibility is that, if children have developed a prototypical expectation of a food given, based on learning, via experience, and if what is presented offers a perceptual mismatch to that expectation, the food may be rejected

Conceptual category of food in early childhood

A conceptual category is one that does not require a perceptual match between items (Herrnstein, 1990), so while an apple and pizza share no perceptual qualities, they are still conceptualised as 'food'. There are biological advantages to the development of early food knowledge (Bovet, Vauclair & Blaye, 2005; Rozin, 1990); however, whether or not conceptual understanding develops during infancy has not been investigated.

Children can sort pictures of food and toys, from around 2 to 3 years of age, into separate boxes after a short training period, though some also spontaneously declared "it's a food" or "it's a toy" (Bovet et al., 2005). The problem in having a practice or training period in such tasks is the question of whether the child had the knowledge or whether there is in-task learning (Oaks & Madole, 2000). Also, while pictures have been shown to promote talk of categorisation in 2 to 3 year olds (Gelman, Chesnick & Waxman, 2005), the use of pictures during infancy can result in participants failing categorisation tasks that they were able to complete when given objects they could manipulate (Mandler, 1997). Therefore, if actual foods cannot be used, model foods may offer more reliable findings.

Other studies involving the investigation of food categories have used methods such as relational tasks (Nguyen & Murphy, 2003), the ratings of foods dependent on the time of day they are tasted (Birch, Billman & Richards, 1984) and what predefined, adult categories of food children are willing to place in their mouths (Rozin, Fallon & Augustoni-Ziskind, 1986a). Nguyen and Murphy (2003) showed that, by 3 years of age, children can already categorise real foods into taxonomic, such as fruit, and script categories, such as breakfast, when using photos and a sorting task; therefore, their ability to categorise foods is relatively complex by pre-school age.

Rozin et al. (1986a) used a different methodology when considering food categorisation, examining children's willingness to place food into their mouths. The study found that young children, aged 16 to 29 months, discriminated poorly between food and non-food items, suggesting a conceptual category of food had not formed. However, the task had high demand characteristics, with the items placed on a plate, in a meal like setting and the children were prompted three times to place the items in their mouths. Furthermore, as detailed above, food neophobia results in infants *not* putting new foods into their mouths and rejecting them on sight. This suggests a conceptual category for food does exist by around 18 months, the beginning of the neophobic period (Addessi et al., 2005; Cashdan, 1998; Cooke et al., 2003; Harper & Sanders, 1975). Children will visually evaluate a substance, categorise it as a novel food, and reject it prior to tasting, while still being willing to place many non-food items into their mouths (Rozin et al., 1986a). As a result of these studies, a number of questions that may be pertinent to the acceptability of foods still remain.

Firstly, can infants demonstrate a clear conceptual category at this age? The theoretical argument above attests to the likelihood of children developing a conceptual food category during late infancy, but this is yet to be confirmed. Secondly, do infants have taxonomic food categories, i.e. fruit and biscuits? This has been demonstrated in toddlers using pictures (Nguyen & Murphy, 2003) but if given actual objects to manipulate, can infants show similar awareness? Finally, as, by late infancy, foods are rejected on sight, it would be interesting to see whether infants are able to visually categorise the foods they are reported to like and those that they are reported to dislike.

Influence of global, colour and local changes

Santos et al. (2001) found that rhesus monkeys attended to colour cues when categorising food, hypothesising that this is due to the potential for foods to change global shape (being torn or eaten) without these changes actually altering edibility. However, changes in the *colour* of foods can indicate whether or not a food is safe to eat. Thus "color serves a valuable function in food selection in such ways as determining when fruit is ripe, when meat is cooked, or when food is spoiled" (Macario, 1991, p. 20).

Marcio (1991) conducted a series of studies looking at the categorisation of food in relation to colour with children. The studies showed that 3 to 4 year-old children are good at identifying the likely colour of food exemplars (e.g. red for strawberry), that they are aware of what colour foods "should be" (e.g. a lettuce leaf should be green not purple) and that younger children (mean age; 2 years 11 months) were also able to identify what colour foods "should be". Furthermore, and perhaps most interestingly, 3 and 4 years olds (3.5 - 5 years in range) were shown a mould of a shape developed to represent a novel item, and the child was asked to either pick an item of the same colour or same shape, but different colour. When the novel item was supposedly representative of a toy, an item of the same *shape* was chosen, when the novel item was representative of a novel food, an item with the same *colour* was chosen in the belief it was more likely to "taste the same". Therefore, colour may be salient when infants categorise foods.

In terms of local changes to the visual properties of food, e.g. changes to a food that has began to dry out or food that has 'bits' in; no studies have been conducted with children. However, Wardle and Cooke (2008) report that many children do not like 'bits' in their food and this is used when marketing yogurts etc.

Visually perceivable, local changes to foods may be salient to children when deciding whether they want to eat a food and, therefore, be a factor when evaluating foods acceptability.

When relating the visual aspects of food to foods acceptability, they may relate to acceptance or rejection in two ways. Firstly, if the visual changes discussed above could lead to a known food being categorised as "new" or "different", then children who have began to show food neophobia may reject the food in a neophobic response. Secondly, if colour or local changes are salient to children during the neophobic period, then this may lead to foods being inferred to have unpleasant textural or taste properties, and lead to them being rejected in a disgust response. These aspects of foods' visual properties, around the time neophobia begins, should be investigated in an attempt to explain why children begin to reject previously accepted foods during infancy, leading to many parents labeling their child as 'picky' (Carruth et al., 2004; Kim et al., 2006).

Current studies

Three aspects of infant's categorical knowledge of food will be investigated; whether children can sort items representing food as different from animals (conceptual category), what other aspects of categorical knowledge infants have, i.e. taxonomic (fruit/biscuits) and like/dislike and, finally, the way in which foods varying on local, global and colour levels (e.g. 'odd' purple bread) are categorised.

As discussed above, food categorisation during infancy has not been researched before; therefore, study one will be conducted to ascertain a) whether infants show conceptual knowledge of food and b) whether the methodology chosen is suitable to investigate the other aspects of food categorisation. While sequential

touching behaviour, whether infants touch objects relating to one group in sequence more often than they would by chance, has been used in numerous studies (Ellis & Oakes, 2006; Mareschal & Tan, 2007; Oaks & Plumert, 2002; Poulin-Dubois, Graham & Sippola, 1995) and is a viable alternative, it is difficult to completely rule out the possibility that the infant is not just touching the items he or she prefers, rather than demonstrating knowledge of category membership (Courage & Howe, 2002). Therefore, the initial study will rely on "exhaustive grouping", physically separating one group of objects to one place and a second set of objects to a distinctly different place (Gopnik & Meltzoff, 1992). This method requires the ability to understand commands and a level of manual dexterity (Courage & Howe, 2002; Torkildsen, et al., 2006). However, the sample used for this study will be infants who attend day nurseries, where they sort items into boxes, when helping to tidy, on a daily basis. Furthermore, the aim of this study is to examine infant's knowledge of food during the onset of neophobia between 18 months and 2 years of age (Cooke, Wardle & Gibson, 2003; Harper & Sanders, 1975), and infants of this age are likely to have the language, understanding and dexterity to attempt this task. In order to limit the possibility of in-task learning, the study will be framed as "play". This will also avoid infants losing interest, which can occur when they are given too many instructions (Torkildsen, et al., 2006). Finally, using a large number of objects for each category, with wide ranging perceptual differences, will show, if the task is completed, a clear demonstration of a conceptual food category.

Study One: Exhaustive Grouping

Hypothesis

A neophobic response results in the rejection of an unknown food, on sight, and begins around 18 months to 2 years of age (Cashdan, 1998; Harper & Sanders, 1975) suggesting that infants have developed a conceptual food category. Therefore, it is hypothesised that, after a period of play, the older infants in the sample will be able to show a clear conceptual food category at around the time neophobia begins, by exhaustively grouping a set of toy foods and toy animals into separate boxes.

Method

Participants

The participants were 26 infants (15 male) aged between 15 and 28 months (mean = 21.3 months). All infants attended a nursery in the Birmingham area either full or part-time.

Materials

A total of 36 toy foods and toy animals (18 in each category) were used in this study. The toys were of a similar size and varied in shape, colour and texture both between, and within, categories. The toys were purchased from the Early Learning Centre. An example of these items is shown in figure 4.2.1.

placed into a box by the experimenter to show what was being asked, and to aid recall.

At the start of the sorting task the child was allowed to sort the items on their own, however, if the infant stopped sorting the toys, or their attention drifted, they were encouraged to continue by the researcher. A random toy would be held between the two boxes and the child asked “does this go with the foods or the animals?” If it was required, the first two mistakes were pointed out by the experimenter. This was done, so that if the child did not understand the verbal instructions, they would have the opportunity to see what was being asked of them and to ensure that the child was paying attention rather than placing the toys without looking. Finally, the child received praise as they placed the toys into the boxes, but after the first two corrections, praise was given if the response was correct or incorrect. A “pass” was recorded if all 36 items were placed in the correct boxes.

Data Analysis

The data collected was parametric; therefore a t-test was used to see if there was a difference in the age of the children able to complete the task, and those that could not. The reason for this study was to examine whether, at around the time neophobia begins, children develop a conceptual food category. In line with this aim a one-tailed hypothesis is used as it is predicted the younger children (prior to food neophobia) will fail the task, while older children will be able to sort the items.

Results

The mean age of the children who were able to categorise toy foods as different from toy animals was higher (mean = 22.67 months, N= 15) than the mean

age for the children who failed the task (mean = 19.45 months, N= 11). The mean difference between the ages was 3.22 and the 95% confidence interval for the estimated population mean difference is between 5.21 and 1.22. The effect size was large (d = 1.33). An independent samples t-test showed that the difference between the groups was significant (t = 3.326, df = 24, p = 0.001, one-tailed).

Discussion

This is the first study to examine infant's conceptual knowledge of a food category at around the time neophobia begins. The data show that infants can exhaustively group 18 toy foods and 18 toy animals into separate boxes from around 22 months of age. This finding supports the hypothesis that infants show a clear conceptual category of food around the time neophobia begins (18 to 24 months), and these data show that it was towards the upper end of this age range (mean = 22.67 months).

It was found during the data collection for this study that infants often played with the toy foods as if they were, or they were pretending they were, real, making attempts to actually bite the food. Furthermore, the food items were used to "feed" the toy animals on a number of occasions. These behaviours were shown across an array of perceptually different items, across almost the entire age range, and there was clear differentiation between how the toy animals and toy foods were handled.

This suggests that, rather than a lack of conceptual understanding, the younger children in this study were failing to understand what was being asked of them when "tidying away". Due to the biological importance of food (Bovet et al., 2005; Rozin, 1990) and the daily interaction with food, a clear conceptual category may occur even earlier than the data here suggests and the demonstration of this may be being masked

by task demands. As a result, subsequent data was collected using the alternative, and more age appropriate, sequential touching methodology.

Study Two: Sequential Touching

Introduction

Sequential touching is a method suitable for categorisation tasks with children around 13 to 30 months of age. The method requires no instructions and is based on observing, and recording, children's touching patterns when presented with various stimuli (see Mareschal & Quinn, 2001 for a review of sequential touching data). The focus of this study is not to consider the debates surrounding children's cognitive categorical development as a whole (see Mandler, 2000 & Quinn & Eimas, 2000) and, therefore, will not use a wide age range. Instead the purpose is to compare within groups, and vary the stimuli used, at a time when food neophobia should have begun (Cashdan, 1998; Harper & Sanders, 1975).

A similar method has been carried out in relation to the categorisation of food, based levels of word knowledge (Smith, Whitmore, Shoreb, Robinson & Dixon, 1999). Smith et al. showed, using the sequential touching method, that infants were able to categorise foods based on their reported level of word knowledge of the items, i.e. if they knew the food and its name, knew the name but not that it related to that food, or they had not heard the name or seen the food.

Sequential touching will be used to assess whether infants show conceptual categorisation when presented with toy foods and animals, whether they differentiate on a basic level when given just toy foods, i.e. fruits and biscuits, and whether, based on parental report, they sequentially touch between those foods they "like" and the

foods that they “don’t like”. However, other elements of categorisation will also be tested within the same session; local, global and colour changes to the foods’ features.

Infants categorise based on global similarities when sorting items of non-food items, e.g. vehicles versus animals. However, when local features were altered, (legs changed for wheels on a car and wheels changed for legs on an animal) infants categorised based on these changes local changes (Rakison & Butterworth, 1998).

During late infancy children’s anxiety over food is likely to be heightened due to food neophobia and the anxiety this causes (Galloway et al., 2003; Pliner et al., 1993). Therefore, it would be interesting to see whether children demonstrating a conceptual food category within the sequential touching task also demonstrate knowledge of foods that have local, global and colour variations, when no conceptual differentiation is available, i.e. all the items are from the same conceptual category, food. This was shown for differing word knowledge when one conceptual category was given (Smith et al. 1999).

Although hybrid tasks, such as Rakison and Butterworth (1998), can lack ecological validity, food offers a stimulus that can provide more valid changes and it would be interesting to see if infant’s attention to detail regarding foods’ visual perceptual qualities change when various alterations are made to the ‘prototypical’ foods. If these changes are salient, and used to categorise the objects given, then this methodology will allow examination of which feature, if any, is the most important when categorising food, i.e. do children categorise based on local, global and/or colour changes when presented with models of food that offer these cues?

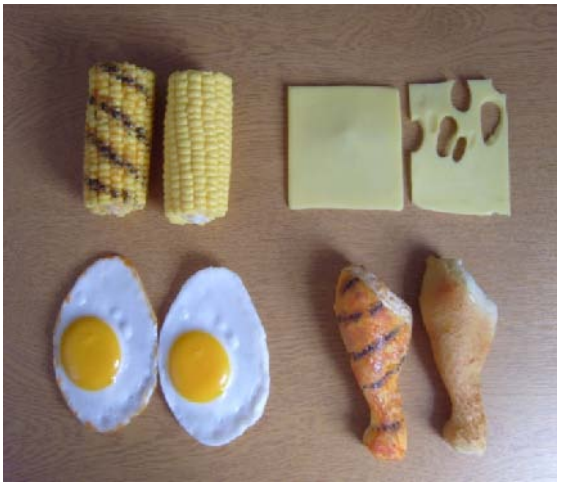
Method

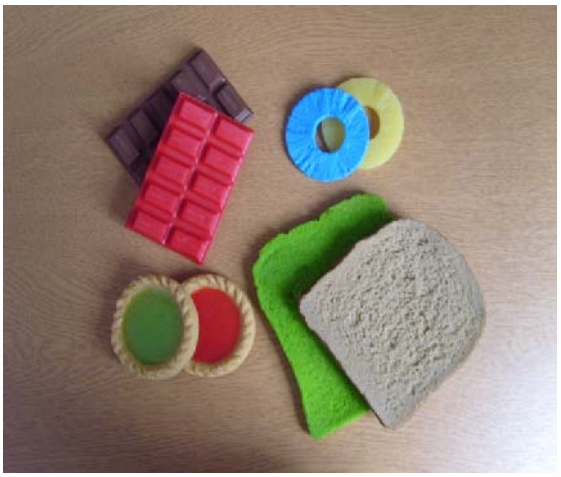
Participants

The participants were nine infants (4 male) aged between 19 and 25 months (mean = 23 months) (after one was removed because the parent labelled items and drew the child's attention to them, and two children were removed because they were upset). Infants were recruited via posters and letters given to local nurseries in the Birmingham area and via a 'SureStart' centre in the Redditch borough.

Materials

The food items for this study were sourced via a company that makes model food items (see http://www.replica.co.uk). The food items were more realistic than those used in the exhaustive grouping study and examples of foods varied by colour, local changes and global changes were purchased. Examples of the type of arrays given in the 'local', 'global' and colour change conditions are shown in figure 4.1.2. The animal toys were taken from the exhaustive grouping task (see fig. 4.1.1). A digital video camera was used to record the task, this was placed at an appropriate level to record all of the touched items, however, the actual distance/angle had to be altered dependent on where the testing took place (6 in the child's home, 3 in a private room in the surestart centre).





Procedure

Infants were presented with a tray containing eight toy replicas of the target objects. Condition one was four toy foods and four toy animals, condition two was four fruits and four biscuits, condition three was four foods selected by the parent/guardian to be those that the child would "most like" and "least like" if the foods were real. Conditions four, five and six used four 'prototypical' foods and four foods that were either changed locally, globally or in terms of their overall colour (see Fig. 4.1.2). Each infant was presented with these six trays, one at a time, for two minutes per tray. It is expected that infants will begin to show successive or alternating touching as the length of time a sequential touching task continues, i.e. they get used to the items presented and the categorisation increases (Oaks & Plumert, 2002). However, as the items changed every two minutes, this did not require controlling for with counter-balanced presentation, instead the trays were given in a random order.

While seated on their parents' laps, on a chair with the parent close, or standing at the table with the parent sitting close by (depending on how the child was comfortable) infants were presented with one of the object trays and told, "Let's see what you can do with these". The infants were allowed to manipulate the objects for two minutes while being videotaped. The objects were placed on the trays in a random format. Parents were asked not to label any of the objects or to encourage play with any particular objects. They were also instructed to refrain from responding to any labelling by the child. If an object was removed or thrown by the child, the parent or experimenter returned the item to an area that the child could reach. If a child was reluctant to touch any of the objects, the experimenter repeated the prompt

while waving his hand over the tray of objects. After two minutes had elapsed, the tray was removed and the next one was presented.

Data Analysis

Coding & Scoring

The videos were coded using a method adopted by a number of other sequential touching studies (Heron & Slaughter, 2008; Mandler, Bauer, & McDonough, 1991; Rakison & Butterworth, 1998). A touch was scored when the infant either touched the object with his or her hand or if an object was touched with another object, i.e. one he or she was holding. Accidental touches were not scored, i.e. it was clear that no attention was paid to the item being touched, or if the items were picked up at random as they were being placed back on the tray (children often placed the item on the table or passed them to their mother who held them within reaching distance). Repeated touches of the same object were only counted as one touch, unless separated by a touch to another object. Two judges independently coded videos for three randomly chosen participants and inter-rater reliability was calculated using two measures; (i) a Pearson's correlation between the run lengths, and (ii) the percentage of agreement between the coded touches noted by the two coders. Overall coder reliability for the run lengths made by the infants was $r = .84$, and percentage reliability for objects touched by the infants was 89% (see Rakison & Butterworth, 1998).

The mean run length (MRL), number of successive touches within each category, was calculated by summing the total number of touches and dividing this by each successive run which can vary from one to the total number of touches exhibited,

if only one category is touched. The analyses below were taken from Mandler, Fivush, and Reznick (1987).

Mean Run length analysis

Infants' sequential touching was analysed to see if it differed significantly from chance performance in any of the six conditions. The MRL was calculated for each child, in each condition and compared using a one sample t-test with the test value set to 1.75 (see Mandler et al., 1987) as this is the expected figure if items are touched randomly. As with previous research, the probability level was set at .10 (Heron & Slaughter, 2008). One infant's data was removed for the "like v's disliked" sequential touching because they were upset and another infants' data was removed from the "global changes" condition for the same reason. The data for these children in the other 5 conditions was unaffected.

Monte Carlo Analysis

In order to look at individuals' sequential touching patterns, sequences that included touching at least three separate items of the same category were assessed (Mandler et al., 1987; Oaks & Plumert, 2002; Starkey, 1981). Using a Monte Carlo program (TouchStat v.3.0; Dixon & Watkins, 2004) the likelihood of one or more categorisation runs occurring by chance was assessed. This program considers the total number of objects touched, the number of categories, how many objects are in each category, the number of touches made within a run and how many unique items were touched within a run (min 3 different items).

If a total of 19 touches are made over the two minutes, a run of 9 touches, involving all four objects from one of the categories, has a probability of p=.008.

Alternative touching can also be examined, where a participant alternates from an item in one category to an item in another category, and so on. Given 20 touches overall, a run of 8 touches alternating between the two categories, involving at least three different objects (e.g., fruit, biscuit, fruit, biscuit, fruit, biscuit, fruit, biscuit) has a probability of p=.06. As in previous research (Heron & Slaughter, 2008; Mandler & Bauer, 1988; Mandler, Bauer & McDonough, 1991; Oaks & Plumert, 2002; Oakes, Plumert, Lansink & Merryman, 1996; Rakison & Butterworth, 1998) the probability value was set to p=.10 for classifying infants as having shown successive or alternating touches and, therefore, were deemed to have exceeded the number of touches in a sequence expected by chance and were classified as a categoriser. Those infants showing no successive or alternating runs were considered to have adopted a random touching strategy (Oaks & Plumert, 2002). For Monte Carlo analysis one-tailed tests are used. This is because the test measures whether run lengths were *longer* than expected by chance, run lengths that are significantly shorter are not relevant. As the data were normal, parametric tests were used.

Results

The first analysis compared the mean run lengths of the whole sample for each of the six tasks, to the run lengths expected by chance (1.75; Mandler, Fivush & Reznick, 1987). One-tailed t-tests (test value = 1.75) were conducted and showed that the mean run length was significantly higher than chance for the conceptual categorisation condition and the basic categorisation condition (see Table 4.2.1).

Table 4.2.1 Mean run length, standard deviation and associated t, d.f. and p values for of the six conditions.

Condition	**MRL**	**S.D.**	**t**	**d.f.**	**p**
Conceptual	2.23	.99	1.46	8	.092*
Basic	3.2	1.94	2.23	8	.03*
Like/Dislike	1.85	.29	.94	7	.19
Global	1.49	.21	-3.58	8	.004
Local	2.07	.86	1.07	7	.16
Colour	1.5	.37	-2.03	8	.039

*Significant at $p < .10$ (only for MRLs *greater* than expected by chance. Significantly lower MRLs, than expected by chance, are not of importance to this analysis).

Monte Carlo Analysis

The run lengths were analysed per infant, per condition. Run lengths were higher in the conceptual and basic categorisation conditions with 2 and 5 categorisers in these conditions, respectively. One-two categorisers were shown in each of the other conditions, except for “colour”, where none of the infants showed a sequence longer than expected by chance (see table 4.2.2). The significance level was set at .10 (as with previous research; Heron & Slaughter, 2008; Mandler & Bauer, 1988; Mandler et al., 1991; Oaks & Plumert, 2002; Oakes et al., 1996; Rakison & Butterworth, 1998), however, those with a significance level below .05 are indicated to show the increased significance of these scores.

Table 4.2.2. No. of categorisers and mean run lengths (S.D) for each of the six conditions.

Condition	**No. of categorisers**	**No. < .05**	**MRL (S.D.)**
Food v's Animals	2/9	2	8 (0)
Fruit v's Biscuits	5/9	2	8.2 (2.49)
Like v's Dislike	1/9	1	7 (0)
Global	2/9	0	5.5 (.71)
Local	1/9	0	5 (0)
Colour	0/9	-	-

Mean number of touches for global, local and colour changes

While the mean run lengths were low for these conditions, as were the number of categorisers, the mean number of touches to the "prototypical" and altered foods across all participants was calculated and the data show that, on average, the altered foods were touched more times than the "prototypical" foods; global 7.5 / 5.6, local 7.6 / 6.1, colour 8.7 / 7.8. However, t-tests show that these differences were not significant; global ($t = 1.41$, $df = 7$, $p > .01$), local ($t = 1.53$, $df = 8$, $p > .01$), colour ($t = .84$, $df = 8$, $p > .01$). Furthermore, a within-subjects ANOVA shows no linear ($F (1, 8) = 1.02$, $p > 0.05$) or quadratic ($F (1, 8) = .24$, $p > 0.05$) trend between the food changes, based on mean number of touches (the global condition had one less participant and the missing figure was given the mean for that condition (Smith et al., 1999)).

Overall Discussion

The exhaustive grouping task within this study suggests that infants display clear knowledge of a conceptual food category, which is not based on appearance; by about 22 months of age (15 infants exhaustively grouped all the items), around the time food neophobia begins (Cooke, Wardle & Gibson, 2003; Harper & Sanders, 1975). However, the data from the sequential touching task is mixed.

The MRL data from the sequential touching task also showed that the food and animal items were handled systematically. However, the Monte Carlo analysis showed that only two infants were shown to clearly categorise between these two sets of items. While the exhaustive grouping data suggest conceptual knowledge of foods towards the end of the second year, the sequential touching data do not support this. A problem with this condition may have been the potential for the items to interact. Many of the children pretended to "feed" the animals which would result in a touch being scored. This could have affected the potential for each group to be touched in sequence and, as a result, the infants would have been unable to show their awareness within this study paradigm.

Theoretically, neophobic rejections and the rejection of known foods may have a basis in categorisation and perception. Infants reject foods highly liable to changes between servings, such as vegetables (Carruth et al., 1998; Jacobi et al., 2003), fruit (Cooke et al., 2003) and mixed foods (Cashdan, 1998). Furthermore, infants seem to prefer to eat foods one a time without sauces, possibly so they can recognise what they are eating (Cashdan, 1998). However, based on the data presented here, limited evidence is provided for this theory.

Of the other conditions in the sequential touching task, only the fruit v's biscuits condition was shown to have a significant MRL. In this condition, five of the

nine participants also categorised the fruit as different from the biscuits, according to the Monte Carlo analysis. The liked foods v's disliked foods showed no significant MRL with only one participant categorising between the two sets of items and this pattern was repeated for the locally changed foods. The global condition showed no significant MRL and one categoriser. Finally, the colour condition produced no significant MRL and none of the infants categorised these items as different. These data suggest that children have limited awareness of foods' perceptual features. However, a number of issues may have prevented the knowledge of foods being demonstrated.

In terms of the "like v's disliked" condition, parents only had a limited array of toy foods to choose from. Of these, the best that most parents could offer were the ones they thought the child would *most* like and *least* like, not clear like/dislike categories. During the second year of life many new and previously known foods are rejected and this is often done on sight (Carruth et al., 1998, 2004; Cashdan, 1998; Harper & Sanders, 1975), therefore, the lack of significant findings may be due to parents being unable to identify clearly disliked foods from the selection available rather than the children being unable to perceptually identify disliked foods.

The salience of local, global and colour changes to food also have theoretical arguments as to why they may influence food choice. While global shape often takes precedent when items are categorised (Biederman, 1987; Brown 1990; Gelman, 1990; Mandler, 1992) literature suggests that this may not be true for food (Addessi et al., 2005; Macario. 1991; Santos, Houser & Spelke, 2001) where colour (Macario, 1991; Santos et al., 2001) and local changes, such as a food containing 'bits' (Wardle & Cooke, 2008), may be more useful in evaluating foods suitability for consumption (Santos et al., 2001). Early focus on these features when an infant becomes more

mobile and able to place food in their own mouths has a biological benefit (Bovet et al., 2005; Rozin, 1990).

Despite this theoretical justification for hypothesising that infants may focus on these food changes towards the end of their second year, and thus categorise based on the presence of these features, this did not occur in the current study. However, this may not be due to a lack of the awareness of the features, in fact in every condition, on average; the altered foods were attended to more than the unaltered foods (though not to a significant level). It may be because, while the toys represent foods, they are still toys. As such, global similarity may have taken prominence. For example, rather than the blue pineapple ring and red chocolate being touched in sequence, due to them appearing "odd", the red chocolate and brown chocolate were attended to due to them being the same shape, irrespective of colour. Despite the lack of support for some of the theoretical arguments in terms of changes to foods perceptual features, this study is the first to provide some evidence that, around the time infants become food neophobic, they have an understanding of a food category that is not based on perception.

Conclusion

The way in which food is categorised during early childhood has theoretical implications as to how the food is subsequently responded to (i.e. eaten or rejected). The current studies are the first to assess the categorisation of food in infancy, used two methodologies and looked at a number of potential, perceptual influences. The findings suggest some knowledge of conceptual understanding of food (i.e. different to animals) and some understanding of basic levels (fruit and biscuits). However, the food categories, beyond food v's animals and fruit v's biscuits, were very generalised

and relied on two factors, the foods would be treated as actual foods and that changes made to foods would be *the* salient category despite opportunities for other types of categorisation (overall shape similarity for example). This method was chosen because it was the first attempt, and pre-defining the categories in a way that only made one available category would have had the potential to influence the infants in an unrealistic manner. Unfortunately, the toy foods, while seemingly perceived as food representations by the infants, may well have been treated like "objects" and, therefore, global shape may have been prominent. Methodology allowing for more *actual* foods to be used may yet show the salience of local, global and or colour changes to foods when categorising during early childhood.

Limitations

As discussed, the use of toys with a task that requires the toy foods to be perceived as real as possible may have hidden any influence of the feature changes. Even in the conditions where significant findings were obtained (animals v's foods and fruit v's biscuits) the use of non-food items may not be ideal. The sample sizes in these studies were also small and future studies should aim to recruit larger samples allowing for more generalisable results and the investigation of individual differences in categorisation styles.

Future Research

Ideally a set of toy foods representing, based on parental report, known and unknown foods would have been useful to include in the study. However, the toy foods that were selected had to be pre-selected and ordered in advance. Buying toys based on individual requirements would not have been viable due to the time and cost

implications. It also seems that the fact these items were toy representations, rather than the real foods, may have affected the results, so best practice, when investigating the acceptance and rejection of food, is likely to involve the use of *actual* foods rather than pictures or toys.

An interesting variant to this study could be to follow a similar priming technique to that conducted by Mareschal and Tan (2008). In this study they gave different groups of children different sets of toys to play with prior to the sequential touching task. This was done in order to try and induce a prime for sorting by either taxonomic features or parts. If children were shown photos of foods with local, colour or global changes, prior to the sequential touching task, it would be interesting to see if this was sufficient to produce categorisation of the toys into the "normal" or "altered" categories. If the toys are being treated as toys rather than "foods", the use of real-life pictures prior to the presentation of the toys may be enough to prime their attention to the foods features rather than global similarities.

STUDY 3

CULTURAL CATEGORISATION OF FOOD DURING CHILDHOOD

Abstract

While it has been shown that children are aware of the socially implicit rule for what foods are eaten when, i.e. dinner food, such as chicken, is less appealing in the morning, it seems that they are unaware of the cultural rules dictating what liked foods are suitable in combination. However, methodological issues, such as high demand characteristics, the use of pictures rather than actual foods or a comparison with adult responses as opposed to a control condition, make this finding questionable.

The paper presents a pilot study (N= 10, Mean Age= 4 years) and the resultant main study. The main study examined children's (N= 33, Mean Age= 4 years 6 months) hedonic ratings of a liked food when it was touching another liked food in a culturally acceptable mix and compared this with their ratings of two liked foods that form a culturally odd mix. The results showed that 20 of 33 children rated the odd combination lower than the acceptable combination, demonstrating awareness of cultural food rules. However, the ratings rarely fell below "ok" suggesting the combination was still considered largely acceptable. This is discussed in relation to findings on contamination sensitivity and it is concluded that, while children may be aware of the cultural categorisation of food, they do not have the ingrained avoidance of the combinations likely to have formed by adulthood.

CULTURAL CATEGORISATION OF FOOD DURING CHILDHOOD

Anecdotally, a disliked food can act as a contaminant, with reports of young children rejecting a liked food if it touches a disliked food (Cashdan, 1998; Harris, 2000; Rozin, 1990; Timimi, Douglas & Tsiftsopoulou, 1997). Furthermore, while we learn that liked foods, such as spaghetti and mince can be enjoyed together, the idea of spaghetti and banana is likely to be less appealing (Rozin, Hammer, Oster, Horowitz & Marmora, 1986).

If two liked foods become unwanted when given in a culturally odd mix, then this suggests that the person has acquired a learnt, socially mediated, cultural food category, i.e. it is likely to be learnt rather than intuitive knowledge. Furthermore, the rejection is either due either to distaste, a perceived change in the sensory properties of the liked foods, or due to disgust, that the thought of eating the liked foods in their given form is offensive. A key aspect of disgust, according to Rozin and Fallon (1987), is that a disgusting item can act as a contaminant, resulting in the rejection of the 'contaminated' food. Therefore, if a liked food is reported less favourably once it has touched another liked food, in a culturally odd mix, then these reduced ratings are more likely to be due to disgust; as long as the sensory properties have not been visibly altered.

Contamination and Contagion

While Fallon et al., (1984) have shown that adult-like contamination is not present until around 7 years of age, key aspects of contamination and contagion have been demonstrated in younger children. Children as young as 4 understand that sugar dissolves and sweetens a drink even though it is no longer visible (Rosen & Rozin,

1993), that germs can cause illness (Seigal, 1988), and that a bug can make a juice noxious once actual physical contact has taken place (Springer & Belk, 1994). Furthermore, a study by Toyama (1999) revealed that 4 year olds can show adult-like associational contamination responses; when a contaminant is in the presence of a liked substance but does not physically touch it. Toyama also reports that, stories describing a little boy or girl drinking water contaminated by faeces or poison, were more likely to be greeted with a "gross" or "wow" from 4 year olds, than stories where water was contaminated with sugar or salt. This suggests, at the very least, some social awareness that the former substances are viewed more negatively.

It may be the case that children are starting to learn that contamination can occur and an adult-like disgust response is forming, but is not yet ingrained. From around 4 years a child will begin to reject "disgusting" food in some social circumstances without doing so in others (Mumme, Gradwohl & Adams-Lariviere, 2007; Toyama, 2000). Furthermore, children show that they are prepared to consume a substance that has been "contaminated" by a disgust item, but know of the social rules as to why they should not (Mumme et al., 2007).

Culturally Guided Categorisation of Food

Birch, Billman and Richards (1984) provided children and adults with a sample of 8 different foods ranging from "for breakfast", "for dinner" and "for morning or afternoon". The foods were presented during the morning or late afternoon and rated on preference. Based on the six foods categorised with 100% agreement by the adult group as being, either, breakfast or dinner foods, children of 3-5 years preferred the morning foods in the morning session and the dinner foods in the afternoon session. These results suggest that pre-school children have learnt the

implicit, culturally defined, preferences that dictate when certain foods are appropriate.

Another cultural food rule that exists, implicitly, is which foods should be served together. If pre-school children show adult like, cultural preferences for foods dependent on time of day, it is possible the rules of what foods form culturally inappropriate combinations, may be also present. A study by Rozin et al. (1986b) investigated this and found that pre-school children were not influenced by culturally odd mixtures of food. Combinations of food that would usually be rejected by adults were offered to children aged 3 years 6 months to 5 years, e.g. a cookie with ketchup, and the majority of children accepted the combinations. This suggests that these children are yet to learn about the way some foods are categorised. However, the demand characteristics in this study were high which may have contributed to an increase the level of acceptance. Despite this, a similar finding is reported by Rozin et al. (1986a) in which 59% of children aged 3 years 6 months to 7 years 2 months responded positively to a picture of spaghetti and banana but, again, the use of a picture rather than actual foods may have failed to elicit the children's true response. Furthermore, Rozin et al. (1986) compared children's responses to that of adults, not other food mixes. It may be that young children do not have an understanding comparable to that of older children and adults, but may still have an awareness of culturally guided food choices.

A study by Fallon, Rozin and Pliner (1984) showed that when a hotdog or M&M sweet was introduced to a drink, six of the eleven children in the youngest group (3 years 9 months to 6 years 1 month) rejected the drink. Though this rejection was not to the same level as the adult group, the finding demonstrates some cultural categorisation of foods in the youngest age group. When considered with Birch et

al's. (1984) finding that children show good awareness of the implicit social rules surrounding food, and the methodological issues within the studies by Rozin et al. (1986a/b), it is still unclear whether young children can show cultural categorisation of food. Three methodological issues need to be addressed; (i) the use of actual foods, rather than pictures, (ii) low demand characteristics, and (iii) a comparison between stimuli within the same age range, i.e. a difference between those foods that do culturally mix and those that do not, rather than the same condition but a comparison to adults. These changes may increase our understanding of children's awareness of cultural food categorisation.

Hypotheses

It was hypothesised that when a liked food touched another liked, in a culturally odd mix, the rating of the foods, on a hedonic scale, would be reduced, in comparison to a control. However, the "contaminating" effect would disappear when the two liked foods had been separated, returning the rating to that of an "unadulterated" level. Furthermore, the older children in the study will show more awareness of cultural categorisation than the youngest participants.

Method

Study one: Pilot

A pilot study was first conducted in order to test the suitability of the methodology. This methodology was adapted from Fallon et al. (1984). Ten participants (6 males) between 3 years 1 months and 4 years 10 months (mean = 4 years) were recruited from a local nursery, all participants were of white, British ethnicity. Information packs were sent out to parents via the nursery. If parents were

happy for their child to take part in the study they were asked to complete a short information sheet describing their child's liked and disliked foods, and to sign and return a consent form.

Materials

Liked foods, based on parental report, were pre-prepared, specific to each of the participants' preferences. The criteria for the test foods were that two were liked and formed a culturally acceptable mix (control condition) and two foods were liked but together formed an unsuitable cultural mix (experimental condition). As cultural food rules are well established by adulthood (Birch et al., 1984; Fallon et al., 1984) those foods considered an acceptable and unacceptable mix were decided upon by the researchers. These foods were cut to a similar size and were of a consistency that would not leave a trace on either the plate or on the other food, once they were removed. The foods were presented on plain, white paper plates and new plates were used for each participant.

The measure used for each child to indicate their preference for the foods was a hedonic rating scale consisting of 3 faces (adapted from Fallon et al., 1984). These represented a sad face if the food was disliked, a straight face if the food was "OK" and a smiley face if the food was liked.

Procedure

Children were tested on a one to one basis. The children were asked to come and "play a game" and if they agreed they were sat at a table with the researcher opposite. Before the testing started, the child was told that they would be shown some different foods and all they had to do was say how much they would like to eat the

food, by pointing to one of the 3 faces, which were laid out in front of the child. To confirm that they understood what the faces represented, the researcher pointed to each face to explain what they meant and then asked the child to practice by pointing to the face they would point to if they "really wanted to eat the food", "thought it would be OK to eat the food" and if they "didn't want to eat the food". Once it was confirmed the child understood the rating scale, the testing began. For each presentation of a food the child was asked by the researcher "how much would you like to eat this food?" while pointing to the food in question. Foods were given in the following format:

1) Liked food alone on a plate (then removed from view) – this first food presented was used for subsequent measures of contamination

2) Another liked food, that if placed with the food from presentation one would form a culturally odd mix, alone on a plate (then removed from view). Presentations one and two were used to confirm parental report of the child's likes.

3) UNADULTERATED MEASURE - Both foods presented but on different plates (then removed from view) – as explained in presentation one, the first food formed the unadulterated measure.

4) TOUCHING - Both foods touching on the same plate

5) REMOVED - The one liked food removed and placed back on its own plate (using tongs)

6) OUT OF SIGHT - The liked food on its own (the other liked food removed from view)

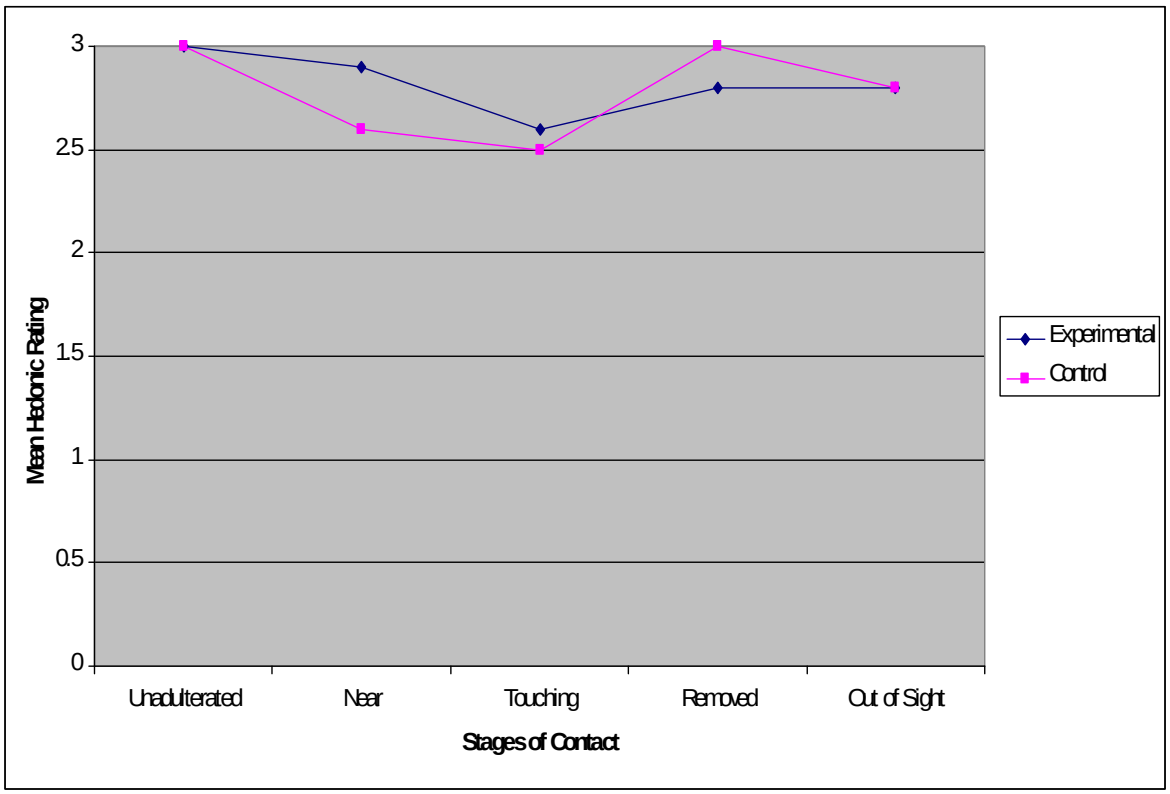
7) The other liked food on its own

The control conditions were done in exactly the same format, except the liked foods formed a culturally acceptable mix. The control condition and experimental condition were counterbalanced between participants.

Results and subsequent adaptations

In order to test whether there was a significant reduction in the preference for the liked food, once it was presented with the culturally odd second liked food, a 'contamination' score was calculated by counting the number of stages required for the rating to return to the "unadulterated" level. This was done by applying a 0 – for participants who rated the liked food the same as their unadulterated score when it was touching the other liked food in a culturally odd mix, a score of 1 – for participants who rated the food the same as the unadulterated score when the liked foods were separated, a score of 2 – if the food was rated the same as the unadulterated score when the second liked food was out of view, or a total contamination response score of 3 – if the rating for the liked food did not return to the unadulterated level during the course of the study. This is a similar scoring system to the one used by Fallon et al., (1984). These scores were then compared to the control condition to see if children reduced their rating of a liked food when given with another liked food in a culturally odd mix. As the data were non-normal, non-parametric tests were used.

Data was analysed using a Wilcoxon signed ranks test and the results showed no difference between the experimental and control conditions ($Z= 1.41$, N- ties = 8, $p> 0.05$) see figure 4.3.1 for mean control and experimental ratings. This suggests that no contamination effect occurred due to a liked food touching another liked food in a culturally odd mix. However, a number of issues raised doubts about the methodology


3
2.5
2
1.5
1
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0
Mean Hedonic Rating
Unadulterated
Near
Touching
Removed
Out of Sight
Stages of Contact
Experimental
Control

some children were trying to “get the answer right”. Having rated a food, some children would respond that they had “already been asked that one” when the food was presented in other formats, and as a result change their rating, rather than recognising that there had been a change in the presentation. This may have been a problem with the instructions, that there were too many stages in which the same foods were presented or, again, the age of the children.

Study two: Main study

A total of 33 children (14 males) were recruited via 3 schools; a Chinese Sunday school in Birmingham, a private junior school in London and a nursery/pre-school in Bristol. The ages of the children ranged from 3 years 3 months – 5 years 11 months (mean = 4 years 6 months). Three ethnic groups took part in this study British Indian (N= 6), British Chinese (N= 13) and White British (N= 14). Information packs were sent out to parents requesting their permission to allow their children to participate in the study. Those willing to give consent were asked to return a signed consent form.

Materials

The same criteria were applied to the food as in the pilot study and the same rating scale was used. However, a questionnaire asking parents to list two to three different foods from various categories, e.g. savoury snacks, cold meats, fruit was also included. The responses given were used to identify liked foods for each child that fulfilled the criteria of not leaving a trace on the plate, or other foods, when removed. From examination of the food groups listed by their parents, it was concluded that the children from all ethnic groups consumed predominantly English food and, therefore,

if cultural categorisation is formed by children of this age, they would be aware of what foods are likely to be served together.

Procedure

The same experimental condition procedure was used for the main study, except for two alterations. Firstly, the number of conditions in which food was presented was reduced resulting in the following format:

1) UNADULTERATED MEASURE – The first and second liked foods were presented on different plates (subsequent measures were based on the first liked food). If either of these foods were not rated as liked, i.e. smiley face, when presented on a plate alone, an alternative was offered until two liked foods, that together formed an odd cultural mix, were identified.
2) TOUCHING – The first liked food was presented touching the second liked food on the same plate
3) REMOVED – The liked food was put back on a separate plate using tongs
4) OUT OF SIGHT – The second liked food was removed completely from view

The second alteration to the procedure was that, after the unadulterated food rating was taken, the questions the children were asked changed to "how much would you like to eat the food when it is like this?" for the 'touching' condition; "What about now I've taken it away from the other food?" for the 'removed' condition; and finally, "what about if I take this other food away?" for the 'out of sight' condition.

The method of presentation (stages 1 to 4 listed above) was reduced for the control condition where only the two culturally acceptable liked foods, 'touching'

stage, were shown. The pilot study showed that parental report of what foods the child would report as liked was very high, therefore, due to the likelihood that children would confirm that they liked the control foods the opportunity was taken to reduce the number of presentations, an issue that may have affected the pilot study. This control was used in the Fallon et al. (1984) study where one measure of acceptability was taken for a drink with the spoon 'in' the drink. If the foods were not rated as liked then the sequence continued as normal in order to create an overall contamination score, however, all children rated the culturally acceptable mix of food as acceptable, i.e. smiley face.

Data analysis

The data collected in this study were non-normal; therefore, non-parametric tests were used for all of the analysis. Furthermore, two-tailed tests are used for the majority of the analysis; however, previous research outlined in the introduction, suggests that younger children do not show contamination. Therefore, when comparing the youngest and oldest groups for differences for contamination sensitivity, it is predicted that the older group will show increased dislike of the contaminated stimuli and a one-tailed test is reported.

Overall Contamination v's control: As in the pilot, overall contamination scores were calculated by counting the number of stages required for the rating of the liked food to return to the "unadulterated" level. So that, 0 = no contamination response, i.e. the food was rating as highly as the unadulterated food when it was touching the second liked food in a cultural unacceptable mix. 1 = the liked food rating returned to the unadulterated rating when removed from the second liked food. 2 = the food was rated the same as the unadulterated rating when the second liked

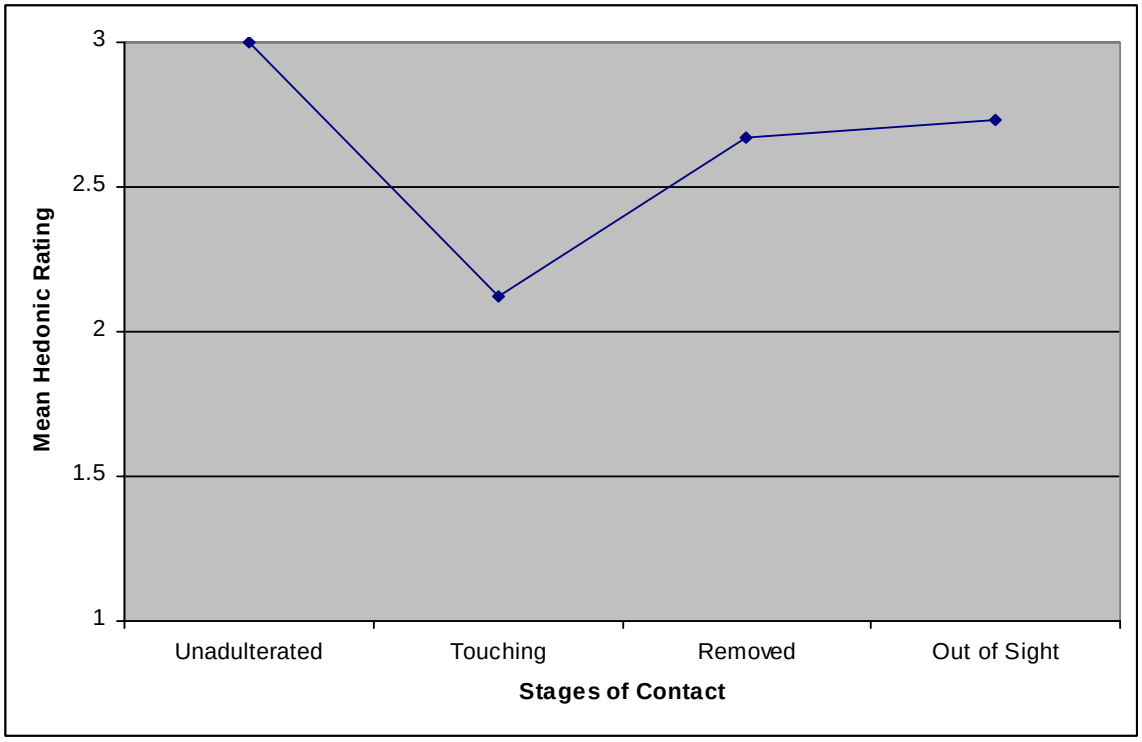
food was completely out of view. 3 = the rating for the liked food did not return to the unadulterated level, which was considered. These overall contamination scores were compared to the control condition, using a Wilcoxon signed ranks tests. A Kruskal-Wallis was used to compare for differences in overall contamination score, compared to control, when participants were split by ethnicity.

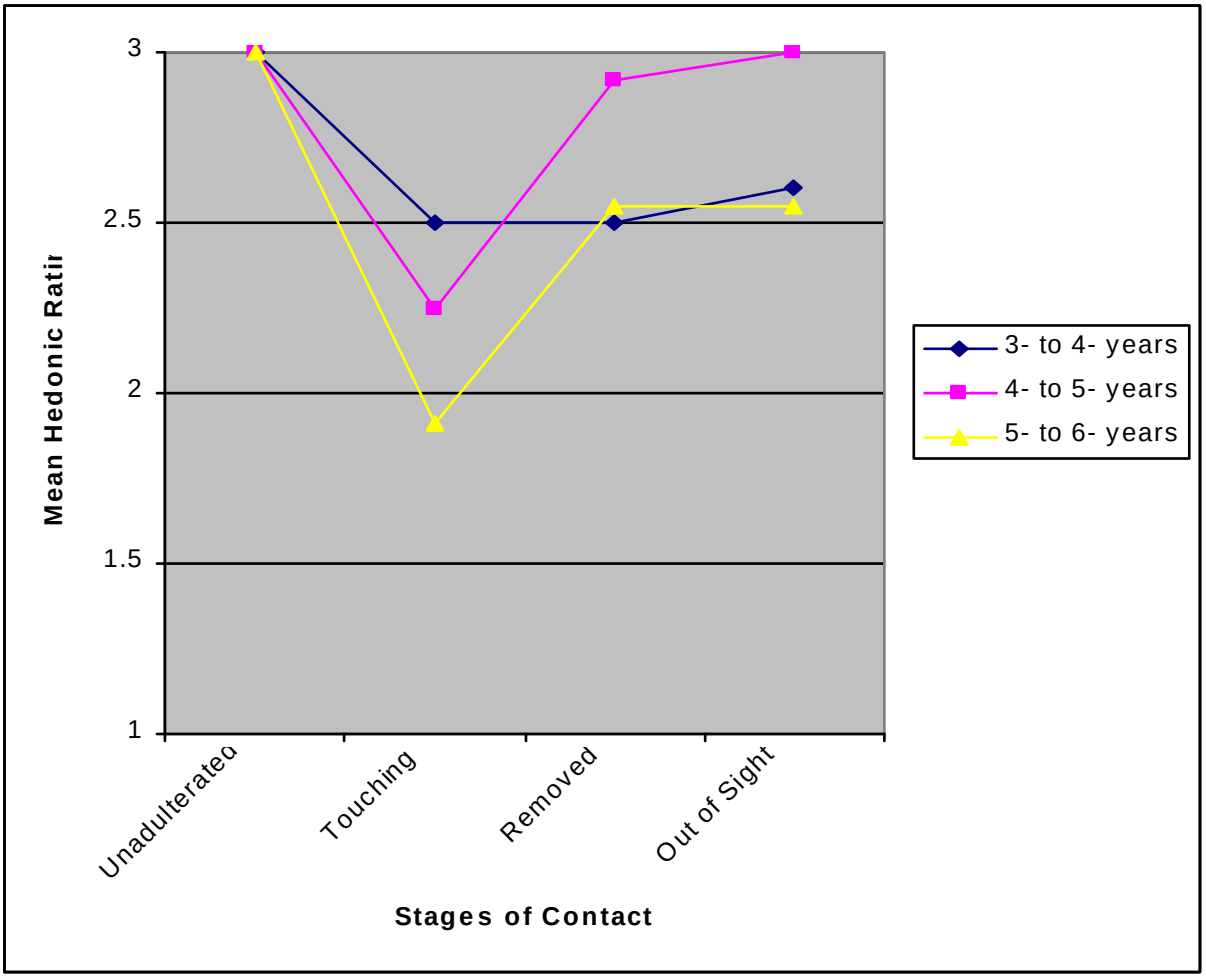
Differences within the experimental stages: A further measure was used to test whether or not the contamination effect continued beyond the 'touching' stage. This was done by comparing the decrease in ratings in the touching, removed and out of sight ratings in the experimental condition, from the unadulterated ratings, using a Friedman one-way ANOVA. Wilcoxon signed ranks tests were then used to examine where the difference was between the three stages and to see whether the liked food returned to an unadulterated level, once the culturally odd mix had been separated.

Age: Participants were split into three age groups; 3 to 4 years, 4 to 5 years and 5 to 6 years and a Kruskal-Wallis was used to test whether there was a difference in the children's response to the culturally odd mix, when the liked food was touching the second liked food in a culturally odd mix, when compared to the unadulterated rating. Finally, a Mann-Whitney was used to test whether the oldest group rated the culturally odd mix as less desirable than did the youngest group.

Results

There was no difference across ethnic groups for total contamination in the experimental condition (X^2 (2, N= 33) = .136 p> .05), therefore, the data was treated as one group. The data showed that there was a difference between the overall contamination score for a liked food touching another liked food in a culturally odd mix, in comparison to a control (z= -4.01, N- ties = 20, p< .0001). Overall, 20 of the


3
2.5
2
1.5
1
Mean Hedonic Rating
Unadulterated
Touching
Removed
Out of Sight
Stages of Contact


Mean Hedonic Ratir
3
2.5
2
1.5
1
Unadulterated
Touching
Removed
Out of Sight
Stages of Contact
3- to 4- years
4- to 5- years
5- to 6- years

Discussion

The results show that children across the age range were aware of the culturally odd mix of food, i.e. the liked foods were rated lower on a hedonic rating scale when in a culturally odd mix, compared to the liked foods that were presented in a culturally acceptable mix. Furthermore, this occurred across the three ethnic groups. When the culturally odd mix of food was separated ('removed' stage), the ratings for the liked food increased significantly, although the mean rating did not return to that of the unadulterated level in the 'removed' or 'out of sight' stages. Analysis of the different age groups show that age did have an effect, those in the oldest groups (5 to 6 years) rated the culturally odd mix as less desirable than those in the youngest group (3 to 4 years).

The culturally odd mix of food was, therefore, treated differently to the culturally acceptable mix, and this demonstrates some knowledge of cultural categorisation of food during early childhood. However, the mean rating for the liked food at the 'touching' stage in the experimental condition only reduced to below the 'ok' level in the 5 to 6 year old group. While the scores for the 'touching' stage reduced significantly, compared to the unadulterated score, in the other two groups, it only fell between the 'liked' and 'ok' scores. Previous research suggests that, between 4 to 7 years of age, young children show some awareness of contamination (Rosen & Rozin, 1993; Seigal, 1988; Springer & Belk, 1994). Furthermore, studies show that, while knowledge of the social rules surrounding food and contamination may exist, the resulting rejection may not be a fully ingrained motivation for rejection (Mumme et al., 2007; Toyama, 2000). The study presented here supports this idea; while there is knowledge of what foods culturally do and do not mix, there is not a huge impact on the acceptability of the liked foods. Furthermore, the age difference in the response

between the youngest and oldest group suggests the learning takes place between 3 and 6 years.

The study by Birch et al. (1984) showed that pre-school children have learnt the implicit, culturally defined rules that dictate time of day preferences for food. However, Rozin et al. (1986) investigated whether or not pre-school children have an awareness of culturally odd food mixes, i.e. cultural food categorisation. The results suggested that pre-school children are unaffected by culturally odd mixes of food, when a picture is used and the comparison is made with adult ratings.

A study by Fallon et al. (1984) showed that when using a hotdog or M&M sweet to 'contaminate' a drink six of the eleven participants aged 3 years 9 months to 6 years 1 month rejected the drink. This was significantly different when compared to an adult group but, again, does show some cultural categorical knowledge of food. The current study uses real foods as the stimuli and, rather than comparing against adult ratings, compares children's response to culturally odd foods against their response to culturally acceptable mixes. The results show that young children do have an understanding that some foods are not meant to be given together, however, this learning takes time to become ingrained and result in the type of rejection shown in the adult groups from previous studies (Fallon et al., 1984; Rozin et al., 1986).

Conducting research with food during childhood using *real* foods may result in children giving a response more consistent with their everyday reaction, in comparison to studies using pictures or other representative, non-food stimuli. The use of actual foods also offers the added potential for the child; to envisage that they may be asked to try the foods and, therefore, give a response more congruent to their actual likes and dislikes. Furthermore, understanding of food in early childhood may

be better gained from comparing across stimuli within similar age ranges, as opposed to comparing children's responses to those of adults.

The results presented here show that children are aware of the way in which food mixes are culturally categorised and that this knowledge increases during pre-school and early childhood. Interestingly, it seems that while the knowledge exists, it is yet to become a true motivation for rejection. If the motivation for the rejection is due to the thought that culturally odd food mixes are 'disgusting' then this may be a cognitive form of disgust, which may not occur until 7- years or over when adult-like disgust is thought to become a motivation for rejection (Falon et al. 1984).

Further Research

Although the texture of the foods were controlled in order to avoid leaving visible traces of food, there is difficulty in knowing whether the reduction in rating is due to the children inferring an alteration in the taste of the liked foods due to the touching, and therefore the potential for distaste, or whether the thought of the foods together is disgusting. Asking children to express this verbally has the potential to mask the motivation due to a lack of language skills required to express the reason for the rejection (Fallon et al., 1984). A further research suggestion would be to measure the facial response of participants as the foods were presented using a facial coding tool such as Ekman and Fiesen's (1978) facial action coding system (FACS) which shows excellent reliability for coding disgust facial expressions (Sayette, Cohn, Wertz, Perrott & Parrott, 2001).

Limitations

The current study used the researcher's awareness of cultural food categorisation to determine what foods would be used as the culturally acceptable mix and which foods would form a culturally odd mix. The study may have benefitted from using a more objective way of establishing these conditions.

CHAPTER 4: DISCUSSION

The aim of this chapter was to estimate the prevalence of the rejection of previously accepted food during early childhood and present data on some of the initial patterns shown with this type of rejection. Furthermore, to present the first of two hypotheses given in this thesis; food neophobia increases anxiety towards food stimuli (Galloway et al., 2003; Pliner et al., 1995; Pliner & Hobden, 1992; Pliner et al., 1993), making the visual properties of food salient and those foods that differ enough from learnt, prototypical expectations are categorised as "new" and are rejected on sight in a neophobic response. Finally, the aim was to investigate some aspects of children's early food categorisation.

Study one has shown that many parents (between 50 and 74%) report their child as having rejected a previously accepted food during childhood, that this begins to occur around 20 months of age and reduces to its lowest levels after 30 months and that the most highly rejected food groups are vegetables, mixed foods, and fruit respectively. A follow up questionnaire given to a smaller sample suggests that children who have rejected a previously accepted food are considered to be more neophobic and more 'picky' than children who have not rejected a previously accepted food. Furthermore, children who were reporting to have had problems (e.g. illness) during the transition to solids in their first year of life, reported increased food neophobia, pickiness and were more likely to have rejected a previously accepted food in their second year.

Previous research suggests that a conceptual category has not formed during infancy (Rozin, 1986b). However, the study used willingness for children to place items in their mouths as a measure of "acceptance"; the items were not actually

consumed and the study has high task demands. It seems that when children become food neophobic they are willing to place a number of non-food items into their mouths while *rejecting* new foods suggesting a conceptual category has developed. Study two of this chapter presents two studies looking at the categorisation of toy foods during infancy, including conceptual, basic, like/dislike and the influence of feature changes to food categorisation. Firstly, an exhaustive grouping task was carried out. Results showed that infants are able to exhaustively group 18 toy animals and 18 toy foods after a period of free play by the age of 22 months, despite wide ranging perceptual differences within each of the categories. A second study, using sequential touching task, showed that infants responded to the animals and foods systematically, but only two of nine showed categorisation of the items. It was concluded that this provides some evidence that a conceptual food category is developing during late infancy.

Of the other sequential touching conditions, only basic categorical knowledge of food was demonstrated (fruit v's biscuit) where the mean run length was significant and 5/9 participants showed categorisation. None of the other data showed significant findings. However, with the theoretical importance of local, global and colour changes to foods suitability and the onset of food neophobia, it was concluded that the use of non-food items may have affected the way infants would have responded, in comparison to their responses to *real* foods.

Study three presented a pilot and main study examining cultural categorisation in children aged 3 years 1 month to 4 years 10 months. While Rozin et al. (1986) showed that, when compared to adults, children do not show cultural categorisation knowledge, Birch et al (1984) showed that children will change their ratings of real foods when they are served at different times of the day. The results show that, while

the children did not reduce their rating of culturally odd mixes below the level of ‘OK’ (overall), they did show a different response to a culturally odd mix of food when compared to a culturally acceptable mix of food. This study suggests that categorical food knowledge is extensive by the time children reach pre-school age and that the use of actual foods is useful, as opposed to toys or pictures, when establishing food knowledge in early childhood. The empirical studies in the following chapter only use actual foods.

CHAPTER 5

REJECTED/DISLIKED FOODS ACTING AS CONTAMINANTS IN EARLY CHILDHOOD; DISGUST

The previous chapter considered the influence of categorisation on the rejection of known and previously accepted foods, during early childhood. Based on the conclusions from Chapter four, the following findings are drawn from children's interactions with *real* food, as opposed to pictures or food models. This will allow for greater ecological validity and, potentially, lead to more reliable results. The current chapter will consider the second of the hypotheses offered to explain why young children may begin to reject previously accepted foods; that disgust may influence the acceptability of food during early childhood. Furthermore, this chapter will investigate whether the likelihood of a rejected food being found 'disgusting' is related to sensory sensitivity, food neophobia and/or early childhood food experiences.

The first of the sections presented here; study four, offers a theoretical review to demonstrate how disgust may occur in early childhood. This is then followed by two empirical studies. The first of these studies was used to develop a method suitable for examining whether rejected foods can act as contaminants. While disliked food acting as a contaminant has been anecdotally reported (Cashdan, 1998; Harris, 2000; Rozin, 1990) no studies have investigated these reports. In the following chapter, study five presents a pilot, followed by the main study in that paper. These were initially conducted with children aged 4 to 6 years as this provided an easier group with which to support the principle that food acting as a contaminant could occur, and to collect some initial, exploratory data. The second empirical paper presented in this

chapter, study six, uses a modified version of the method used with 4 to 6 year olds, in order to determine whether food can act as a contaminant during late infancy. This study also provides more in-depth questionnaire data, to try and account for differences between children who demonstrate contamination, in comparison to those who were unaffected by the presence of a rejected food.

REVIEW ONE

CAN DISGUST INFLUENCE THE ACCEPTANCE OF FOOD DURING INFANCY? A THEORETICAL REVIEW

Abstract

During infancy a facial disgust response occurs to some tastes and varies in intensity (Rosenstein & Oster, 1988). This response continues into adulthood where non-taste stimuli, e.g. cockroaches, cause a similar reaction (Sullivan & Lewis, 2003). The non-taste response may also vary in intensity with each factor having additive effects (Martins & Pliner, 2006). The positive correlation reported between disgust and fear towards stimuli (de Jong & Merckelbach, 1998) could be one such factor. Furthermore, though research has shown disgust towards food is based on cognition, i.e. animalness (Rozin & Fallon, 1987), recent research suggests texture is salient (Martins & Pliner, 2006). The similarities between taste and non-taste disgust responses led Rozin et al., (1999) to suggest disgust may develop from distaste.

A theoretical model, based on previous research, is proposed in which perceptual food disgust develops from distaste, around the time neophobia begins. Furthermore, it is suggested that neophobia has an additive effect on disgust, increasing the potential for a disgust response. The increased anxiety in relation to food increases the salience of the foods' perceptual features. The infant has prototypical, learnt expectations of the food given, and examples providing a perceptual mismatch, or perceived to have aversive taste/textural properties, are rejected on sight in a mild disgust response. This results in a perseverant response to prototypical foods. Pressure to eat the rejected foods may increase the disgust

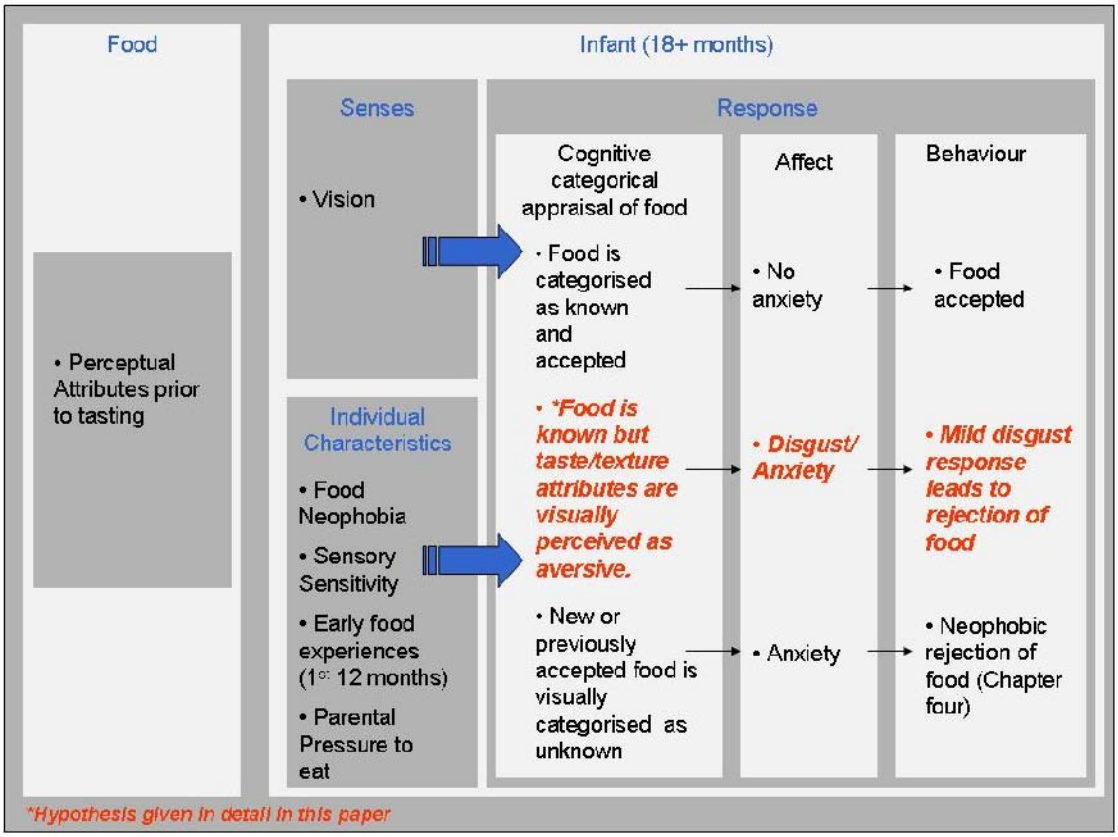
response. If there is no pressure to eat, modelling, exposure, widening of categories and reduced anxiety over time is likely to allow the foods to be re-introduced.

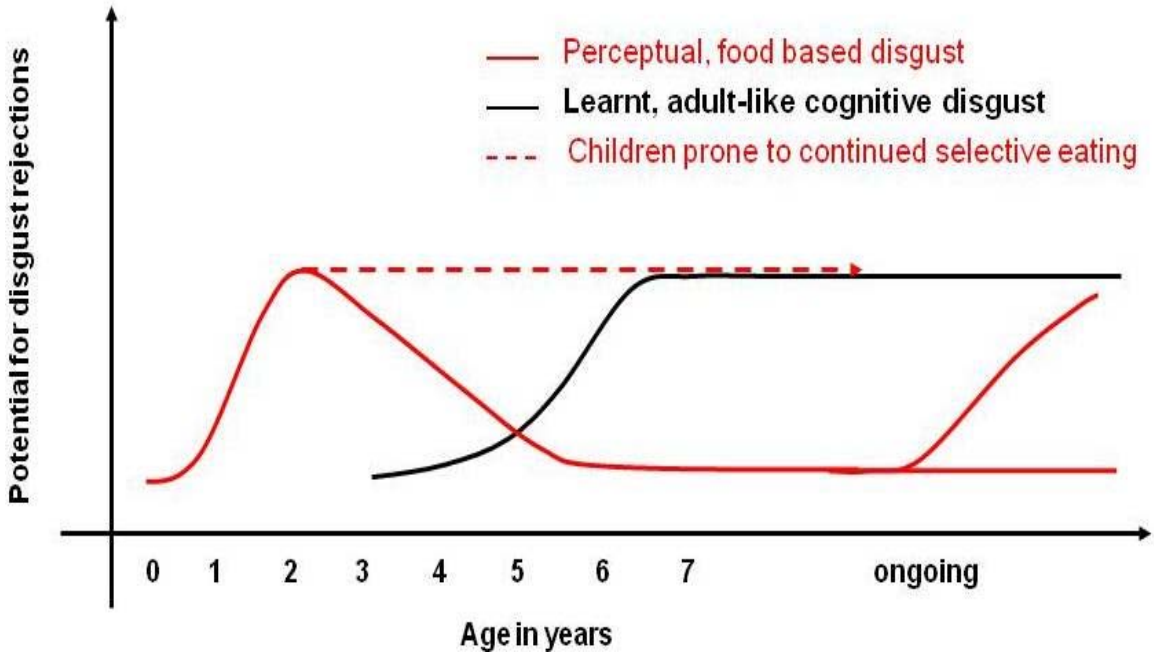
CAN DISGUST INFLUENCE THE ACCEPTANCE OF FOOD DURING INFANCY? A THEORETICAL REVIEW

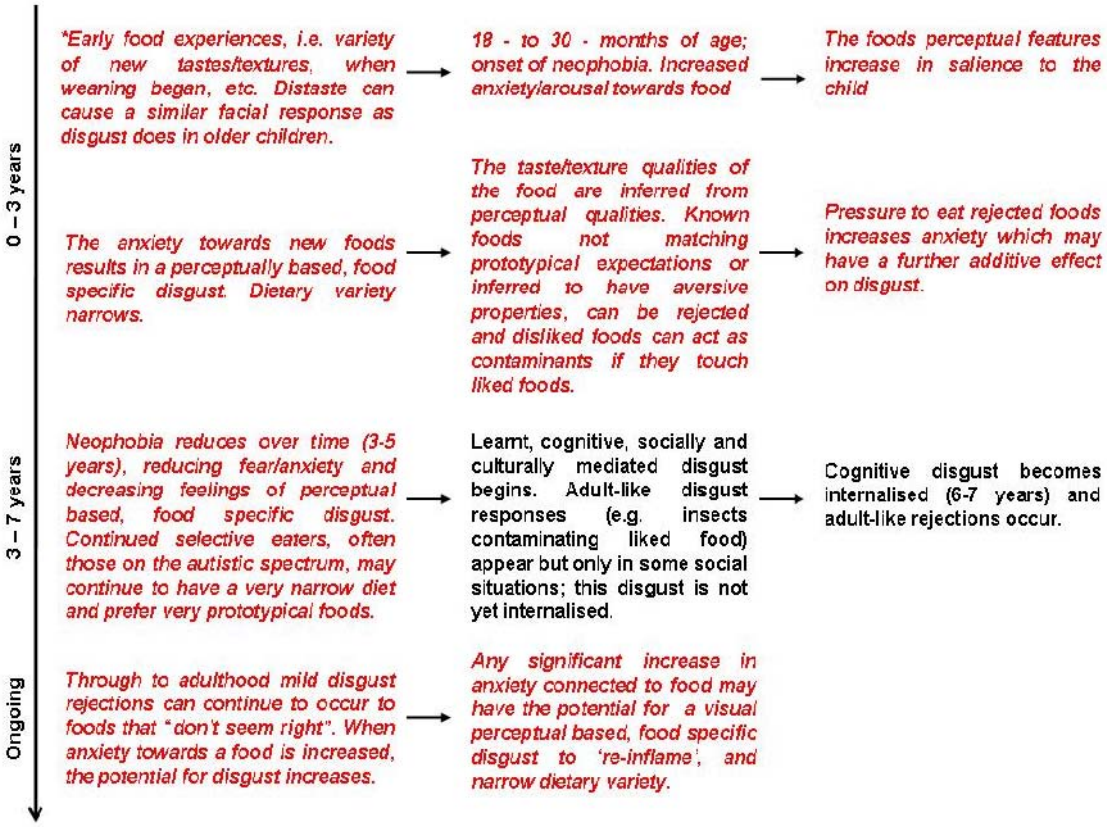
Overview

The review presented here introduces a second hypothesis for why infants begin to reject previously accepted foods; that disgust can influence this form of rejection. Together, the hypotheses proposed within this chapter are offered to explain, why an infant may reject a food he has eaten before, even though the food is recognised, why previously accepted food may be rejected and seemingly considered different to 'normal', and why other foods continue to be accepted without a problem (see fig. 5.4.1). While there are many reasons why food can be rejected at any given time, not least due to distaste, the model presented here offers an explanation as to why foods may be rejected *on sight* at the beginning of the neophobic period, and why dietary variety may narrow during this time.

The theoretical review presented below was formed from the review of literature provided in chapter 2 of this thesis.


Food
• Perceptual Attributes prior to tasting
Infant (18+ months)
Senses
• Vision
Individual Characteristics
• Food Neophobia
• Sensory Sensitivity
• Early food experiences (1°: 12 months)
• Parental Pressure to eat
Response
Cognitive categorical appraisal of food
Affect
Behaviour
• Food is categorised as known and accepted
• No anxiety
• Food accepted
• *Food is known but taste/texture attributes are visually perceived as aversive.
• Disgust/ Anxiety
• Mild disgust response leads to rejection of food
• New or previously accepted food is visually categorised as unknown
• Anxiety
• Neophobic rejection of food (Chapter four)
*Hypothesis given in detail in this paper


Perceptual, food based disgust
Learnt, adult-like cognitive disgust
Children prone to continued selective eating
Potential for disgust rejections
0
1
2
3
4
5
6
7
ongoing
Age in years



*Model begins

beginning of neophobia is likely to be a period of sensitivity towards food. Visual elements of foods are likely to become salient as food has to be recognised before being consumed, in order to reduce this anxiety.

Reports of fear and disgust have been shown to correlate when measured against a phobia inducing stimulus (Cisler et al., 2007; de Jong & Merckelbach, 1998; Mulkens, de Jong & Merckelbach, 1996; Tolin, Lohr, Sawchuk & Lee, 1997). Furthermore, Thorpe and Salkovskis (1998) proposed, that when a substance becomes the source of a phobia, the feelings of disgust towards that stimulus may increase. The proposal by Martins and Pliner (2006) then, that disgust responses could vary in strength, with each latent disgust factor having an additive effect, suggests that anxiety towards food could be one such additive effect, e.g. a person who has anxiety towards food, and infers the food to have a "slimy" aversive texture, is likely to find that food more disgusting than if only one factor was present. Disgust itself is thought to be a food-related emotion (Rozin & Fallon, 1987) and a number of researchers suggest disgust may have developed from distaste (Fallon *et al.*, 1987; Rozin, Haidt & McCauley, 1999; Torochuk & Ellis, 2007). Therefore, it is proposed here that experiences of distaste in early infancy give the child a reference for "disgusting" foods. When anxiety towards foods begins in the form of neophobia, those foods that are perceived to be visually aversive or that "don't seem right", have an increased potential to evoke a mild disgust rejection. While the child may recognise the food presented; local, colour or global changes to the foods' visual properties, that do not match the child's learnt, prototypical expectations of that food, or changes within the food that the child infers be texturally aversive or taste aversive, mean the food is rejected on sight in a disgust response.

The rejection due to this "disgust response" is likely to be a mild one, with just enough disgust evoked to not want to eat the food. However, Simpson, Anthony, Schmeer and Overton (2007) showed that a substance that evokes disgust does so to a higher level at the prospect of ingesting the item, therefore if an attempt is made to pressure the child into consumption, the disgust response is likely to increase, along with anxiety, and may even result in a longer term aversion (Batsell & Brown, 1998; Batsell & Brown, Ansfield & Paschall, 2002). Finally, an essential element of disgust as proposed by Rozin and Fallon (1987) is that disgusting substances act as contaminants. Therefore, if a food based perceptual disgust does appear during late infancy then rejected foods should have the potential to contaminate liked foods when they touch, a finding that has been reported anecdotally by Cashdan (1998), Harris (2000), Rozin (1990) and often demonstrated by "selective eaters" (Timimi, Douglas, Tsiftsopoulou, 1997).

Research on the elements of food that can initiate disgust responses (as opposed to non-foods, e.g. a fly) has focused on the ideational factors such as animalness and livingness. These disgust reactions require more than perceptual knowledge, however recent research proposes that textural properties, that could be perceived visually, are more influential in eliciting disgust (Martins & Pliner, 2006). Insight into textural properties and other perceptually based inferences can occur without ideational, cognitive knowledge and therefore be present in young children. Textural and other potential disgust factors could be elicited from the child's increased focus on the food's perceptual features, caused by the anxiety towards food at the onset of neophobia, resulting in on-sight rejections. During the time period in which neophobia begins, the foods often reported as rejected are fruit, vegetables and mixed foods (Brown & Harris, 2007; Cashdan, 1998; Carruth et al., 1998; Jacobi et

al., 2003), all of which are highly liable to perceptual changes between servings in the domains of texture, size and colour, in comparison to many manufactured food products. These changes could result in the inference of adverse taste/texture, or the foods could be categorised as "doesn't seem right" and rejected.

Rozin et al. (1986) showed that between 16 and 29 months of age, children will put 35% of adult disgust items in their mouth, and because of this, Rozin et al. concluded that disgust is not present during this time. However, the disgust items used were those considered disgusting according to adult criteria, and therefore required cognitive knowledge of nature and origin; that is, items that are disgusting on an ideological basis. This form of disgust rejection will not be shown until the child has had time to learn about, and socialise to, the subjective, culturally mediated, disgusting properties these items possess.

Neophobia begins between 18 to 24 months of age (Addessi, et al. 2005; Cashdan, 1988; Cooke et al. 2003; Harper & Sanders, 1975) and at this time children often *stop* putting new foods into their mouths. The measure used by Rozin et al. (1986) to calculate "acceptance" was children's willingness to put the items into their mouths not to actually consume the substance. Children often explore the properties of an item by placing it in their mouth but the intention is unlikely to be consumption (Tulve, Suggs, McCurdy, Hubal & Moya, 2002). Therefore the willingness for a child to place an adult disgust item in their mouth, while often rejecting food on sight, *may not be* that there is no form of non-taste disgust in young children but that disgust at this age is *only towards foods*.

Although not identical to human adult disgust, animals also react in negative ways towards offensive or aversive objects. Monkeys can squash items, throw them away and wipe their hands after touching the offensive substance (Garcia, Quick &

White, 1984) and rats have been shown to gag, gape their mouths and shake their heads to presentation of conditioned aversions (Toronchuck & Ellis, 2007). Furthermore, mammals that hold food in their paws have shown that, after experiencing the consequences of poison, the foods tactile cues and olfactory features, rather than solely taste, can be used to judge whether or not it should be eaten (Domjan, 2005). Together, these studies demonstrate the prominence of non-taste food features in perception. Therefore, a form of disgust, that is perceptual and does not rely solely on cognitive knowledge, may exist to non-taste stimuli.

3 – 7 years

Around this time it is proposed that the visual perceptual, food based, disgust will decline in the majority of children. As neophobia reduces in intensity (Birch et al. 1987; Koivisto & Sjödén, 1996; Pelchat & Pliner, 1995; Pliner & Salvy, 2006) so should the correlating potential for disgust. More foods will have been exposed to the child, resulting in easier acceptance of textures, and the child will have a wider understanding of food categories (Nguyen and Murphy, 2003), allowing for more variation in presentation of food before it would be considered "odd". Modelling adults (Adessi et al., 2005; Harper & Sanders, 1975; Hendy & Raudenbush, 2000) and peers (Birch, 1980; Hendy, 2002) also encourages acceptance of new foods and the reduction of food neophobia and may help in reducing the disgust response.

The more adult-like, cognitive disgust seems to develop over a period of time, beginning around 3-5 years, as a cognitive knowledge of contamination begins to show (Rosen & Rozin, 1993; Springer & Belk, 1994; Toyama, 1999, Toyama, 2000). However, the initial adult-like disgust responses may not be an intrinsic desire to avoid contact with the "disgusting" items, but instead due to the child developing an

understanding of social expectations. From around 4 years a child will begin to reject "disgusting" food in some social circumstances without doing so in others (Mumme, Gradwohl & Adams-Lariviere, 2007; Toyama, 2000). Furthermore, children show that they are prepared to consume a substance that has been "contaminated" by a disgust item, but know of the social rules as to why they should not (Mumme et al., 2007). It seems that this initial learning does eventually become ingrained and shows itself as the internal, learnt, cognitive disgust that Fallon et al., (1987) report.

Individual differences

Few food preferences are innate (Desor, Maller & Turner, 1973; Harris, Thomas & Booth, 1990; Rosentein & Oster, 1988). Research has shown that the majority of our food choices are learnt via exposure (Birch et al. 1998; Birch & Marlin, 1982; Birch et al., 1987; Nicklaus et al. 2005; Pliner, 1982; Wardle et al., 2003; Wardle et al., 2003). Therefore it is likely that early dietary variety and exposure may be beneficial to later food consumption (Skinner, Carruth, Bounds, Zeigler, & Reidy, 2002; Skuse, 1993; Sullivan & Birch, 1994).

Blossfeld, Collins, Kiely and Delahunty (2007) found that infants' willingness to consume different textures (pureed/chopped carrots) were influenced by, among others, early dietary variety and breast feeding duration. Furthermore, the scores for "pickiness" and "fussiness" were negatively correlated with the intake of chopped carrots. These data suggest that early food experiences have an effect on food consumption in the second year of life. It seems that this pattern of early experiences and later food acceptance also continues well beyond the first years of life. Coulthard, Harris and Emmett (2009) found that children who were introduced to lumpy textures after 10 months suffered with more feeding difficulties, including less dietary variety

and eating insufficient amounts, at 7 years than those who were introduced to lumpy textures prior to 10 months; even after controlling for early food difficulties. Galloway et al. (2003) studied the factors contributing to "picky" girls at 7 years and also found that early experiences were important to later food acceptance. Infants who were breast fed, and whose parents reported more time to eat healthily, were found to be less "picky" at 7 years of age. This could be due to the transfer of flavours early in life through the breast milk and the mothers' healthy diet (Gerrish & Mennella, 2001; Mennella & Beauchamp, 1996; Mennella, Jagnow & Beauchamp, 2001), the increased time these mothers had to prepare a range of foods for their child, or a combination of both.

Some tastes from breast milk, as a result of the mothers' diet, transmit to the child and, while not significantly increasing intake, may influence their acceptance of new food flavours (Gerrish & Mennella, 2001; Mennella & Beauchamp, 1996; Mennella et al., 2001). When a child begins to consume solids during the first year of life, it seems there is a period of easy acceptance (Skuse, 1993) which may be influenced by flavour learning during breast feeding and even prenatally (Hudson & Distel, 1999; Mennella et al., 2001). Just one exposure to a new taste has been shown to increase the acceptance of that food and of similar foods during infancy (Birch et al. 1998). The number of exposures needed to influence liking and acceptance towards the end of infancy, when neophobia is likely to have begun, increases to 10-15 (Birch & Marlin, 1982; Birch et al., 1987). In combination, the acceptance of a variety of tastes, textures and foods with different visual appearances could lead to wider categories forming around the onset of neophobia and reduce the number of foods failing to match prototypical expectations or perceived to have an adverse

texture. Therefore different early experiences may contribute to more or less visual perceptual, food based disgust rejections in individuals.

Another element of the response that could account for individual differences is how neophobic a child is. The proposal offered here suggests that the anxiety produced as a result of neophobia is key to the onset of this visual perceptual, food based disgust response. Therefore, infants with higher levels of neophobia should have a higher anxiety towards food stuffs, consequently a greater focus on perceptual qualities of food and therefore more potential for disgust based food rejections. Different levels of neophobia correlate with different levels if anxiety in adults (Galloway et al., 2003; Pliner and Hobden, 1992) and anxiety reducing behavioural techniques are used to help reduce neophobia in adults and children (Singer, Ambuel, Wade, & Jaffe, 1992; Marcontell et al., 2003).

Finally, as visual perception is relevant to on-sight food rejections towards the end of infancy, a child's sensory sensitivity could also be an important factor in explaining individual differences in children's propensity to reject a food on sight in a disgust response. Children on the autistic spectrum, who are often sensory sensitive and can become selective eaters (Timimi et al., 1997), have less dietary variety (Nicholls et al., 2001), have more problems with textures, reject more foods (Schreck, Williams and Smith, 2004) and are more likely to want specific presentation of foods and specific utensils, when compared to controls (Schreck et al., 2004; Timimi et al., 1997; Williams et al., 2005) and these preferences appear around 18 months of age and can continue to be selective eaters for many years (Nicholls et al. 2001; Schreck, Williams and Smith, 2004; Timimi et al., 1997; Williams, Gibbons & Schreck, 2005).

Increased food related anxiety and increased disgust in adults: Ongoing

The final part of this proposal for a perceptual, food based disgust is that it continues through to adulthood. If this is the case then anxiety in relation to food later on in life should have the propensity to inflame disgust, as it did during the beginning of neophobia. It is likely that rejections of known and accepted foods do occur on occasion in adulthood as foods that intuitively "don't seem right", are sometimes rejected, based on the visual properties of the food. Cardello (2003) found that as the level of concern about a food increased, the rating for how liked a food was decreased. An example expressed here is the propensity for consumers to reject non-prototypical fruit and vegetables when shopping (McCarthy, 2006). This seems to be a normal response and causes just enough anxiety to reject the food presented and opt for the "prototypical" examples.

When anxiety over food increases beyond "normal" levels it seems a far more pronounced effect may occurs in adults, and this is reflected in studies relating to eating disorders and disgust. Though literature is sparse, Troop, Treasure and Serpell (2002) measured the disgust sensitivity in participants with a history of, or current, eating disorders and found that, rather than an increase in all disgust domains, such as sexual practices or gastroenteric products, only food and body disgust sensitivity increased (also see Davey, Buckland, Tantow & Dallos, 1998 for similar findings). The studied showed that both current patients and those in remission from an eating disorder showed elevated levels of disgust in relation to animal foods. The disgust scale used (Baker & Davey, 1994, as cited in Troop et al. 2002) only questioned participants on their response to animal foods, is currently unpublished and therefore it is not clear whether the foods evoking disgust did so purely on "animalness" or whether the visual properties of the food could have influenced the reported feelings

of disgust, as in Martins and Pliner (2006). While eating disorders in later life are usually connected with drive for thinness (Fairburn & Harrison, 2003), with the increase in anxiety over food stimuli, usually related to prospect of intake (Cardello, 2003; Simpson et al., 2007), there may be an increase in disgust towards certain properties of food that can be visually inferred.

Overview of hypothesis

Rozin and Fallon (1987) show that, just the prospect of consuming the stimulus, is enough to result in a disgust response and, furthermore, that the substance can contaminate an otherwise acceptable food. The proposal presented here suggests that the rejection of previously accepted food, on sight, could be a similar disgust response but that it is specific to food, i.e. a fly will not cause the same reaction. It is perceptually based rather than cognitive, and that the antecedent is the increase in anxiety/fear during the onset of neophobia which results in an increased focus on foods' perceptual features and an increased potential for a disgust response if foods a) do not match learnt, perceptual expectations, or, b), are perceived to have an aversive taste/texture.

Furthermore, it is suggested that individual differences in early food experiences, level of food neophobia and how sensory sensitivity a child is, could account for individual differences in the potential for a disgust response based on the foods' visual properties. Finally that this disgust response has a reduced influence over food choices as the neophobic rejections reduce (Birch et al. 1987; Koivisto & Sjödén, 1996; Pelchat & Pliner, 1995), continues into adulthood along side a learnt, cognitive disgust, and food related anxieties later in life may have the propensity to inflame the response, as food neophobia has in infancy.

Future research

Further research has to confirm a number of things. Firstly, it needs to be shown that, during infancy, children find perceptual changes within foods salient. Secondly, the anecdotal evidence (Cashdan, 1998; Harris, 2000; Rozin, 1990), and evidence from case reports of clinical patients (Timimi et al. 1997), that disliked foods can act as contaminants, needs to be documented during infancy, and early childhood, and shown under controlled conditions. Also, whether or not early dietary experiences, level of neophobia and level of sensory sensitivity have mediating effects on infants' propensity to find some foods disgusting should be investigated. If these elements of the model can be supported in future research, then the proposal presented here that a perceptually based, food related disgust occurs in infancy would be supported.

Finally, the hypothesis that an increase in food based anxiety may result in a "reappearance" of these early food rejections, due to an inflamed disgust response, should be investigated. Currently research into "selective eaters", who seem to develop problems at the start of the neophobic period (approx. 18 months), have anxiety towards foods, and who can continue to have problems for many years, shows that they eat a specific range of foods often consisting of carbohydrates (Nicholls et al. 2001; Timimi et al. 1997; Williams et al. 2005). It may be that these foods are more consistent in terms of visual properties and offer fewer textural cues for disgust, therefore lowering anxiety and allowing for easy consumption. This pattern may also be true of food preferences for people who suffer from other forms of raised anxiety towards food.

Applications:

It is suggested here that the rejection of some previously accepted foods is likely to be a normal occurrence towards the second year of life and that increased propensity towards sensory sensitivity and neophobia may further increase the likelihood of dietary narrowing around this time. Infants should be given opportunities for a wide variety of early food learning during the period of easy acceptance in the first year of life, including breast feeding where possible, wide exposure to tastes and textures during age appropriate stages (Harris, 1993) and with the use of modelling (Adessi et al., 2005; Birch, 1980; Harper & Sanders, 1975; Hendy, 2002; Hendy & Raudenbush, 2000). This may help in widening children's "accepted" food categories, result in fewer prototypical expectations of foods and fewer concerns over texture. However, if previously accepted foods are rejected there should be no pressure to eat these foods. Modelling, exposure, widening of categories and the reduction of neophobia over time should allow for the foods to be reintroduced, if pressure to eat is avoided. Pressure to eat is likely to increase disgust feelings, increase refusal and possibly create more long term rejections (Batsell & Brown, 1998; Batsell et al., 2002). As children's early food rejections are most commonly reported to be fruit (Cooke et al., 2003) and vegetables (Carruth et al., 1998; Jacobi, Agras, Bryson & Hammer, 2003), and research suggests that the mere prompting to eat can result in lower consumption and cause a significant increase in negative affect towards the pressured food (Galloway, Fiorito, Francis & Birch, 2006), aversions could be detrimental to later health.

It is possible, however, that if pressure to eat inflames the disgust response, reducing the likelihood of accepting the food, then lowering anxiety may allow a food to be accepted. The initial disgust response is likely to be mild so if the carer can

verbally reassure the child, and provide a calming situation, it may be enough to increase acceptance, at least for a small amount of the food, and therefore allow exposure to take place (Birch et al., 1998; Birch & Marlin, 1982; Birch et al., 1987; Wardle et al. 2003a; Wardle et al., 2003b). A study by Farrow and Blissett (2006) showed that maternal mind-mindedness, the ability to focus on the mind of the child, is associated with a more positive feeding interaction at 6 months, and an authoritative feeding style, characterised by high levels of responsiveness, but also structure (Hughes, Power, Orlet Fisher, Mueller & Nicklas, 2005), has been shown to be beneficial in increasing fruit, vegetable and dairy consumption in African American and Hispanic children 3 to 5 years of age (Patrick, Nicklas, Hughes & Morales, 2005). It may be that parental responsiveness, and a calming environment, could help during the neophobic period to lower anxiety and disgust and aid acceptance.

Finally, if increased anxiety towards food stimuli does result in predictable patterns of food rejection, based on the visual elements of foods, this could have implications in the treatment of people with eating anxieties and disorders across the age span.

STUDY 4

DISLIKED FOOD ACTING AS A CONTAMINANT IN PRE-SCHOOL CHILDREN: A DISGUST BASED MOTIVATION FOR FOOD REJECTION?

Abstract

Anecdotal evidence suggests that disliked food can act as a contaminant. Unlike previous work looking at disgust, this type of contamination, where learnt knowledge of nature and origin may not be required, has not been investigated. The current study presents a pilot and a main study using an experimental procedure to test the observation that rejected foods can act as contaminants.

The children (4 years 5 months – 6 years 1 month old, N= 30) were shown various presentations of food and asked to rate their preferences on a hedonic scale. These data show that children reduce their rating of a liked food, once it has been in contact with a disliked food in comparison to a control. There was a trend for females to be more sensitive to contamination than males, though this did not reach significance. Furthermore, level of food neophobia did not account for the level of contamination shown and neither did the taste/smell subsection of the Short Sensory Profile (SSP) or the overall SSP score.

This study was the first to test the anecdotal reports that food can act as a contaminant and the data offer some support for the hypothesis that disgust may influence the acceptance of food prior to 7 years of age.

DISLIKED FOOD ACTING AS A CONTAMINANT IN PRE-SCHOOL CHILDREN: A DISGUST BASED MOTIVATION FOR FOOD REJECTION?

> *"Anyone who's ever tucked into a full English breakfast knows the importance of mushrooms in keeping the baked beans from touching the bacon"* – Harris (2006, p. 17)

Fallon, Rozin and Pliner (1984) gave children various scenarios, via story telling and accompanying pictures, in which a drink that was rated by the participants as liked when "unadulterated", was then contaminated in various stages by substances that reflect the four reasons for human food rejections, e.g. "poison" for danger rejections and faeces for disgust rejections. The data showed that children do not show an 'adult-like' understanding of contagion, based on disgusting substances, until around 7 years of age (though later studies suggest that this may not be the case, aspects of contamination and contagion have been demonstrated in younger children (Rosen & Rozin, 1993; Seigal, 1988; Springer & Belk, 1994; Toyama, 1999)).

Fallon et al. (1984) used fairly universal, non food, disgust items in their study; a grasshopper and faeces. However, it may be that foods themselves, if particularly disliked, can act as contaminants. As the opening quote demonstrates, it is sometimes favourable for certain foods to be kept away from others and a number of researchers have reported, anecdotally, that young children may reject a liked food once it has touched a disliked food (Cashdan, 1998; Harris, 2000; Rozin, 1990; Timimi, Douglas & Tsiftsopoulou, 1997) demonstrating a contamination response.

If this is the case then a number of individual differences may be relevant to this response. Food neophobia is defined as avoidance of, and reluctance to taste,

unfamiliar foods (Pelchat & Pliner, 1986), a behavior that correlates with disgust (Nordin, Broman, Garvill & Nyroos, 2004; unpublished work cited in Pliner & Salvy, 2006). Therefore, a child with a high level of neophobia may be more likely to respond by showing a contamination response towards disliked foods, than a child who is less neophobic, and this propensity may reduce with age, as food neophobia reduces.

Another factor that may be of importance in contamination responses is the level of sensory sensitivity; with studies showing children with high levels of sensory sensitivity can become very selective eaters (Timimi et al. 1997), have less dietary variety (Nicholls et al. 2001) and be very particular about the presentation of food (Schreck et al. 2004; Timimi et al. 1997; Williams et al. 2005). Therefore, children with higher levels of sensory sensitivity may be more likely to reject a food that has touched a disliked food, than a child who is less sensory sensitive.

Finally, gender may be important in understanding why, if disliked foods can act as a contaminant, one child may be more susceptible than another. Higher levels of disgust are often reported by women than by men (Davey, 1994; Haidt, McCauley & Rozin, 1994; Nordin et al., 2004; Schienle, Schäfer, Stark, Walter, & Vaitl, 2005), therefore if a contamination response is due to disgust, there may be an increased likelihood of a contamination response shown by females. The gender pattern for food neophobia is less clear with studies reporting higher levels in both males and females (Alley & Burroughs, 1991; Frank & Van der Klaauw, 1994; Hursti & Sjoden, 1997; Tuorila *et al.*, 2001) or no gender differences in some studies (Koivisto & Sjoden, 1996; Pliner & Hobden, 1992; Loewen & Pliner, 2000). During childhood, while there is a slight increase in reports of neophobia for males, this difference is not significant (Cooke, Carnell & Wardle, 2006; Falciglia, Couch, Gribble, Pabst &

Frank, 2000). Therefore gender may be influential when examining contamination responses by increasing the propensity for either neophobia or disgust, though with generally higher levels during childhood (Birch et al. 1987; Koivisto & Sjödén, 1996; Pelchat & Pliner, 1995; Pliner & Salvy, 2006), any gender difference may not become apparent in a young sample.

Hypotheses

The aim of the following study was to examine the anecdotal reports that disliked foods can act as contaminants during childhood (Cashdan, 1998; Harris, 2000; Rozin, 1990; Timimi, Douglas & Tsiftsopoulou, 1997) and it was hypothesised that a disgust based rejection would occur between the ages of 4 to 6 years, i.e. a continued reduction in the rating of a liked food, compared to the unadulterated rating, once it has touched a disliked food and after the disliked food has been removed. Secondly, the younger children in the sample may be more prone to a contamination response than the older children in the sample, in line with neophobia decreasing with age (Birch et al. 1987; Koivisto & Sjödén, 1996; Pelchat & Pliner, 1995; Pliner & Salvy, 2006). And finally, it was hypothesised that gender may affect the response, and that the higher the neophobia and sensory sensitivity scores reported by the parents of the children, the more likely it would be that the children would show a contamination response due to a disliked food touching a liked food.

Method

Study one: Pilot

A pilot study was first conducted in order to test the suitability of the methodology. This involved adaptation of the method used by Fallon et al., (1984)

involving various ‘contaminants’ coming into contact with a drink at different stages, e.g. “near”, “in” etc. The children were 6 males and 5 females aged between 3 years 1 months and 4 years 10 months (mean = 4 years) and were recruited from a local nursery. Information packs were sent out to parents via the nursery. If parents were happy for their child to take part in the study they were asked to complete a short information sheet describing their child’s liked and disliked foods, and to sign and return a consent form.

Materials

Foods, based on parental report, were pre-prepared, specific to each participant’s preferences. The criteria for the test foods were that one was liked, one was disliked, together they formed a culturally accepted combination, that they were cut to a similar size and that they were of a consistency that would not leave a trace either on the plate or on the other food. The control foods had to fulfil the same criteria but consisted of two liked foods. The foods were presented on plain, white paper plates and new plates were used for each participant.

The measure used for each child to indicate their preference for the foods was a hedonic rating scale consisting of 3 faces (adapted from Fallon et al., 1984). These represented a sad face if the food was disliked, a straight face if the food was “OK” and a smiley face if the food was liked.

Procedure

The children were tested on a one to one basis within 30 minutes of finishing their lunch. The children were asked to come and “play a game” and if they agreed they were sat at a table with the researcher opposite. Before the testing started the

participant was told that they would be shown some different foods and all they had to do was say how much they would like to eat the food, by pointing to one of the 3 faces, which were laid out in front of the child. To confirm they understood what the faces represented the researcher pointed to each face to explain what they meant and then asked the child to practice by pointing to the face they would point to if they "really wanted to eat the food", "thought it would be OK to eat the food" and if they "didn't want to eat the food". Once it was confirmed the child understood the rating scale the testing began.

For each presentation of a food the child was asked by the researcher "how much would you like to eat this food?" while pointing to the food in question. The only times the researcher asked the child to rate the disliked food was at the start of the testing to confirm the parental report that the food was disliked, and at the end of the testing to confirm that the child's answer would not change, in order to give reliability to any changes in rating applied to the liked food. On all other occasions the researcher clearly pointed to the liked food when asking for the child's rating. Foods were given in the following format:

1) Disliked food alone on a plate (then removed from view)

2) Liked food alone on a plate (then removed from view)

3) UNADULTERATED MEASURE - Both foods presented but on different plates (then removed from view)

4) TOUCHING - Both foods touching on the same plate

5) REMOVED - The liked food back on its own plate (taken from the other plate using tongs)

6) OUT OF SIGHT - The liked food on its own (the disliked food removed from view)

7) The disliked food on its own

The control conditions were done in exactly the same format, except the disliked food was exchanged for another liked food. The control condition and experimental condition were counterbalanced between children. Once all the presentations were completed the child was thanked and rewarded for their participation with a sticker.

Results and subsequent adaptations

In order to test whether there was a significant reduction in the preference for the liked food, once it had come into contact with the disliked food, a contamination score was calculated by counting the number of stages required for the rating to return to the "unadulterated" level; from 0 – for no contamination to 3 – if the rating for the liked food did not return to the unadulterated level (See Chapter Four, study three for more detail). The data were non-normal; therefore, the analysis was conducted using non-parametric tests.

Data was analysed using a Wilcoxon signed ranks test and the results showed no difference between the experimental and control conditions ($Z= 1.633$, N- ties = 3, $p> 0.05$). This suggests that no contamination effect occurred due to a disliked food touching a liked food. However, a number of issues raised doubts about the methodology used for the study, suggesting adaptations were necessary before accepting a null hypothesis.

Although it did not near significance, the descriptive data suggested that a greater contamination response occurred in the control condition, a reduction of .4 (from a mean score of 3 to a mean score of 2.6) in liking when "near" the disliked food and .5 reductions when "touching" the disliked food. The experimental condition produced a reduction of .2 and .4, respectively. There is no theoretical explanation as to why two liked foods, which form a culturally accepted combination and that do not leave any trace on one another, would result in either of the foods becoming less desired. This suggests the participants may have been too young to fully understand what was being asked of them and they were changing their answers without a clear understanding. Further justification for the adaptation of this methodology is given in Chapter four, study three.

Study two: Main study

A total of 30 participants (18 males) were recruited from an infant school in north London and an infant school in Birmingham. The ages of the participants ranged from 4 years 5 months – 6 years 1 month (mean = 5 years). Information packs were sent out to parents requesting their permission to allow their children to participate in the study. Those willing to give consent were asked to return a signed consent form and complete 3 questionnaires.

Materials

The criterion for the foods used is given in the pilot method section above. Three questionnaires were also used. Firstly, the short sensory sensitivity profile (SSP; Dunn, 1999) was included in the packs given to parents. Secondly, the 10-item Child Food Neophobia Scale (CFNS; Pliner, 1994), with the word "ethnic" removed

(see Flight et al., 2003; Russel & Worsley, 2008), was added. And finally, a questionnaire listing 20 different foods, that fulfilled the criteria of not leaving a trace on the plate or other foods, for which parents were ask to rate on a likert scale as 1 “Extremely Liked” – 6 “Extremely Disliked” by their child, was included in order to identify suitable stimuli.

Procedure

Confirmation of whether the foods were liked or disliked followed the same procedure as the pilot. Once it was confirmed the child understood the rating scale the testing began. Foods were given in the following format:

1) UNADULTERATED MEASURE – The liked food and the disliked foods presented on different plates (the rating for the disliked food was also taken at this point to confirm it was disliked and both were removed after taking the ratings)
2) TOUCHING – The liked food touching the disliked food on the same plate
3) REMOVED – The liked food was put back on a separate plate using tongs
4) OUT OF SIGHT – The disliked food was removed completely from view

Children were asked “how much would you like to eat the food when it is like this?” for the ‘touching’ condition. “What about now I’ve taken it away from the other food?” for the ‘removed’ condition. And finally, “what about if I take this other food away?” for the ‘out of sight’ condition. This format was followed for both the control condition (two liked foods) and the experimental condition (a liked food touching a disliked food).

Data analysis

Overall Contamination: Overall contamination scores were calculated by counting the number of stages required for the rating of the liked food to return to the "unadulterated" level. So that, 0 = no contamination response, i.e. the food was rating as highly as the unadulterated food when it was touching the disliked food. 1 = the liked food rating returned to the unadulterated rating when removed from the disliked food. 2 = the food was rated the same as the unadulterated rating when the disliked food was completely out of view. 3 = the rating for the liked food did not return to the unadulterated level, which was considered a "complete contamination response". As in the pilot study, the data were non-normal so the analysis presented here uses non-parametric tests. Furthmore, all tests are reported as two-tailed. These overall contamination scores were compared to the overall contamination scores in the control experiment, using a Wilcoxon signed ranks tests. The second measure tested to see if the contamination effect continued beyond the 'touching' stage. This was done by comparing stage 3 (removed) ratings and stage 4 (out of sight) ratings for the experimental conditions, with the same stages in the control conditions. Again, Wilcoxon signed ranks tests were used. As multiple comparisons were used, the bonferroni correction was calculated to give an alpha-value of .017.

Age: Child groups were split into those showing the full contamination response and those showing a partial response. These two groups were compared, by age, using a Mann-Whitney test.

Gender Differences: Child groups were split into males and females and their contamination scores from the experimental condition were compared. Gender differences were also examined for the contamination response once the disliked food had been removed and then taken out of sight. These were done using a Mann-

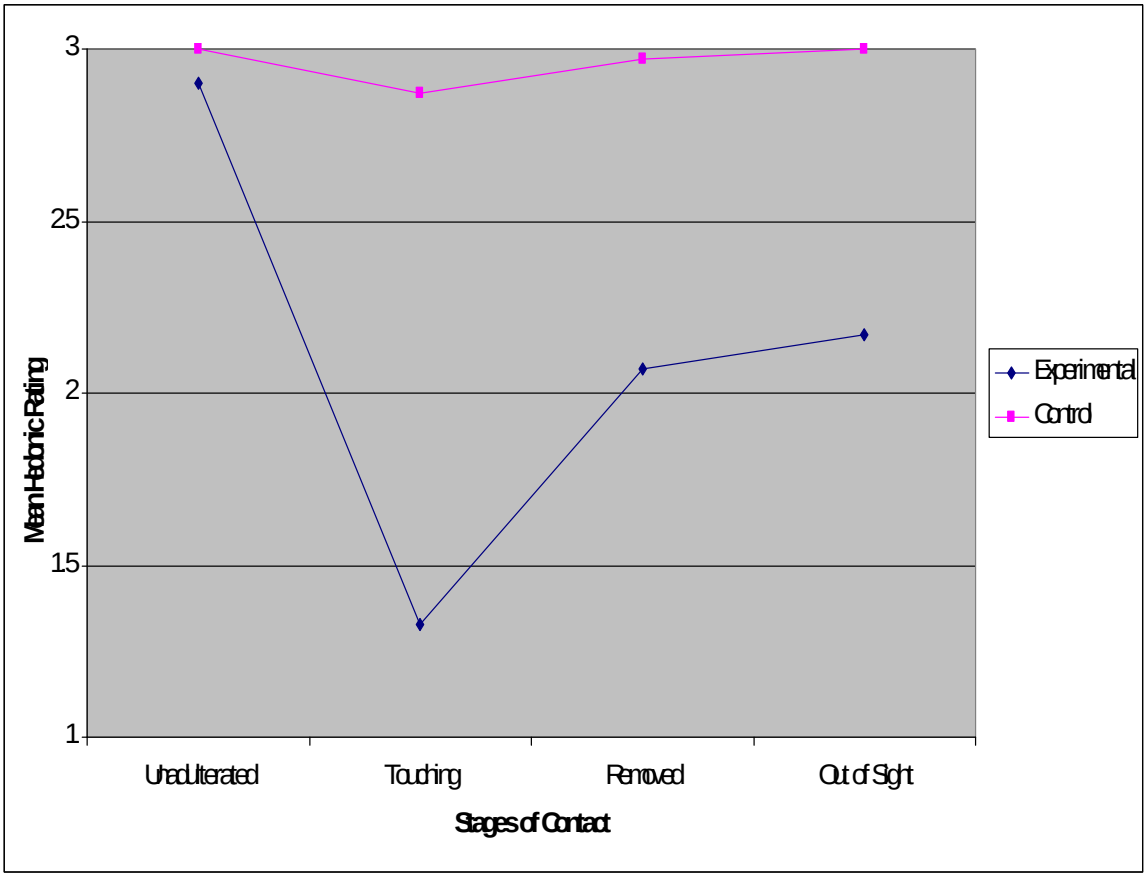
Whitney and this alpha-value was also corrected using a bonferroni calculation and set at .017.

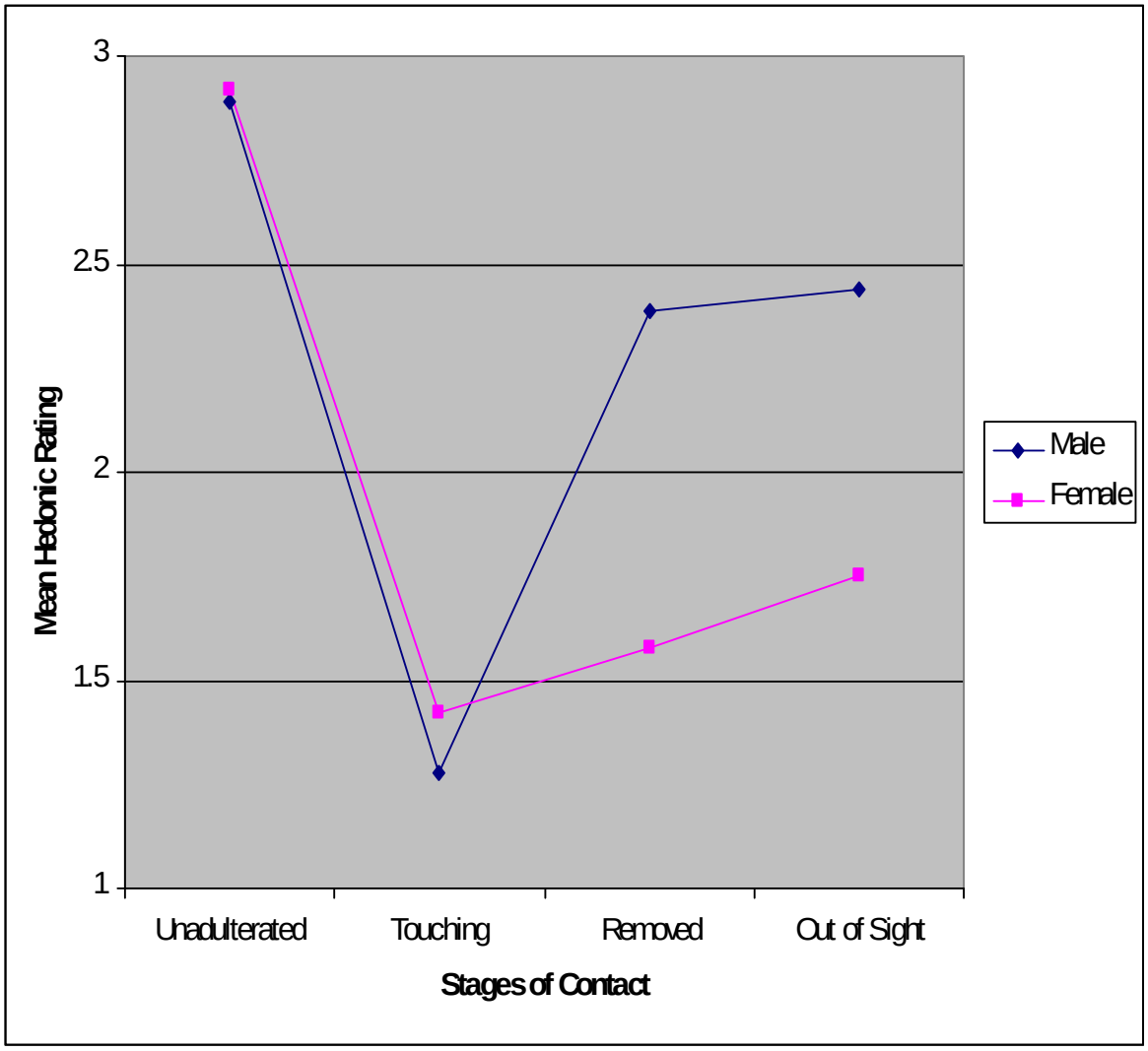
Sensory Sensitivity: The scores for the total SSP (α = .83) and the taste/smell subscale (α = .91) were calculated to see if there was a significant difference between those showing the complete contamination response and those whose rating of the liked food returned to the level of the unadulterated rating at some point during the study, a partial response, again the alpha-value was corrected to .025. For the sample as a whole, the median total sensory sensitivity score was 150.5 (range = 65) and the median for the taste/small subscale was 13 (range 18).

Neophobia: Finally, children's overall score (α = .91) on the Child Food Neophobia Scale (CFNS; Pliner, 1994) was compared for those who showed a full contamination response and those who showed a partial response. Out of the 30 children in the study, 23 parents returned the neophobia questionnaire and 24 parents returned the sensory sensitivity questionnaire. The median neophobia score was 46 (range = 51) for this sample.

Results

The data showed that there was a difference between the overall contamination score for a food touching a disliked food, in comparison to a control (z= -4.902, N- ties = 30, p< .001). In order to examine whether the 'contamination response' continued beyond the liked food actually touching the disliked food, stage 3 of the experimental and control conditions were compared separately and show that once the disliked food had been removed, the rating for the liked food was still significantly reduced compared to control (z= -3.874, N- ties = 18, p< .001). The same was true for stage 4, the 'out of sight', condition (z= -3.704, N- ties = 16, p<


3
2.5
2
1.5
1
Mean Hedonic Rating
Unadulterated
Touching
Removed
Out of Sight
Stages of Contact
Experimental
Control


3
2.5
2
1.5
1
Mean Hedonic Rating
Unadulterated
Touching
Removed
Out of Sight
Stages of Contact
Male
Female

Whitney test showed a significant difference (U= 52.5, N_1= 16, N_2= 14, > .05). With younger participants (median = 4 years 10 months) more likely to show the full response than the older participants (median = 5 years 6 months). The overall neophobia score was compared between those participants showing a full contamination response, and those who did not. A Mann-Whitney showed there was no difference in the neophobia scores (U=58, N_1= 12, N_2= 11, p > .05). There was also no difference between the total SSP score and the contamination response (U=51, N_1= 13, N_2= 11, p > .025) or the taste/smell subscale of the SSP and the children's contamination score (U=61.5, N_1= 13, N_2= 11, p > .025).

Discussion

The results from the main study show that a disliked food can affect the rating of a liked food, in comparison to a control. Furthermore, of the 30 participants, 16 showed a "full" contamination response, i.e. once the disliked food had touched the liked food, the rating for the liked food did not return to the unadulterated level. The suggestion presented here is that this is a reduction in rating based on *disgust.* According to Rozin and Fallon (1987, p.23) disgust is the "revulsion at the prospect of (oral) incorporation of an offensive substance. The offensive objects are contaminants; that is, if they even briefly contact an acceptable food, they tend to render that food unacceptable". Participants in this study were presented with an unadulterated liked food and, overall, once that food had been in contact with a disliked food they rated it as less desirable. The foods chosen for the study were controlled in order to avoid presenting culturally odd mixes of food, for example ham and chocolate, and were chosen on the basis that they would not leave a physical trace once they had been removed from one another. Therefore, the fact that the foods were

unlikely to have been altered in terms of their sensory properties and the "contamination response" continued even once the liked food was not physically touching the disliked food, leads to the conclusion that this is more likely to be a disgust response than a "dislike" response. Therefore the data offer some support the hypothesis that disgust based rejections occur in children aged between 4 and 6 years of age, prior to the age suggested by Fallon et al., (1984).

According to Fallon et al., (1984) children between the ages of 3 years 9 months and 6 years 1 month children do not show rejections based on disgust. However, the method used was story telling and accompanying pictures, the examples used to represent disgust were a grasshopper and faeces and the measure used to determine the reason for rejection was, partly, verbal report. These factors make it difficult to demonstrate disgust rejections in children of this age. The study presented here, using the real foods as the stimuli, controls for sensory changes to the food, uses highly disliked foods, rather than non-food disgust substances, and shows that a disliked food can act as a contaminant within this age group, and that the motivation for the rejection is likely to be disgust.

Neophobia is linked to the rejection of both new (Birch et al. 1987; Koivisto & Sjödén, 1996; Pelchat & Pliner, 1986; Pelchat & Pliner, 1995; Pliner & Salvy, 2006) and previously accepted foods (Carruth et al., 1998; Carruth & Skinner, 2000; Galloway et al. 2003) and has been linked to potential increases in disgust (Nordin, Broman, Garvill and Nyroos, 2004; Pliner, unpublished as cited in Pliner & Salvy, 2006). Therefore, it was hypothesised that those children showing the full contamination response would have higher levels of neophobia, as measured by the CFNS (Pliner, 1994), than the children who did not show the full response. This was

not the case, the data showed that there was no difference between the disgust response and the level of neophobia parents reported.

However, the analysis suggests that the propensity to find disliked foods contaminating, decreased with age. If, via an increased potential for disgust, neophobia is linked to contamination sensitivity in regards to food, then this finding fits that the younger children, with the higher likelihood of food neophobia, would be more inclined to show the full contamination response and the contamination response would reduce with age, in line with a reduction in food neophobia (Birch et al. 1987; Koivisto & Sjödén, 1996; Pelchat & Pliner, 1995; Pliner & Salvy, 2006). While the questionnaire showed no difference, this provides only a subjective measure of parental report and may not be sensitive enough to reveal small decreases in neophobia across this age range, the more behavioural based measure of children's own rating of the contaminated food, may have been sensitive to the developmental changes within the age group used in this sample.

Another factor that has been shown to be influential in higher reported levels of disgust is gender, with studies showing higher levels of disgust in women than in men (Davey, 1994; Haidt et al., 1994; Nordin et al., 2004; Schienle et al., 2005). Furthermore, gender differences in food neophobia have been found, though they are fairly mixed (Alley & Burroughs, 1991; Frank & Van der Klaauw, 1994; Hursti & Sjoden, 1997; Koivisto & Sjoden, 1996; Loewen & Pliner, 2000; Pliner & Hobden, 1992; Tuorila *et al.,* 2001) and gender differences in neophobia during childhood (a slight increases in males) does not reach significance (Cooke, Carnell & Wardle, 2006; Falciglia et al., 2000). Therefore, it was hypothesised that there may be a gender difference in the contamination response. While females rated the liked food as less desirable in both the 'removed' and 'out of sight' conditions, these differences

were not significant (see fig. 5.5.2). A larger sample may have produced a significant effect though it may also be that, while gender may influence disgust in older samples, the higher levels of general food neophobia during childhood (Birch et al. 1987; Koivisto & Sjödén, 1996; Pelchat & Pliner, 1995; Pliner & Salvy, 2006) could mask later gender differences.

Sensory sensitivity was also examined, using the SSP (Dunn, 1999), to see if those children showing the full contamination response would have higher levels of either overall sensory sensitivity, or higher levels on the taste/smell subscale. Studies have shown that increased sensory sensitivity can result in children becoming very selective eaters (Timimi et al. 1997), having less dietary variety (Nicholls et al. 2001) and having more specific demands for the way food is presentated (Schreck et al. 2004; Timimi et al. 1997; Williams et al. 2005). Added to this, the finding that odour ratings correlate with with food neophobia (Raudenbush, van der Klaauw & Frank, 1995) suggests that increased sensory sensitivity may increase the likelihood of children having more the propensity for a contamination response. However, in this study, no differences were found for either the taste/smell subscale, or total SSP scores, and whether or not participants showed a full contamination response. It may be that, unless sensory sensitivity is greatly affected, as often is the case with children on the autistic spectrum (Nicholls et al. 2001; Schreck et al. 2004; Timimi et al. 1997; Williams et al. 2005), there is no influence on whether or not children show a contamination response. However, the measure used here is a general sensory measure, with only limited questions regarding food, and usually used with clinical populations (Tomchek & Dunn, 2007). Therefore, the measure may not have been able to detect subtle differences in the sensory sensitivity of a small sample, from a non-clinical group and solely in relation to food stimuli.

The study presented here shows that disliked foods can act as a contaminant between the ages of 4 years 5 months and 6 years 1 month and, due to the contaminating properties of disliked food, they may be considered "disgusting" by the child. Furthermore, the study shows that the *younger* children were more likely to show a full contamination response than the older children in this sample and females were more likely to still be concerned about the liked food even after the disliked food had been removed and completely taken from view, though this effect was not significant.

Although, theoretically, sensory sensitivity and food neophobia could influence children's contamination response to food, and possibly non-food substances, the CFNS and SSP did not produce any significant results in this study. It could be that these factors are not important in contamination sensitivity but it may also be that either the sample was too small or the scales used here, in relation to contamination responses towards food, were not suitable measures for a non-clinical, young sample.

Limitations

The argument presented here is that, based on Rozin and Fallon's (1987, p. 23) definition of disgust, some disliked foods may have contamination properties for young children and, therefore are considered disgusting. However, the measure used was an unadulterated liked food receiving a reduced rating in desire to consume once it had been in contact with a disliked food, and that the reduction would continue even after the disliked food was removed. Despite using foods that would not leave any visible trace, and would be unlikely to alter the sensory properties of the liked food, it cannot be ruled out that the children inferred that the sensory properties *might* have

been altered and therefore the food would not taste nice and therefore the rejection would be more likely due to distaste. Furthermore, children were required to respond on a hedonic scale of 1-3 for how much they would like to eat the liked food, no measure of actual willingness to consume was taken and therefore it is unclear whether or not the food was just considered less favourable or if it had been truly "contaminated".

Future Research

Further research may benefit from recording the facial responses of participants during contamination experiments which could be coded to see if a disgust facial response is given to any of the food combinations. The facial response for distaste and disgust are very similar from birth to adulthood (Sullivan & Lewis, 2003) and any disgust facial response to solely visual stimuli would add support to the suggestion that young children reject food due to disgust and remove the need for verbal report. Another method would be to use actual willingness to consume the foods, or not, as the measure of contamination response, again removing the need for inference or verbal report.

The results here suggest that food can act as a contaminant between the ages 4 years 5 months to 6 years 1 month. However, it was the younger group, who may be more neophobic than the older participants (Birch et al. 1987; Koivisto & Sjödén, 1996; Pelchat & Pliner, 1995; Pliner & Salvy, 2006), who were more likely to show a full contamination response. It would therefore be interesting to see if disliked foods can act as contaminants earlier than shown here.

Finally, Martins and Pliner (2005) suggest that aversive texture accounts for a large variance in ratings of disgust for food. However, in order to control for changes

in the food sensory properties due to the foods touching, this study required the use of disliked, relatively dry foods that were easy to remove in order to try and justify the conclusion that disgust, not distaste, is the motivational factor behind the reduction in rating. If a measure can be used that differentiates between rejection due to inferred distaste and disgust, that does not require verbal report, using foods of a more aversive texture may result in higher levels of contamination responses.

Implications/Applications

If foods can act as a contaminant during childhood, and the contamination response is due to disgust, then the potential for rejection due to disgust should be included when considering young children's rejection of food. Disgust increases at the prospect of eating the disgust substance (Simpson, Anthony, Schmeer & Overton, 2007) and pressure to eat an aversive substance can result in long term aversions (Batsell & Brown, 1998; Batsell & Brown, Ansfield & Paschall, 2002). As, during early childhood, the most highly rejected food groups are often fruit and vegetables (Carruth et al. 1998; Cooke et al. 2003; Jacobi et al. 2003), if any of these rejections are due to disgust, during a sensitive period in early development (see Review one for detailed review), then attempts to pressure consumption may have long term negative health consequences. As fruit and vegetables are likely to be foods that parents want their children to eat, the likelihood of persistent attempts to make children eat these foods is high and therefore, the possibility of long term aversions is also high. Furthermore, attempts to place liked foods with disliked foods, in the hope that the disliked food will be viewed as more favourable, may have the opposite effect to that expected.

STUDY 5

DISLIKED FOOD ACTING AS A CONTAMINANT DURING INFANCY: A DISGUST BASED MOTIVATION FOR REJECTION?

Abstract

This study was conducted to examine whether, during infancy, disliked foods can act as contaminants to liked foods. Infants (aged 18 to 25 months, N= 18) were offered a liked food, touching a disliked food, on the same plate. Their response to this liked food was compared to their response to a control condition, a liked food touching a second liked food. These data show that children were less likely to eat the liked food touching the disliked, than the control. Of the 18 infants tested, 8 children either wanted the disliked food completely removed from the plate, or would not consume the liked food at all, once it had been 'contaminated' by the disliked food.

In order to compare for individual differences, three questionnaire measures were taken; 'pickiness'/willingness to eat a new food, a measure of sensory sensitivity and early food experiences. None of these factors were found to be significant when comparing those infants that showed a partial or full contamination response, and those who showed no response. However, low variability and a small sample size make it difficult to make firm conclusions regarding the role these characteristics may play.

This study was the first to test the anecdotal reports that food can act as a contaminant with an infant sample and the data offer some support for the hypothesis that disgust may influence the acceptance of food, prior to 7 years of age.

DISLIKED FOOD ACTING AS A CONTAMINANT DURING INFANCY: A DISGUST BASED MOTIVATION FOR REJECTION?

Introduction

Distaste, disgust and contamination

During infancy a negative facial response occurs to some distasteful substances and this reaction varies in intensity, dependent on the elicitor (Rosenstein & Oster, 1988). This response continues into adulthood where non-taste disgusting stimuli can cause a similar reaction (Sullivan & Lewis, 2003). The non-taste response, like the distaste response in infancy, also varies in intensity (Rozin & Fallon, 1987), with disgust evoking factors possibly having additive effects (Martins & Pliner, 2006). The positive correlation reported between disgust and fear of a stimulus (de Jong & Merckelbach, 1998) could be one such factor. Furthermore, though research has shown disgust towards food is based on cognition, i.e. animalness (Rozin & Fallon, 1987), recent research suggests textural properties of food are also salient when perceiving something as disgusting (Martins & Pliner, 2006).

The similarities in the distaste response during infancy and the disgust response towards non-taste stimuli, beginning during mid childhood, have led researchers to suggest disgust may have developed from distaste (Rozin & Fallon, 1987; Rozin, Haidt & McCauley, 1999; Torochuk & Ellis, 2007). A key aspect of disgust is that disgusting items *have contaminating properties*, that is, they can render an otherwise acceptable food rejected if contact is made (Rozin & Fallon, 1987). The anecdotal reports that rejected food can act as a contaminant during childhood (Cashdan, 1998; Harris, 2000; Timimi, Douglas, Tsiftsopoulou, 1997; Rozin, 1990) suggest that younger children may show disgust like rejections, but initially do so towards foods, rather than the non-food, socialised, adult-disgust stimuli, such as

grasshoppers used by Fallon et al., (1984). Disgust itself is thought to be a food-related emotion (Rozin & Fallon, 1987) and the vast experience even very young children have had with food may allow for psychological rejections based on the influence of a rejected food.

The aim of the present study was to examine whether rejected foods can act as contaminants (Cashdan, 1998; Harris, 2000; Timimi et al., 1997; Rozin, 1990) around the beginning of the neophobic period (Addessi, Galloway, Visalberghi, & Birch, 2005; Cashdan, 1998; Cooke, Wardle & Gibson, 2003; Harper & Sanders, 1975). Furthermore, whether early experiences, pickiness/willingness to try novel foods or level of sensory sensitivity, as reported by parents, account for any individual differences in children's response to a liked food touching a rejected food.

Hypotheses

It was hypothesised that infants would show a contamination response towards a liked food that was touching a disliked food, in comparison to a control condition. In terms of individual differences, it was also hypothesised that those children reported to be more 'picky' and less willing to try new foods would be more likely to show contamination fears, children with increased sensory sensitivity and low sensation seeking would show greater contamination fears, and children with less food variety in the first year would show increased contamination fears.

Method

A total of 19 participants (12 males) were recruited via letters to parents whose children were attending nurseries within the Birmingham area. One participant was removed from the study because she was willing to eat 3 different parentally

reported disliked foods so data on the remaining 18 are reported. The ages of the participants ranged from 1 year 6 months – 2 years 2 month (mean = 1 year 10 months). Information packs were sent out to parents requesting their permission to allow their children to participate in the study. Those willing to give consent were asked to return a signed consent form.

Materials

Three questionnaires were given during a home visit for the parent to complete in their own time. A pre-paid, addressed envelope was given so that these could be returned easily. The questionnaires consisted of; A) Infant/Toddler sensory profile (Dunn, 2002) in order to examine the influence of sensation seeking, sensory sensitivity, sensation avoiding and tactile, visual and oral processing. B) A questionnaire relating to the child's early food experiences (see Study One). And C) the 'pickiness', and 'willingness to try new foods'; measures used by Blossfeld et al. (2007). Overall, the questionnaires took approximately 10 minutes to complete.

The other study materials consisted of a number of parentally reported liked and disliked foods. The criteria were that the foods were of a relatively dry consistency, i.e. they could be removed from a plate without leaving residue on other items, and that the foods used in each presentation sequence, according to parental report, would not appear odd when given together. These foods were prepared by the child's parent/guardian and served as they normally would be, i.e. same plates, table/high chair etc.

Procedure

16 of the 18 children were tested in their home, with their mother (two children were tested with their child minders during a 'play date' at another child's home). This was done prior to a normal lunchtime meal (approx. 10 minutes before they were due to eat lunch). Foods were presented in bite size portions (to avoid satiety) in the following order (Parts one and two of the procedure were counter-balanced);

Part one

UNADULTERATED (a) – A parentally reported disliked food was offered on its own. This was to confirm that the food would be rejected. In the majority of cases this was rejected on sight (16/18). However, the disliked food was also used if it was tasted and subsequently rejected. The analysis presented below was conducted without the participants who rejected the disliked food after tasting; this had no effect on the subsequent results. If the 'disliked' food was consumed without a problem, another parentally reported food was given, until a suitable, rejected food was identified.

UNADULTERATED (b) – A liked food was given to confirm parental report that it was liked and readily eaten, if this was rejected, again this was repeated until a food fulfilling the criteria was accepted (this occurrence was not observed).

TOUCHING – The liked food, touching the disliked food on the same plate, was presented. If the liked food was consumed, then this part of the study was concluded. However, if the child would not eat the liked food the disliked food was removed.

REMOVED (PARTIAL CONTAMINATION)– If the child would not eat the liked food while it was on the same plate as the disliked food, then the child's mother removed the disliked food (approximately half the children showing this response removed the disliked food themselves, either putting it away from the plate, dropping it on the floor or placing it in their mothers' hand). If the child ate the liked food, once the disliked food was removed, the study was concluded.

FULL CONTAMINATION – If the liked food was rejected, even after the disliked food was removed, a fresh piece of the liked food was given to confirm the rejection was not due to satiety.

Part two

TWO LIKED FOODS TOUCHING – As a control, two liked foods were given on the same plate, in order to compare this to the child's response to a disliked food touching a liked food. Originally this was done as above, i.e. one food at a time and then together. However, as the parentally reported foods were consistently consumed by the children, after the 4th testing session, it was decided that the individual presentation was unnecessary and time consuming.

Data analysis

As the data reported here was non-normal, non-parametric tests were used. Furthermore, two-tailed tests are reported.

Overall Contamination: Overall contamination scores were calculated by counting the number of stages required for the liked food to be consumed. So that, 0 =

no contamination response, i.e. the liked food was eaten when touching the disliked food. 1 = the liked food was eaten when the disliked food was removed. 2 = the food was not eaten until a fresh piece, that had not touched the disliked food, was given. These overall contamination scores were compared to the overall scores obtained in the control condition, using a Wilcoxon signed ranks tests.

Age: Participants were split into those showing a full or partial contamination response and those not showing a response. These two groups were compared, by age, using a Mann-Whitney test.

Sensory profile: A number of factors on the Infant/toddler profile were used to try to account for individual differences. These were chosen because of their theoretical relevance, e.g. oral sensitivity is likely to relate to food, and based on previous literature, e.g. sensation seeking is negatively correlated to food neophobia (Loewen & Pliner, 2000; Pliner & Hobden, 1992; Raudenbush et al, 1995). Those showing no contamination response were compared to those showing a full or partial response. Although the Infant/Toddler Profile is used to calculate the likelihood of children having a 'Definite Difference', 'Probable Difference' (Less than others), 'Typical performance', or 'Definite Difference', 'Probable Difference' (More than others), as the sample was from a non-clinical population, and a similar age range, their raw score were used to compare for differences. The lower the score, the more sensitive they are than others, in that domain.

'Pickiness/willingness to eat new foods': Participants overall scores on the 'pickiness' and the 'willingness to eat a new food' measures were compared between those who showed a full or partial contamination response and those who showed no response.

Early Experiences questionnaire: Although details of early feeding experiences were recorded via parental report, there were too few variances in responses to justify examination of differences, i.e. 11 parents report giving lumpy solids prior to 10 months and only two parents report after 10 months, making comparisons impossible. From the early experiences data, parental report of early food variety was used as this was measured on a 1-10 likert scale and provided suitable variance.

Where multiple analyses were performed on the same data, the alpha value was adjusted using a bonferroni correction up to .01, if multiple comparisons reduce the alpha below this level (that is >5 comparisons) .01 was used to avoid setting the significance threshold too high (Woods & Raju, 2001). Despite two follow-up letters, only 13 of the 18 parents in the study returned completed 'pickiness and willingness to try new foods' questionnaires and 15 of the 18 early experiences questionnaires. Those without questionnaire data were coded as 'missing data' during analysis. All data was analysed using SPSS v15.

Results

The characteristics of the participants are shown in table. 5.6.1. As the data are non-parametric, the median and range for each score are given.

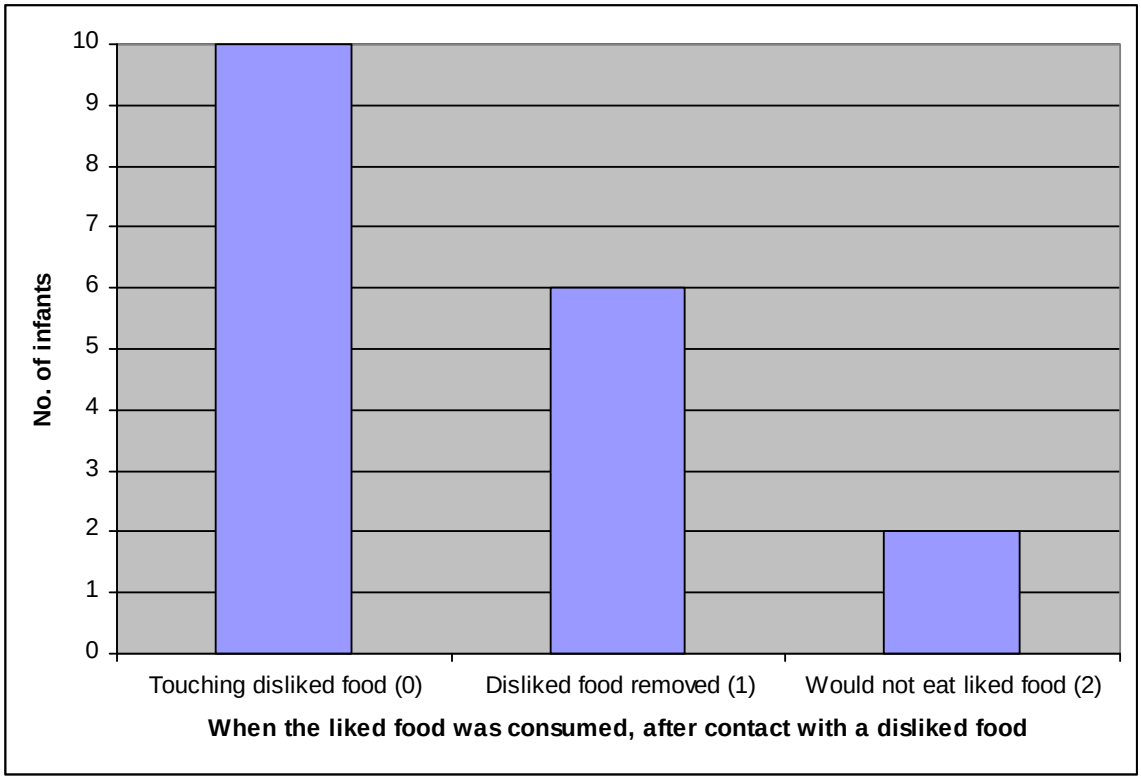
Table. 5.6.1: The median and range scores for the parentally reported questionnaires, split into those showing no contamination response and those showing a partial or full response and the Cronbach's alphas of the questionnaires.

Participants' Characteristics	Value			
	Median (Range)		N	α
Age (in months):	**95.5 (29)**	101 (40)	**10** / 8	
'Pickiness':	**2.17(2.5)**	3 (2.17)	**6** / 7	.83
Willingness to Eat New Foods:	**5.5 (3)**	4.33 (5)	**6** / 7	.72
Overall Sensory Sensitivity:	**37 (19)**	40 (15)	**6** / 7	.72
Sensation avoiding:	**39 (12)**	40 (10)	**6** / 7	.4
Sensation Seeking:	**31.5 (16)**	24 (9)	**6** / 7	.66
Visual Processing:	**25 (7)**	22 (4)	**6** / 7	.43
Oral Processing:	**28 (9)**	28 (12)	**6** / 7	.37
Early Dietary Variety:	**9 (5)**	7.5 (5)	**6** / 7	

NB **Those showing no contamination** / Those showing Full or Partial Contamination

Overall Difference

The data showed that there was a difference between the overall contamination score for a food touching a disliked food, in comparison to a control ($z = -2.64$, N- ties = 8, $p < .01$). All 18 children were willing to eat the liked food when touching another liked food while figure 5.6.1 shows the point at which children would eat the liked food after contact with the disliked food


10
9
8
7
6
5
4
3
2
1
0
No. of infants
Touching disliked food (0)
Disliked food removed (1)
Would not eat liked food (2)
When the liked food was consumed, after contact with a disliked food

Infant/Toddler Profile

When comparing those who showed a partial or total contamination response with those who showed no response the findings showed that there was no significant differences; total Infant/Toddler Sensory Profile score and whether or not there was a contamination response ($U=17$, $N_1= 6$, $N_2= 7$, $p> .01$), sensation avoiding subscale of the questionnaire ($U=18$, $N_1= 6$, $N_2= 7$, $p> .01$), sensation seeking ($U=13$, $N_1= 6$, $N_2= 7$, $p> .01$), visual processing ($U=10$, $N_1= 6$, $N_2= 7$, $p> .01$) and oral processing ($U=17$, $N_1= 6$, $N_2= 7$, $p> .01$).

Early Experiences

The parental report of early exposure variety was compared for those showing a full or partial contamination response and those showing no response. A Mann Whitney test shows there was no significant difference ($U=18.5$, $N_1= 7$, $N_2= 8$, $p> .01$).

Discussion

The results show that 8 of the 18 infants showed some level of contamination response towards a liked food that has touched a disliked food, in comparison to a control. Of these eight infants, six wanted the disliked food completely removed from the plate before they were willing to eat the liked food but only two of the children would not eat the liked food at all, once it had touched the disliked food. None of 18 children rejected liked foods that touched one another. Of the two children showing the full contamination response, this was not due to satiation as they were willing to eat a fresh piece of the same food. This finding offers some support for the hypothesis that disliked foods can act as contaminants during infancy, but the evidence is limited.

For an item to be considered disgusting, the contamination should remain even after the disgust stimulus has been removed; the law of contagion that once something is in contact, it is always in contact (Curtis & Biran, 2001). Therefore, further research is required before the hypothesis that disgust may influence intake during infancy is accepted.

In an attempt to account for why one child may find a disliked food contaminating and another child be unaffected by the presence of a disliked food, some parental report questionnaire measures were collected. While those infants showing a full or partial contamination response were older, and therefore more likely to have begun to be food neophobic (Birch et al., 1987; Koivisto & Sjödén, 1996; Pelchat & Pliner, 1995), had higher 'pickiness' scores, were lower on the 'willingness to eat a new food' measure, more sensitive to visual processing and had less dietary variety in their first year of life, none of the measures were found to be significantly different. However, the data set was small and collected from a sample of relatively good eaters with an, overall, very high willingness to try new foods and low variability between participants. Therefore, a larger sample size with a more varied range of 'good' and 'bad' eaters may have produced significant findings. Despite the small sample the median scores for infants' picky eating and willingness to try new foods in this study were similar to those found in previous research (Blossfeld et al., 2007).

The current study proposes that disgust may be influencing early food rejections. The data show that *disliked food* may act as a contaminant for some children. However, while this phenomenon has been reported anecdotally during childhood (Cashdan, 1998; Harris, 2000; Timimi, Douglas, Tsiftsopoulou, 1997; Rozin, 1990) only two infants showed the full response in the current study.

Limitations

The main limitation in this study is the small sample size. While showing a significant effect of food acting as a contaminant, none of the measures taken to try to account for individual differences were significant. A larger sample size would allow for individual differences to be measured in a more meaningful way and may provide an explanation as to why some children consider rejected foods as contaminants. Furthermore, the majority of the children in this study were good eaters. While this is shown in the high 'willingness to eat new foods' measure and low 'pickiness' scores, the majority of parents also reported difficulty in thinking of a disliked food that matches the criteria needed in this study and some of the children were given two or three 'disliked' foods before they visibly rejected one. This sample, therefore, may have underestimated the contaminating effects of disliked food within this age group.

Future Research

As above, a larger sample is needed with greater variability. However, a more varied age range would also be useful in showing the developmental pattern of this type of response to disliked foods. Further, the aim of this study was to show that foods can act as a contaminant despite there being no visual changes to the liked food, i.e. no sauces, or foods that would leave a trace. However, texture has been implicated in contributing to the disgust response towards food (Martins & Pliner, 2006), so a method that would allow foods with, potentially, more aversive texture would allow for greater understanding of disliked foods acting as contaminants. It is possible that this could be achieved by using video cameras to record the children's discrete responses to the presentations of foods and code the facial reactions to see if disgust can be identified. Finally, 10 of the 18 children showed no response to the disliked

food. However, the disliked foods used in this study were the first to be visibly rejected by the child and there is no way of knowing whether the food selected was disliked *enough* to produce a contamination response. A method of finding highly rejected foods may produce increased prevalence for this type of rejection.

Implications/Applications

The implication of this finding is both theoretical and practical. Currently, disgust is not thought to be a motivation for the rejection of food until around 7 years of age (Fallon et al., 1984) and, while some aspects are shown earlier, contamination is also only been shown from around 4 years of age (Rosen & Rozin, 1993; Seigal, 1988; Springer & Belk, 1994). The current study uses disliked foods to show that contamination, and potentially disgust, can occur during late infancy and may be a motivating factor behind some food rejections. If this is the case then pressure to eat rejected foods should be avoided in order to prevent long term aversions forming (Batsell & Brown, 1998; Batsell & Brown, Ansfield & Paschall, 2002). Furthermore, media messages often point towards the tactic of "hiding" foods, for example in a sandwich or a sauce, or suggest placing disliked foods next to liked foods to try and induce a preference for the disliked food. These tactics may actually have the opposite effect, and result in the liked food being rejected.

CHAPTER 5: DISCUSSION

The aim of the present chapter was to investigate whether disgust could be a motivation for the rejection of food during early childhood. The first section provides a theoretical review showing that, while disgust based on nature and origin cannot occur until cognition has developed to understand these adult-like concepts, an earlier, perceptual, food based form of disgust could occur with food neophobia as the catalyst.

To provide some evidence for this theoretical proposal two empirical studies are reported. Firstly, a study was conducted with 4 to 6 year old children in order to try to demonstrate the anecdotal reports that disliked foods can act as contaminants during childhood (Cashdan, 1998; Harris, 2000; Rozin, 1990), in an experimental setting. The study showed that, in comparison to a control, a disliked food touching a liked food reduces children's rating of that liked food, even after the disliked food has been removed. Further analysis showed that there was no difference in the food neophobia or sensory sensitivity scores for those who reported a reduced liking of the 'contaminated' food and those who did not.

The second empirical study presented in this chapter offered less clear findings. Using an adapted methodology, and replacing the hedonic rating scale with a behavioural measure consisting of willingness to consume the foods, it was shown that children aged 18 to 25 months were less likely to eat a liked food touching a disliked food, in comparison to a control condition consisting of a liked food touching another liked food, however, only 2 children completely refused the 'contaminated' food. Three questionnaire measures were taken in an attempt to account for individual differences, 'pickiness'/willingness to eat a new food, sensory sensitivity and reported

early experiences. While many of these measures were in the predicted direction, none of the findings were significant. Low variability and a relatively small sample size make it difficult for clear conclusions to be made about the impact of these individual characteristics.

Taken together, this chapter provides both theoretical and some empirical evidence that disgust could influence the acceptability of food during early childhood. Previous literature suggests that contamination occurs from about four years of age (Rosen & Rozin, 1993; Seigal, 1988; Springer & Belk, 1994) and that disgust in its adult form does not appear until around 7 years of age. However, disgust is a food-related emotion (Rozin & Fallon, 1987), and these studies are the first to consider food, in particular disliked food, as a contaminant and suggest that disgust and its fundamental feature, contamination (Rozin & Fallon, 1987), can occur in early childhood. Individual differences in the propensity for this to occur have been found to be non-significant within these studies, despite their theoretical relevance, but further research may yet find these characteristics to be influential.

CHAPTER 6

GENERAL DISCUSSION

6. 1 Aims and hypotheses of this present thesis

As outlined in section 2.4 the present thesis aimed to further understanding of why children begin to reject previously accepted food during early childhood. The rationale for this being that, to date, no studies have directly examined the rejection of known and previously accepted foods. However, studies investigating 'picky' eating often include the rejection of new *and known foods* (Carruth et al., 1998; Carruth et al., 2004; Galloway et al., 2003; Kim et al., 2006) and these children are likely to have a more unhealthy diet (Cooke et al., 2006; Falciglia et al., 2000; Russell & Worsley, 2008). Therefore, increased understanding as to why known foods are rejected may allow for interventions and improved health via increased dietary variety. The present thesis aimed to address this by investigating a number of areas:

1) The prevalence of the rejection of previously accepted foods and initial patterns associated with this type of rejection.

2) The influence of categorisation of food on subsequent acceptance or rejection.

3) Disgust as a motivation for rejecting food in early childhood.

The first aim was to examine the prevalence of the rejection of previously accepted foods. It was hypothesised that this would be a common occurrence in nursery aged children and that onset would be around 18 to 24 months of age, in line with the beginning of food neophobia. Previous research has shown that fruit, vegetables and mixed foods are often rejected during childhood (Cashdan, 1998; Carruth et al., 1998; Jacobi et al., 2003) it was, therefore, also hypothesised that these foods would be among the most highly rejected, previously accepted foods. Finally, it

was hypothesised that children reported to have higher food neophobia and 'picky' eating, and those children who had food related problems in their first year of life, would be more likely to have rejected a previously accepted food.

Secondly, the first of two hypotheses was investigated; that children's early categorisation of food could result in categorisation errors. That is, a previously accepted food, due to a mismatch between learnt expectations and the perceptual features of the food given at the time, is categorised as "new" and rejected in a neophobic response. Therefore, the aim was to investigate children's early categorical food awareness and what feature changes within food may be salient during infancy when categorising foods. It was hypothesised that infants would show the ability to conceptually categorise foods, to categorise foods in a basic form (i.e. fruit as different to biscuits), that liked foods would be categorised as different to disliked foods and that global, local and colour changes would be salient features when categorising foods.

Finally, the third aim was to investigate the hypothesis that disgust can influence the acceptance of food during early childhood. This required the development of suitable methodology for investigating experimentally, the anecdotal reports that disliked food can act as a contaminant during childhood (Cashdan, 1998; Harris, 2000; Rozin, 1990; Timimi, Douglas & Tsiftsopoulou, 1997). It was hypothesised that disliked foods can act as contaminants and, therefore, may actually be considered "disgusting" by the child.

6.2 Summary of results and their contribution to the understanding of the rejection of previously accepted food during early childhood

The main aims of the thesis were addressed in the two empirical chapters, both of which contained three separate, but related, papers. While each paper had a separate results and discussion section, below is a summary of the findings (figure 6.1.1 shows the model developed for this thesis and how the papers relate to its investigation) and how the findings fit within previous research.

6.2.1 The prevalence and initial patterns for the rejection of previously known and accepted foods during childhood

Study one of this thesis was the first to examine the rejection of previously accepted foods; however, the data match previous prevalence estimates for similar research. Studies examining 'picky' eating show up to 50% of parents describe their children as 'picky' by the age of 19 months (Carruth et al., 2004; Kim et al., 2006). Two prevalence estimates were obtained for this thesis; a survey of 202 nurseries, but with a low response rate, resulted in an estimate of approx. 74% of parents reporting that their child had rejected a previously accepted food. These data need to be interpreted with caution as the sample is likely to be highly self-selected. A small follow up survey was conducted with one nursery, but with a far higher response rate, and this showed that approximately 50% of parents reported this form of food rejection but again, caution is needed as only one nursery was given this questionnaire, therefore, the sample may not be representative. Despite these caveats, it seems that the rejection of previously accepted food is a common occurrence during childhood.

The data from study one also allowed for an estimation of the onset for the rejection of previously accepted food and this too matches similar research. As shown above, up to 50% of parents report their child as 'picky' by 19 months of age (Carruth et al., 2004). Furthermore, food neophobia, the avoidance of new foods, begins towards the end of the second year (Addessi et al., 2005; Cashdan, 1998; Cooke et al., 2003; Harper & Sanders, 1975). Study one suggests that the rejection of previously accepted food has an onset of around 21 months and is unlikely to occur, for the first time, after 30 months.

The types of food rejected were also examined. Previous research suggests that fruit, vegetables and 'mixed' foods are the most highly rejected during childhood (Cashdan, 1998; Carruth et al., 1998; Jacobi et al., 2003). The data presented here for the rejection of previously accepted foods also shows that fruit, vegetables and 'mixed' foods are the most frequently reported categories.

Finally, previous research suggests that problems with the transition to solids, such as sickness during this time, can result in later difficulties with food (Dahl, 1987; Johnson & Harris, 2004). In study one, those children who were reported to have problems with the transition to solids were also reported to have higher levels of 'picky' eating, higher food neophobia and were more likely to have rejected a previously accepted food.

While this is the first research to explicitly examine the rejection of previously known and accepted foods during early childhood, the data fit well with previous research on food rejection. This type of rejection is common, begins at around the same time as food neophobia and when there is an increase in 'picky' eating, involves the rejection of food categories shown to be highly rejected by children and seems to relate to high food neophobia and picky eating.

Food neophobia is the rejection of new foods and is thought to be an evolutionary defence against the ingestion of toxins (Rozin, 1976). The only theory currently available when explaining 'picky' eating, which involves the rejection of new (neophobia) and known foods, is that it is due to the child's desire for autonomy (Carruth et al., 1998), though little evidence is provided. This thesis adds a further hypothesis to the literature on the rejection of foods in early childhood by suggesting that the rejection of previously known and accepted foods may be due to a perceptual mismatch between what is given and what is expected, resulting in a neophobic response and rejection of the food.

6.2.2 Categorisation of food during childhood

6.2.2.1 Conceptual category, basic category and like/dislike categories

The data obtained for the categorisation of food during childhood were mixed. Only a few studies have examined how food is categorised during early childhood. The previous research suggests that, based on children's willingness to place non-food items in their mouths, young children do not have a conceptual category for food (Rozin et al., 1986b). However, an exhaustive grouping task showed that, by late infancy, children were able to group animals and foods by their conceptual category (study two). A further study (also presented in study two) using sequential touching showed that infants touched foods and animals in a systematic fashion, based on their MRL, suggesting the awareness of the category distinction, but only two of nine participants showed categorisation based on Monte Carlo analysis.

Further sequential touching data suggests that infants have basic categorical knowledge of food. When given fruit and biscuits infants touched them systematically and five of the nine participants showed categorical knowledge based on the Monte

Carlo analysis. Finally, sequential touching was used to examine whether infants would show a categorical distinction, based on parental report, between those foods they like and those foods they dislike. This was not the case, however, the limited number of choices available meant that many of the parents could not clearly say four foods they knew their child would like and four that they felt would be disliked and therefore, the categories may not have been distinct enough. This current thesis is the first to look at the early categorisation of food in this way. The results are mixed and do not provide a clear picture of infants' knowledge of food categories. Some evidence was found to support the idea that a conceptual category has formed by late infancy, but this was not confirmed with the sequential touching method. Rozin et al. (1986b) suggests that little categorical knowledge of food exists during infancy; however, further research should be conducted to clarify whether this is the case.

6.2.2.2 The influence of local, global and colour changes to food

Mistakes when categorising foods as edible and inedible can easily lead to death (Galef, 1988, 1990; Rozin, 1976, 1990), therefore, it is biologically beneficial for children to be aware that feature changes may affect foods' toxicity, at an early age. While global shape is often prominent when categorising (Biederman, 1987; Brown 1990; Gelman, 1990; Mandler, 1992), this may not be the case for food, where features such as colour may offer more valuable information (Macario, 1991; Santos et al., 2001).

The effects of these changes to food had not been examined during infancy before, so an exploratory study was conducted (study two). The data show that while, based on mean number of overall touches, infants may have found the food that had been altered based on global shape, overall colour and local features interesting, these

features did not lead to the infants actually categorising based on whether the food was altered or not. As this was the first study to look at food categorisation in this way during infancy the aim was to allow the child to interact with the items as he or she wished, rather than impose a single, predefined category and, therefore, other features, such as overall shape, could be used to categorise the items. This seemed to be what happened and it was thought that the reason may have been because, while the toys were meant to be representations of food, they were still toys, and global similarities were salient. Due to the belief that the use of non-food items may have affected the study, a further study was conducted with older children to see if the use of actual foods, rather than representations, would be beneficial.

6.2.2.3 Cultural categorisation

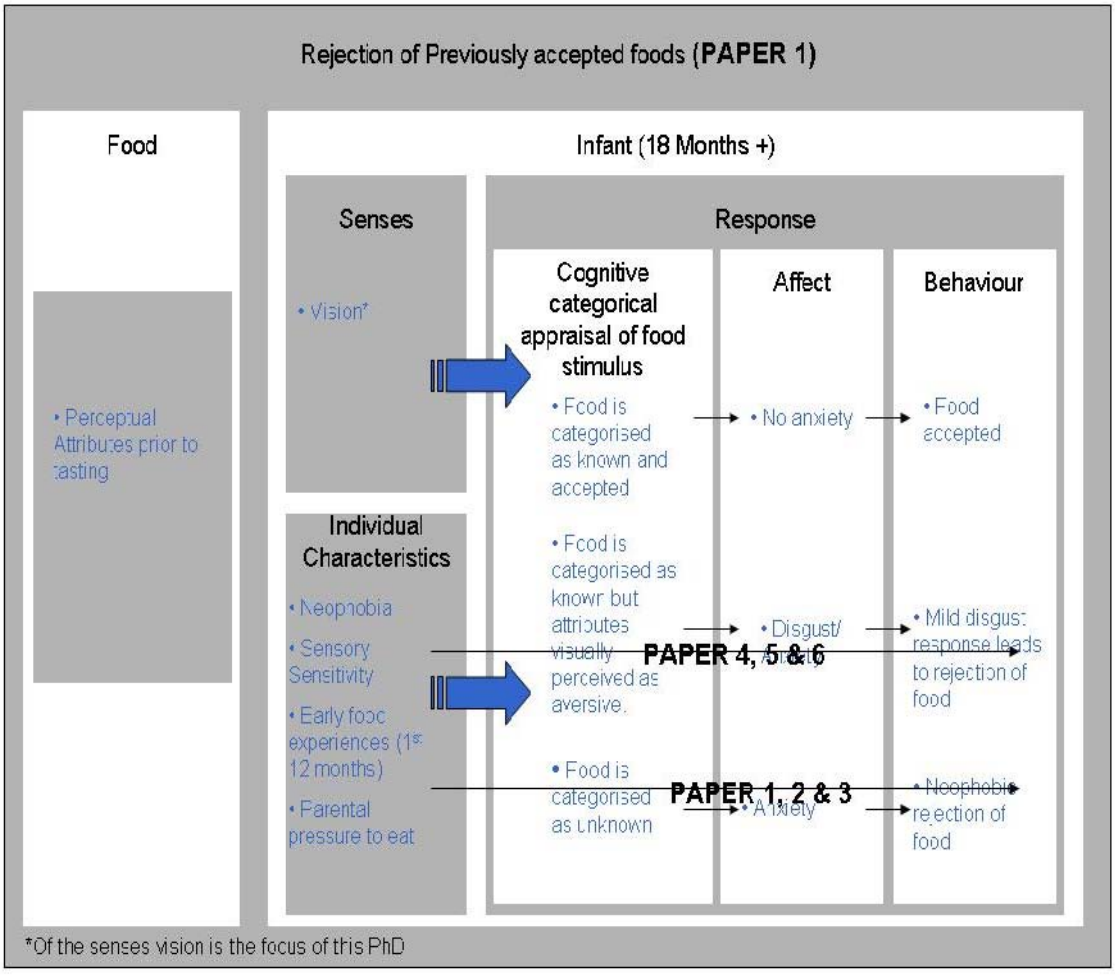
Based on the findings from study two it was felt that discrepancies in previous research may be due to (i) studies using items representative of food, rather than actual foods, and (ii) comparing findings against adult baselines rather than control conditions within the same age group. In order to examine this, and investigate the categorisation in children, study three looked at cultural categorisation of food. Previous research suggests children are unaware of the implicit cultural rules for what foods form acceptable mixes (Rozin et al., 1986) when pictures are used and children's responses are compared to adults. However, when actual foods are used, children have been shown to demonstrate knowledge of cultural rules for which foods should be eaten at what time of the day (Birch et al., 1984).

Study three used real foods to test whether children would rate two liked foods served together, that form a culturally odd mix, as less appealing than two liked foods that form a culturally acceptable mix. The study found that, while it does not seem to

affect willingness to eat the foods, children are aware of cultural categorisation between foods. Based on this finding it was felt that the subsequent studies should aim to use real, rather than representations, of food and that, because of potential discrepancies between the way in which adults and children conceptually view food (Fallon et al., 1987), within age comparisons may provide more information than comparisons to adult controls.

6.2.3 The influence on disgust on the acceptability of food during early childhood

Previous research suggests that disgust is not a motivation for rejecting food until around 7 years of age (Fallon & Rozin, 1983). Therefore, the initial aim was to show, theoretically, how disgust may be present during late infancy. This was done in a review paper written for this thesis and it was argued that food neophobia is the catalyst for a perceptual, food related disgust. The argument contributes to current knowledge by showing that an early form of disgust rejections may occur prior to the conceptual, adult-like disgust shown by Fallon et al. (1987). In order to provide some evidence for this, two studies were conducted (studies four and five). The aim of study four was to develop a method suitable for measuring whether a disliked food could act as a contaminant in children. The results confirmed the anecdotal reports that if a disliked food touches a liked food, it may result in the rejection of the liked food (Cashdan, 1998; Harris, 2000; Rozin, 1990; Timimi et al., 1997). Study five was conducted with infants and used an adapted methodology; however, the findings offered little support for the theory that disgust towards food may be present during infancy. This study showed that infants may reject a liked food when it is touching a disliked food, while they are willing to eat a liked food that has touched a second liked food. However, only two infants completely rejected the “contaminated” liked


Rejection of Previously accepted foods (PAPER 1)
Food
• Perceptual Attributes prior to tasting
Infant (18 Months +)
Senses
• Vision*
Individual Characteristics
• Neophobia
• Sensory Sensitivity
• Early food experiences (1st 12 months)
• Parental pressure to eat
Response
Cognitive categorical appraisal of food stimulus
Affect
Behaviour
• Food is categorised as known and accepted
• No anxiety
• Food accepted
• Food is categorised as known but attributes visually perceived as aversive.
• Disgust/ Anxiety
• Mild disgust response leads to rejection of food
PAPER 4, 5 & 6
• Food is categorised as unknown
• Anxiety
• Neophobic rejection of food
PAPER 1, 2 & 3
*Of the senses vision is the focus of this PhD

6.3 Limitations of the present thesis

Several methodologies and age groups were used within the current thesis and, therefore, limitations for specific papers are addressed within the discussion sections. However, the more general issue of sample size and the difficulties in recruitment will be discussed here. Of the studies presented, increased participant numbers would have increased the generalisability of the results, increased statistical power, allowed for more exploration of individual differences and provided more compelling evidence. Unfortunately, a number of difficulties occurred in recruitment of participants.

Firstly, there was difficulty in recruiting nurseries willing to take part in the studies. In total, approximately 50 nurseries were approached by phone, letter or in person. With no incentive, and with a general lack of interest, only 8 of these nurseries agreed to take part. However, with the nursery varying in sizes from around 10 children up to 100+ children, this, potentially, allowed for sufficient recruitment of children and parents.

Secondly, when recruiting the parents and children for the nursery based studies, of around 250 letters that were sent out to parents, between 15 and 30 consents would be given. Some of these would leave the nursery prior to the study, be away when the study was taking place or be uncooperative during the study, and have to be withdrawn. Together, these circumstances resulted in relatively low numbers for nursery based studies.

The third issue arose when other methodologies were used. In order to conduct the sequential touching data collection children needed to be one on one with a carer, video recording had to take place and it had to be done in a quiet location (i.e. a room away from other children). This proved to be inappropriate for a nursery based study due to staff numbers and space, therefore, had to be conducted with parents at the

child's home. The 18 month to 2 year contamination data also had to be conducted at the child's home as it required specific foods to be served and the nurseries were unwilling for this to be done. While choosing these methodologies increased the appropriateness of the studies and the ecological validity of what was being carried out, it added to the difficulty in recruitment. Of the parents willing to give consent for nursery based studies, less were willing or able to consent to home based studies. The consequence was more valid studies with smaller sample sizes.

6.4 Conclusions

The present thesis is the first research to look directly at the rejection of known and previously accepted foods during early childhood. The thesis offers a contribution to the theoretical and conceptual understanding of why this type of rejection may occur, has resulted in the development of new methodologies, provides some evidence for the hypotheses presented and builds on existing food research. Two aspects have been considered; categorisation and disgust, and while these require further investigation, the work presented here offers good insight and a starting point towards confirming the relevance of these hypotheses in the acceptance and rejection of food during early childhood.

If categorisation and disgust do play a role in determining whether a food is accepted or rejected during early childhood and the catalyst is a peak in food neophobia, then these aspects can inform what would be considered normative development. The current research focus tends to be deviations from "normal" acceptance; however, it may be that this period in early childhood includes a normal narrowing of dietary variety that, *if handled sensitively*, may have no detrimental long

term effects and be resolved as the child ages and gains a greater understanding of food.

6.5 Implications/Future research:

If disgust and categorisation are important in the rejection of previously accepted foods then this has a number of implications. It is likely that some children are predisposed to this form of food rejection and, as a result, a more narrow diet. It seems that food neophobia is largely genetic (Cooke et al., 2007; Knappila et al., 2007) and, therefore, some children will be less inclined to try new foods and have a more specific desire for the way food is presented. Furthermore, though the evidence within this thesis is limited, if sensory sensitivity is influential (Coulthard & Blissett, 2009) then those children with higher sensitivity are more likely to reject many new and known foods. However, these predispoisitions may be heavily influenced by environment (Birch, 1999). Infants should be given every opportunity to sample a wide range of foods, flavours and textures, ideally beginning with breast milk (Mennella & Beuchamp, 1999; Mennella & Beuchamp, 1996; Mennella, Jagnow & Beauchamp, 2001). This early food learning may allow for children to develop wider prototypes of what a food "should be" and allow for more variations between each serving to be incorporated into what is normal. A study by Birch et al. (1998) showed that, while infants were willing to consume more of a food from the same category as they were exposed to; this was not the case for a homemade version of the food. This suggests that both pre-purchased and homemade foods should be given, in order for variations in texture, flavor and appearance to be experienced.

Furthermore, the high prevalence of the rejection of previously accepted food and 'picky' eating (Carruth et al., 1998) suggests that this is a normal developmental process; therefore, parents should be encouraged to remain calm if this occurs. If

disgust is a factor in the rejection then pressure to eat will only exacerbate the problem and may cause longer term rejections (Batsell & Brown, 1998; Batsell et al., 2002). With the use of continued exposure (Birch et al., 1998; Birch & Marlin, 1982; Birch et al., 1987; Nicklaus et al., 2005), modeling (Harper & Sanders, 1975), and as food neophobia reduces with age (Birch et al., 1987; Koivisto & Sjödén, 1996; Pelchat & Pliner, 1995), it should be possible reintroduce the rejected foods to the diet.

Individual study suggestions are given within each specific write-up, however, general future research into the rejection of food during infancy should pursue the possibilities above. The impact of early dietary variety and exposure, along with measures of food neophobia and sensory sensitivity, will begin to inform real life advice and applications for parents and caregivers. As reported, dietary variety at 4 years is predicitive of variety at 8 years (Skinner et al., 2002), so providing interventions that can be aimed at infants, and those infants that may be particulary prone to a narrow diet, could be highly beneficial and increase the consumption of fruit and vegetables during childhood.

List of Appendices

Appendix A

10-item C-FNS

Child Food Neophobia Scale – 10 item

Please read each statement and circle the number that best indicates how closely that statement describes your son/daughter.

For example……..1_____2_____(3)_____4_____5_____6_____7

The scale used is: 1 – very much like your son/daughter, up to 7 – extremely unlike your son/daughter.

1. XXXX constantly samples new and different foods
   1_____2_____3_____4_____5_____6_____7

2. XXXX does not trust new foods
   1_____2_____3_____4_____5_____6_____7

3. If XXXX do not know what is in a food s/he won't try it
   1_____2_____3_____4_____5_____6_____7

4. XXXX likes food from different countries
   1_____2_____3_____4_____5_____6_____7

5. XXXX thinks some foods look too strange to eat
   1_____2_____3_____4_____5_____6_____7

6. At parties, XXXX will try a new food
   1_____2_____3_____4_____5_____6_____7

7. XXXX is afraid to eat things s/he has never seen before
   1_____2_____3_____4_____5_____6_____7

8. XXXX is very particular about the foods s/he will eat
   1_____2_____3_____4_____5_____6_____7

9. XXXX will eat almost anything
   1_____2_____3_____4_____5_____6_____7

10. XXXX likes to try new foreign foods
    1_____2_____3_____4_____5_____6_____7

Appendix B

4-item Adapted C-FNS

<u>Child Food Neophobia Scale</u> – 4 item

On a scale of 1-4, please indicate how much you agree or disagree with the following statements:
(Please Circle each response)

1) My child is constantly sampling new foods.

Strongly Disagree			Strongly Agree
1	2	3	4

2) My child doesn't trust new foods.

Strongly Disagree			Strongly Agree
1	2	3	4

3) My child is afraid to eat things s/he has never had before.

Strongly Disagree			Strongly Agree
1	2	3	4

4) If my child doesn't know what's in a new food s/he won't try it.

Strongly Disagree			Strongly Agree
1	2	3	4

Appendix C

3-item ‘picky’ eating measure

<u>Picky Eating Measure</u> – 3 item

On a scale of 1-5, please indicate how much you disagree or agree with the following statements:
(Please Circle each response)

1) My child's diet consists of only a few foods.

Disagree				Agree
1	2	3	4	5

2) My child is unwilling to eat many of the foods that our family eats at mealtimes.

Disagree				Agree
1	2	3	4	5

3) My child is fussy or picky about what she eats.

Disagree				Agree
1	2	3	4	5

Appendix D

‘Picky’/willingness to eat measure

Food Experiences Questionnaire

1. *Your Child*

    a. Name: On consent form

    b. Date of Birth: On consent Form

    c. Gender (Please tick): Male ___ Female ___

    d. Siblings: Number of ___
    Position in family (e.g. Eldest) _____

Please fill in the following questions by circling the most appropriate number**:**

For example:…
1_____2_____3_____(4)_____5_____6_____7

Responses to food:

To what extent do you consider your child to be a feeding problem?

Not at all To a great extent
1_____2_____3_____4_____5_____6_____7

Please rank your child's eating behaviour as a whole

Extremely poor eater Extremely good eater
1_____2_____3_____4_____5_____6_____7

In general, at the end of the meal how often has your child eaten the amount you think s/he should eat?

Never Always
1_____2_____3_____4_____5_____6_____7

How often do you attempt to persuade your child to eat a food?

Never Always
1_____2_____3_____4_____5_____6_____7

How often do you provide food reward for eating a food you think your child should eat?

Never Always
1_____2_____3_____4_____5_____6_____7

How often would you provide a special food for your child because s/he does not like what the rest of the family is eating?

Never Always
1_____2_____3_____4_____5_____6_____7

Neophobia

Overall, to what extent does your child like a wide variety of foods from those that you think s/he should eat?

Not at all To a great extent
1_____2_____3_____4_____5_____6_____7

How often does your child try new and unfamiliar foods at home?

Never Always
1_____2_____3_____4_____5_____6_____7

How willing is your child to try new and unfamiliar foods when offered?

Never Extremely Willing
1_____2_____3_____4_____5_____6_____7

Thank you for your time.

Appendix E

Short Sensory Profile (SSP)

Short Sensory Profile

SORY PROFILE

Winnie Dunn,
D., OTR, FAOTA

Child's Name: _____ Birth Date: _____ Date: _____

Completed by: _____ Relationship to Child: _____

Service Provider's Name: _____ Discipline: _____

INSTRUCTIONS

Please check the box that best describes the frequency with which your child does the following behaviors. Please answer all of the statements. If you are unable to comment because you have not observed the behavior or believe that it does not apply to your child, please draw an X through the number for that item. Please do not write in the Section Raw Score Total row.

Use the following key to mark your responses:

ALWAYS	When presented with the opportunity, your child always responds in this manner, 100% of the time.
FREQUENTLY	When presented with the opportunity, your child frequently responds in this manner, about 75% of the time.
OCCASIONALLY	When presented with the opportunity, your child occasionally responds in this manner, about 50% of the time.
SELDOM	When presented with the opportunity, your child seldom responds in this manner, about 25% of the time.
NEVER	When presented with the opportunity, your child never responds in this manner, 0% of the time.

	ALWAYS	FREQUENTLY	OCCASIONALLY	SELDOM	NEVER
Tactile Sensitivity					
Expresses distress during grooming (for example, fights or cries during haircutting, face washing, fingernail cutting)					
Prefers long-sleeved clothing when it is warm or short sleeves when it is cold					
Avoids going barefoot, especially in sand or grass					
Reacts emotionally or aggressively to touch					
Withdraws from splashing water					
Has difficulty standing in line or close to other people					
Rubs or scratches out a spot that has been touched					
Section Raw Score Total					
Taste/Smell Sensitivity					
Avoids certain tastes or food smells that are typically part of children's diets					
Will only eat certain tastes (list: _____)					
Limits self to particular food textures/temperatures (list: _____)					
Picky eater, especially regarding food textures					
Section Raw Score Total					
Movement Sensitivity					
Becomes anxious or distressed when feet leave the ground					
Fears falling or heights					
Dislikes activities where head is upside down (for example, somersaults, roughhousing)					
Section Raw Score Total					
Underresponsive/Seeks Sensation					
Enjoys strange noises/seeks to make noise for noise's sake					
Seeks all kinds of movement and this interferes with daily routines (for example, can't sit still, fidgets)					
Becomes overly excitable during movement activity					
Touches people and objects					
Doesn't seem to notice when face or hands are messy					
Jumps from one activity to another so that it interferes with play					
Leaves clothing twisted on body					
Section Raw Score Total					

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m	Auditory Filtering	Always	Frequently	Occasionally	Seldom	Never
2	Is distracted or has trouble functioning if there is a lot of noise around					
3	Appears to not hear what you say (for example, does not "tune in" to what you say; appears to ignore you)					
4	Can't work with background noise (for example, fan, refrigerator)					
5	Has trouble completing tasks when the radio is on					
6	Doesn't respond when name is called but you know the child's hearing is OK					
7	Has difficulty paying attention					
	Section Raw Score Total					

m	Low Energy/Weak					
8	Seems to have weak muscles					
9	Tires easily, especially when standing or holding particular body position					
0	Has a weak grasp					
1	Can't lift heavy objects (for example, weak in comparison to same age children)					
2	Props to support self (even during activity)					
3	Poor endurance/tires easily					
	Section Raw Score Total					

m	Visual/Auditory Sensitivity					
4	Responds negatively to unexpected or loud noises (for example, cries or hides at noise from vacuum cleaner, dog barking, hair dryer)					
5	Holds hands over ears to protect ears from sound					
6	Is bothered by bright lights after others have adapted to the light					
7	Watches everyone when they move around the room					
8	Covers eyes or squints to protect eyes from light					
	Section Raw Score Total					

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SCORE KEY

1 = Always	4 = Seldom
2 = Frequently	5 = Never
3 = Occasionally	

ructions: Transfer the score for each section to the Section Raw Score Total column. Plot these totals by marking an X in the appropriate classification column (Typical Performance, Probable Difference, Definite Difference).*

ction	Section Raw Score Total	Typical Performance	Probable Difference	Definite Difference
ctile Sensitivity	/35	35 30		
ste/Smell Sensitivity	/20	20 16		
ovement Sensitivity	/15	15 13		
derresponsive/Seeks Sensation	/35	35		
ditory Filtering	/30	30 26		
w Energy/Weak	/30	30 26		
ual/Auditory Sensitivity	/25	25 19		
tal	/190	190 155	154 142	

ssifications are based on the performance of children without disabilities (n = 1,037).

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8 9 10 11 12 A B C D E

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Appendix F

Infant/toddler sensory profile

Infant/Toddler Sensory Profile™

Winnie Dunn, Ph.D., OTR, FAOTA
with Debora B. Daniels, M.A., CCC-SLP

Caregiver Questionnaire

7 TO 36 MONTHS

Child's Name: _____ Birth Date: _____ Date: _____

Completed by: _____ Relationship to Child: _____

Service Provider's Name: _____ Discipline: _____

Circle the birth order of your child within the family: 1st 2nd 3rd 4th 5th Other _____

Have there been more than 3 children, between the ages of birth–18 years, living in your household during the past 12 months? _____

INSTRUCTIONS

Please check the box that best describes the frequency with which your child does the following behaviors. Please answer all of the statements. If you are unable to respond because you have not observed the behavior or believe that it does not apply to your child, please draw an X through the number for that item. Write any comments at the end of each section.

Use the following key to mark your responses:

ALMOST ALWAYS	When presented with the opportunity, your child **almost always** responds in this manner, 90% or more of the time.
FREQUENTLY	When presented with the opportunity, your child **frequently** responds in this manner, about 75% of the time.
OCCASIONALLY	When presented with the opportunity, your child **occasionally** responds in this manner, about 50% of the time.
SELDOM	When presented with the opportunity, your child **seldom** responds in this manner, about 25% of the time.
ALMOST NEVER	When presented with the opportunity, your child **almost never** responds in this manner, 10% or less of the time.

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6 7 8 9 10 11 12 A B C D E

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Item		A. General Processing	ALMOST ALWAYS	FREQUENTLY	OCCASIONALLY	SELDOM	ALMOST NEVER
	1	My child's behavior deteriorates when the schedule changes.					
	2	My child avoids playing with others.					
	3	My child withdraws from situations.					

Note: You do not calculate a Raw Score Total for this section.

Comments

Item		B. Auditory Processing	ALMOST ALWAYS	FREQUENTLY	OCCASIONALLY	SELDOM	ALMOST NEVER
	4	I have to speak loudly to get my child's attention.					
	5	I have to touch my child to gain attention.					
	6	My child enjoys making sounds with his/her mouth.					
	7	My child takes a long time to respond, even to familiar voices.					
	8	My child startles easily at sound, compared to other children the same age.					
	9	My child is distracted and/or has difficulty eating in noisy environments.					
	10	My child ignores me when I am talking.					
	11	My child tries to escape from noisy environments.					
	12	My child finds ways to make noise with toys.					
	13	It takes a long time for my child to respond to his/her name when it is called.					
		Section Raw Score Total					

Comments

Item		C. Visual Processing	ALMOST ALWAYS	FREQUENTLY	OCCASIONALLY	SELDOM	ALMOST NEVER
	14	My child enjoys looking at moving or spinning objects (for example, ceiling fans, toys with wheels, floor fans).					
	15	My child enjoys looking at shiny objects.					
	16	My child avoids eye contact with me.					
	17	My child refuses to look at books with me.					
	18	My child does not recognize self in the mirror.					
	19	My child enjoys looking at own reflection in the mirror.					
	20	My child prefers fast-paced, brightly colored TV shows.					
		Section Raw Score Total					

Comments

Item		D. Tactile Processing	ALMOST ALWAYS	FREQUENTLY	OCCASIONALLY	SELDOM	ALMOST NEVER
	21	My child resists being held.					
	22	My child becomes agitated when having hair washed.					
	23	My child avoids getting face/nose wiped.					
	24	My child is distressed when having nails trimmed.					
	25	My child resists being cuddled.					
	26	My child is upset by changes in the bath water temperature, from one bath to the next.					
	27	My child avoids contact with rough or cold surfaces (for example, squirms, arches, cries).					
	28	My child becomes very upset if own clothing, hands, and/or face are messy.					
	29	My child gets upset with extreme differences in room temperature (for example, hotter, colder).					
	30	My child becomes anxious when walking or crawling on certain surfaces (for example, grass, sand, carpet, tile).					
	31	My child enjoys playing with food.					
	32	My child seeks opportunities to feel vibrations (for example, stereo speakers, washer, dryer).					
	33	My child bumps into things, seeming to not notice objects in the way.					
	34	My child enjoys splashing during bath time.					
	35	My child uses hands to explore food and other textures.					
		Section Raw Score Total					

omments

Item		E. Vestibular Processing	ALMOST ALWAYS	FREQUENTLY	OCCASIONALLY	SELDOM	ALMOST NEVER
	36	My child requires more support for sitting than other children the same age (for example, infant seat, pillows, towel roll).					
	37	My child enjoys physical activity (for example, bouncing, being held up high in the air).					
	38	My child enjoys rhythmical activities (for example, swinging, rocking, car rides).					
	39	My child becomes upset when placed on back to change diapers.					
	40	My child resists having head tipped back during bathing.					
	41	My child cries or fusses whenever I try to move him/her.					
		Section Raw Score Total					

mments

Item	#	Oral Sensory Processing	Almost Always	Frequently	Occasionally	Seldom	Almost Never
~	42	My child licks/chews on nonfood objects.					
~	43	My child mouths objects.					
—	44	My child is unaware of food or liquid left on lips.					
|	45	My child refuses all but a few food choices.					
|	46	My child resists having teeth brushed.					
—	47	My child refuses to drink from a cup.					
|	48	My child refuses to try new foods.					
		Section Raw Score Total					

Comments

What do you see as your child's strengths? _____

What are your concerns? _____

STOP HERE IF YOUR CHILD IS 7 TO 36 MONTHS OLD.

ICON KEY	
—	Low Registration
~	Sensation Seeking
@	Sensory Sensitivity
|	Sensation Avoiding

SCORE KEY	
1	Almost Always
2	Frequently
3	Occasionally
4	Seldom
5	Almost Never

Appendix G

Early Experiences questionnaire

Early Feeding Experiences Questionnaire

Please fill in the following questions **in relation to your child up to 12 months old:**

1. *Your Child*

    a. Name: On consent form

    b. Date of Birth: On consent Form

    c. Gender (Please tick): Male ___ Female ___

    d. Siblings: Number of ___
    Position in family (e.g. Eldest) _____

2. *Breast/Bottle feeding*

    a. **Before solids** how was your child fed? (Please tick)
    Breast milk ___ Formula ___ Both ___

    b. If your child was breastfed, how many weeks did this continue? _____

3. *Weaning*

    a. At what age did you begin to wean your child onto (Approx. in weeks):

    1st Stage (Pureed foods)? _____
    2nd Stage (Mashed foods)? _____
    2nd Stage (Lumpy mashed)? _____
    Finger foods (Solids)? _____

    b. Was your child predominantly weaned on homemade foods or pre-prepared, bought food? (Please tick)

    1st Stage (Pureed): Homemade ___ Purchased ___ mixture of both ___
    2nd Stage (Mashed): Homemade ___ Purchased ___ mixture of both ___
    2nd Stage (Lumpy)? Homemade ___ Purchased ___ mixture of both ___
    Finger foods (Solids): Homemade ___ Purchased ___ mixture of both ___

    c. Did your child encounter any problems with the transition to solids? (Difficulty with unfamiliar textures, reflux etc) _____
    _____
    _____
    _____ (if no, proceed to section 4)

d. If so, when did these problems start? (Approx. in weeks):
_____

e. How many weeks did these problems last? (Approx. in weeks):
_____

4. *Family Eating Patterns*

a. Did your child follow any particular diet in their 1st year (e.g. vegetarian)?
(Please tick)
Yes ___ No ___
If yes, please give details
_____
_____
_____
_____

b. Does your family exclude any particular foods? (Please tick)
Yes ___ No ___
If yes, please give details
_____
_____
_____
_____

c. Do any other members of your family follow any particular diet?
(Please tick)
Yes ___ No ___
If yes, please give details
_____
_____
_____
_____

d. Indicate on a scale of 1-10 how varied your child's diet was up to the age of 1 year (Please Circle)

Very Limited Very Varied

1 2 3 4 5 6 7 8 9 10

Appendix H

1st prevalence Questionnaire

Questionnaire for the prevalence of infants rejecting previously accepted foods.

Parent/CarersName:_____Date:_____
Child's Gender M/F:_____Child's D/O/B:_____
Child's Ethnic origin:_____
_____

Has your Child ever rejected a food he or she previously accepted? (please circle)

Yes No (If no, do not continue)

Has this happened in the last: (please circle all applicable)

Week Month 6 months

How often does your child reject previously accepted foods?
(please circle)

Never 1 2 3 4 5 6 7 Almost Always

The *most recent* time your child rejected a previously accepted food, what was rejected?

_____

How was that food cooked and presented? (i.e. boiled potatoes – mashed)

_____

What was the colour of the food?

_____

Were other foods given with the rejected food as part of the same meal? Yes No
If so, were any of these foods rejected and what were they?

_____
_____

Have you tried to give your child this food since it was rejected? Yes No
If so, was it rejected this time? Yes No

Was your child suffering from any illness, the day he or she rejected the food?

Yes No If yes, what illness (i.e. sickness)?

_____
_____

Thank you for taking the time to complete this questionnaire

Appendix I

2nd prevalence Questionnaire

Survey for the prevalence of infants rejecting previously accepted foods*.

***<u>Definition</u>: The rejection of a food you considered your child to readily accept as part of his or her diet.**

Date: _____
Child's Gender M/F: _____ Child's D/O/B: _____
Child's Ethnic origin: _____

1) Has your Child ever rejected a previously accepted food?
(Please Circle)

Yes No (**If no, please move to section B**)

2) Approximately, how old was your child when this <u>first</u> began to happen?
(Please Circle)

6- to 12- months 12- to 18- months 18- to 24- months 2- to $2^{1/2}$ years

$2^{1/2}$- to 3- years 3- to $3^{1/2}$- years $3^{1/2}$- to 4- years Over 4 years

3) On a scale of 1-7, since the first time it happened, how often has your child rejected a previously accepted food, since the first time?
(Please Circle)

Less than once a year About once a month Over once a week

1 2 3 4 5 6 7

4) From the categories below, which of the previously accepted food(s) have been rejected at some point?
(Please tick… you may indicate more than one)

- Grains and Grain products; e.g. Cereal, bread, pasta, rice _____
- Vegetables _____
- Fruit _____
- Dairy products; e.g. yoghurt, cheese _____
- Mixed dishes; e.g. casserole, shepherds pie, lasagne, curry _____
- Mixed dishes layered; e.g. sandwich, pizza _____
- Meat; chicken, beef, pork _____
- Other protein; e.g. nuts, peanut butter, eggs, beans _____
- Potato; e.g. mash, chips, waffles _____
- Sweets; e.g. ice cream, other desserts, KitKat, Mars Bars _____

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