A Theoretical Proposal for a Perceptually Driven, Food-Based Disgust that Can Influence Food Acceptance During Early Childhood

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Abstract: Disgust, the "revulsion at the prospect of (oral) incorporation of an offensive substance", is not thought to influence the acceptability of food during infancy and early childhood. This is because the feelings of disgust require a person to have developed an understanding of contagion and to be aware of the nature and origin of a given disgust stimulus, which does not occur until around seven years of age. Despite this need for higher cognitive functioning, studies have demonstrated the potential for disgust in children as young as two years of age. Furthermore, it seems that young children can demonstrate aspects of disgust without having the cognitive understanding of contagion. This review is the first paper to demonstrate *how* core disgust may influence the acceptability of foods from late infancy. Firstly, food neophobia may act as a catalyst for disgust. Secondly, that disgust in young children can result from the visual perceptual features of food (as opposed to a cognitive response based on non-food disgust stimuli). Thirdly, that some disliked foods have contaminating properties, much like non-food, adult disgust stimuli (e.g. insects). Fourthly, that the response reduces as the child ages and learns more about food and its variability between presentations. Finally, individual differences exist to explain why an individual child may be more or less likely to respond to a given food with a disgust response. This proposal adds to the current debate relating to the motivations of 'picky' eating during early childhood and introduces an alternative to the proposal that these behaviours are the result of a child's desire for autonomy.

Keywords: Disgust, infant/child eating behaviours, food neophobia, contagion, picky eating.

INTRODUCTION

Food neophobia, the avoidance/fear of new foods, begins between the ages of 18 and 30 months [1-4]. Food neophobia peaks in these early years and reduces thereafter [5-7]. Food neophobia is thought to be the consequence of an evolutionary development that prevents young children from consuming unknown and potentially poisonous substances, as they become more mobile [8] and is considered a normal stage of development experienced by most children to varying degrees [9]. At the onset of neophobia the visual elements of foods are likely to become salient as infants need to recognise the food items they are given, prior to eating them. New foods have to be introduced gradually into children's 'accepted' category (see work on exposure: [5, 10-15]) and consumption of new foods is encouraged by infants modelling the behaviour of adults and peers [4,16-18].

When neophobia begins new foods are often rejected but parents also report the rejection of known and previously accepted foods [19]. These rejections seem to occur *on sight* and contribute to children being labeled 'picky' by their parents [2,19]. Parents report that children like "food where all of the ingredients are without sauce and easily identifiable" [2 p. 623] and "in some cases a familiar food prepared differently was viewed as novel" [19 p.185].

Previous research has considered this reaction to relate to children's desire for autonomy [19]. However, several recent studies have provided evidence that core disgust may be a motivation for food rejection from as early as two years of age [20-22] and an alternative explanation is that the onset of disgust could partly account for the onset of these 'picky' behaviours. The potential problem with this disgust explanation is that current theories require children to have developed sufficient cognitive understanding and socialization before core disgust can influence their responses to a stimulus [23]. The current article offers an explanation for how a disgust response may emerge *prior* to this cognitive development and provides an argument as to how disgust may explain why infants become 'picky' and begin rejecting both new and previously accepted foods when food neophobia begins.

DEVELOPMENT OF ADULT-LIKE DISGUST AND CONTAMINATION

There are at least four main types of human food aversions; distaste, disgust, inappropriateness and danger [24]. Distaste refers to the sensory qualities of

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the food, and substances described as distasteful vary from person to person. Inappropriateness and danger refer to non-food items that may harm us if consumed. Finally, disgust is related to the understanding of the nature and origin of a substance and is defined 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" [25 p. 23].

Human diets can vary from person to person due to exposure [13-15,26], ideology [27] and culture [2,26]. 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 [25,28,29] but, while many similarities exist, what is seen as disgusting seems to be a learnt, socially and culturally mediated response [29].

Disgust is viewed as a basic human emotion [30] and the feeling of disgust towards a non-taste stimulus is usually accompanied by a characteristic facial response including turning away, mouth gaping, nose wrinkling, eye squinching and sometimes a gag reflex [25,31-34]. This facial response is shown by neonates and infants, but only in response to distaste [25,31,35,36], and remains almost identical in presentation from birth to adulthood [36]. 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 [31]. The response to *non-taste stimulus* (e.g. faeces) includes the same facial response and also varies in intensity depending on the elicitor [25]. The similarities between distaste and disgust have led some researchers to suggest that the emotion of disgust could have developed from early experiences of distaste [23,37,38]. While originally a response to expel potentially harmful substances from being ingested, disgust is thought to have evolved to defend the body from harm by non-taste disgusting substances and even immoral thoughts and actions [23,39].

Research examining when certain motivations for food rejection become adult-like was originally conducted by Fallon, Rozin and Pliner [37]. They looked at the development of the four main rejections, including disgust, by presenting children with stories and corresponding pictures. The stories involved various items taken to represent each of the four categories, e.g. faeces and insects for disgust, and 'poison' for danger. These were then depicted as contaminating a drink at different stages, e.g. by the drink, in the drink, taken out of the drink. The data from this study suggests that disgust and the associated contaminating effects are not *fully* present until around seven years of age, i.e. by this age there is no statistical difference between the adult and child response. However, it is difficult to demonstrate an adult-like disgust response in children younger than around seven years of age with the use of stimuli such as an insect because the child needs to understand the ideational factors and the facts about the nature/origin of these items that make them 'disgusting' [23,25].

Studies have shown that younger children seem to at least understand the "fundamental feature" [25 p. 567] of disgust: contamination. Children as young as three years show awareness of the transfer of properties from one item to another [40] and by four years children show knowledge of the key elements of contamination, such as contagion, the transmission of disease [22,40-42]. Children of this age even show a degree of associational contamination, i.e. just the proximity of the contaminant is enough to reduce the liking of an accepted substance [43].

Furthermore, research suggests that the socially mediated element of a disgust rejection may be developing in the years leading up to acquisition of the full, non-taste disgust response at around seven years of age, but that the feeling is not yet fully ingrained. A study by Mumme, Gradwohl and Adams-Lariviere (Unpublished data) showed that children around five years of age 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 [22] also shows that the response to dropped food may be socially mediated, even by children as young as two years. These studies suggest that, while children younger than 7 years of age may be *learning* what is 'disgusting', the feeling is not yet a true motivation for food rejection and a food rejected in one scenario may be acceptable in another. One proposal for how this learning may occur is the acquisition of disgust *via* parent-child transmission [21,23].

Stevenson, Oaten, Case, Repacholi, and Wagland [21] investigated the idea that disgust has a progressive, socially mediated developmental process. The study considered core disgust (which largely relates to oral incorporation), as well as animal disgust

elicitors and sociomoral disgust. The study measured parental report, observer judgments of facial responses and avoidance, as well as accessing the relationship between parent and child disgust.

In relation to the core disgust measures, the study found some evidence of facial disgust responses in children as young as two and a half years and that disgust responses could be observed in children even when the same child did not demonstrate any knowledge of factors such as contagion. Furthermore, the study showed that children's disgust measures correlate, though only modestly, with parental response. Data from, arguably, the most direct measure of child disgust, facial response, suggest that the overall pattern is similar to that found by Fallon *et al*. [37]; the youngest children (mean = 2.5 years) showing occasional revulsion to core disgust items but that it is not to the same degree as the adults' response until around seven years of age. Overall, the findings map on to the previous research relating to contamination, providing some evidence that disgust may be present in early childhood, that cognition is not always required to express disgust, and that there is a progressive development to the full adult-like, cognitive disgust response.

Based on the adult-like cognitive criterion described by Fallon *et al*. [37], 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, food neophobia is thought to be the result of omnivores *trying to avoid poisoning* from ingesting unknown substances [2,8]. Therefore, children actually begin to reject foods due to *danger* from around 18 months to 30 months. If the hypothesis that neophobia is a mechanism to avoid poisoning [2,8] is correct, then these danger rejections are not based on cognitive knowledge that some food-like items can be harmful, as assessed in the study by Fallon *et al*. They are instead ingrained, intuitive, perceptually driven responses towards substances that the child conceives as a something that can possibly be ingested, but that is rejected because it is not visually recognisable, and the consequences of that ingestion is unknown. This is, essentially, a food-based response. At the time neophobia begins, infants will avoid new foods while continuing to put many potentially dangerous and 'disgusting' non-foods into their mouths [44]. Early disgust responses could manifest themselves in a similar way, i.e. an intuitive, perceptually driven response directed specifically towards foods rather than a cognitive understanding of nature and origin.

Despite Fallon *et al*.'s [37] evidence that an adult-like, cognitive disgust does not fully appear in children until around seven years of age, it could still be that disgust can influence the acceptance of food during late infancy and early childhood. In order for this to be the case various factors would have to be shown to account for the observed behavioural patterns. Firstly, as reports of 'pickiness' rise sharply to around 50% in the second year of life [45,46] there needs to be a catalyst for this behavioural shift that could also relate to the increased likelihood of disgust responses. Secondly, as discussed above, the disgust response could not be cognitively based at this age so there needs to be evidence that the disgust could be the result of perceptual elements and, furthermore, that these relate specifically to food while other items continue to be mouthed. Thirdly, as contamination is a key factor in disgust stimuli, some of the foods that are rejected during this period in early childhood should have contaminating properties. Fourthly, while picky eating behaviours and neophobia are high during early childhood, this reduces towards middle-childhood [1-4]. Therefore, if disgust is a contributing factor, there should be a mechanism explaining why we would be likely to see a reduction in the sensitivity of this response as the child ages. Finally, not all children are reported as 'picky' eaters and both food neophobia and 'picky' eating behaviours are considered to vary from child to child [9,45,47]. Consequently, there should also be an explanation for why there may be individual differences in the propensity for children to respond to food with disgust in these early years.

Figure **1** gives a graphical representation of how the cognitive disgust, reviewed above, develops. Some initial understanding of contamination is present from 2-3 years of age and this rises to a full, adult-like disgust response from around 7 years of age. The figure also shows how the proposed perceptually driven, food-based disgust develops. There is no disgust in the first year of life and the onset is in line with food neophobia, when anxiety over food will heighten. As food neophobia diminishes so does the correlated feelings of disgust. However, the potential for a disgust response to food remains and has the propensity to be evoked if there is any concern over what is being eaten. Individual differences in this food-based response can occur due to differences in levels of food neophobia, sensory sensitivity and previous experience. This perceptually drive, food-based disgust is explained in detail below.

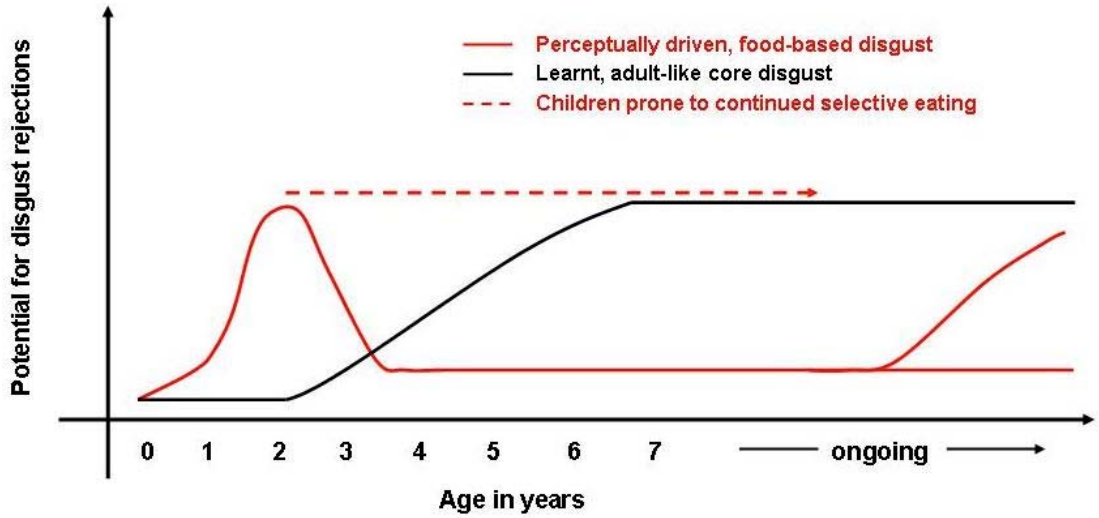

Figure 1: Graphical representation of the literature on learnt, adult-like core disgust and the proposal for the development of a perceptually driven, food-based disgust.

i. Food Neophobia: The Catalyst to an Early Disgust Response

Food neophobia seems to be related to genuine anxiety [48-51] and is treated as a true phobia in both adults and children [52,52, also see 53]. Therefore, the beginning of neophobia is a period of sensitivity towards food. Visual elements of foods are likely to become salient as food has to be recognised before being consumed as a way of reducing this anxiety.

Fear and disgust have been shown to positively correlate when measured against a phobia-inducing stimulus. For example, a person who is scared of spiders will find them more disgusting than a person who is not [54-57]. Furthermore, Thorpe and Salkovskis [58] state that, when a substance becomes the source of a phobia, the feelings of disgust towards that stimulus may increase. Disgust itself is thought to be a food-related emotion [25] and may have developed from distaste [37,38]. Therefore, if a substance (food) which is so closely related to disgust becomes the source of the anxiety, the potential for disgust is heightened.

Martins and Pliner [59] suggest that disgust responses may vary in strength with each latent disgust factor having an additive effect. Anxiety towards food could be one such additive effect, e.g. a person who has anxiety towards food, and considers the food to have a “slimy” texture, may find that food more disgusting than if only one of those factors were present. It is proposed here that experiences of distaste in early infancy, along with parental-child transmission of disgust [21], give the child a reference for ‘disgusting’ foods. When anxiety towards foods begins to occur in the form of food neophobia, those foods that are visually perceived to be aversive have an increased potential to evoke a disgust motivated rejection. While the child may or may not recognise the food presented, visual properties that do not match the child’s learnt, prototypical expectations, or if features of the food result in the child inferring it to be texturally/taste aversive, then 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 [60] showed that a substance that can evoke disgust, does so to a higher level at the prospect of ingesting the item. Therefore, if the child is pressured into consuming the food, the disgust response is likely to increase along with the anxiety, and may result in a longer term aversion [61,62].

ii. Non-Cognitive, Food-Based, Perceptually Driven Response

Martins and Pliner [59] propose that textural properties of food are more influential in eliciting disgust than the cognitive factors, such as animalness. Insight into textural properties, and other perceptually based inferences, can occur without ideational, cognitive-based knowledge and, therefore, can 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, which is caused by the anxiety towards food at the onset of neophobia. As a result, foods that motivate a

disgust response would be rejected on sight, even if they were previously accepted. During the time period in which neophobia begins, the foods often reported as rejected are fruit, vegetables and mixed foods [2,45,47], all of which, in comparison to many manufactured food products, are liable to perceptual changes between servings in the domains of texture, size, colour and taste. These changes could result in the inference of adverse taste/texture, and lead to a disgust based rejection.

Rozin, Hammer, Horowitz and Marmora [44] showed that between 16 and 29 months of age, children would put around 35% of adult disgust items in their mouth and concluded, therefore, that disgust is not present during this time. However, the disgust items used were those considered disgusting according to adult criteria. These required cognitive knowledge of nature and origin in order for them to be considered disgusting. 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. The only item consistently rejected by the youngest children was hair, a substance that the child can visually infer to be aversive if placed in the mouth [44].

The measure used by Rozin *et al*. [44] 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 [63]. However, when food neophobia begins children often *stop* putting new foods into their mouths whilst continuing to mouth non-foods. Therefore, the willingness for a child to place an adult disgust item in their mouth, while often rejecting some new and known foods on sight, may not be that young children cannot be motivated to reject food due to disgust but that only potential food stuffs prompt the response.

Although not identical to human adult disgust, animals also react in negative ways towards offensive or aversive substances. Monkeys can squash items, throw them away and wipe their hands after touching the offensive substance [64] and rats have been shown to gag, gape their mouths and shake their heads to presentation of conditioned aversions [38]. 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 [65]. 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 stimuli without the need for tasting. A similar separation of those disgust items that can be visually perceived (concrete) and those of a more abstract nature (disgusting due to their meaning) has been proposed by Stevenson *et al*. [21].

iii. Disliked Food Must Act as a Contaminant

If the potential exists for infants to begin rejecting foods in a food-based disgust response, then an essential element of disgust, contamination, has to occur, i.e. some of the foods rejected by older infants and young children need to be shown to render otherwise accepted foods as unwanted [25]. This occurrence has been anecdotally reported to occur during early childhood by Rozin [27], Cashdan [2] and Harris [66], and is demonstrated by 'selective eaters' [67]. In support of this, two recent studies have shown that liked foods may be rejected, or rated as less desirable, if they have touched disliked foods [20,68].

iv. Declining Influence After Early Childhood

As neophobia reduces in intensity [5-7,69] so should the correlating potential for disgust. In addition, the child will have been exposed to more foods resulting in easier acceptance of textures, and wider understanding of food categories [70]. Thus, more variation in presentation of food will be accepted by the child before the visual aspects would differ sufficiently from their prototype to be considered aversive. Modelling adults [1,4,18] and peers [16,17] also encourages acceptance of new foods and contributes to the reduction of food neophobia and may help in reducing the proposed disgust response.

v. Individual Differences

Few food preferences are innate [31,71,72]. Research has shown that the majority of our food choices are learnt via exposure [5,10-15]. Exposure is likely to account for the cultural variation in food choices [73] and has been shown to reduce food neophobia [5]. Furthermore, choice of early feeding method has even been shown to account for later measures of 'picky' eating behaviours, with breastfed children less likely to be considered 'picky' at 7 years of age [48]. Therefore, it is likely that early dietary variety and exposure may be beneficial to the variety of foods

consumed as the child ages [74-78] and reduce disgust responses.

Another element that could account for individual differences in an early disgust response is the extent of the child's food neophobia. The proposal offered here suggests that the anxiety produced as a result of food neophobia is fundamental to the onset of this proposed visual perceptual, food-based disgust response. As a result, infants with higher levels of food neophobia should have a higher anxiety towards food stuffs. As a consequence, these children will have a greater focus on perceptual qualities of food and, therefore, will show more potential for disgust based food rejections. Literature has shown that different levels of neophobia correlate with different levels of anxiety in adults [48,50] and that anxiety reducing behavioural techniques are used to help reduce neophobia in adults and children [52,79]. This is unlikely to change, at least during the early years, as food neophobia and food rejection remain fairly stable [76].

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. Sensory sensitivity refers to increased or decreased threshold to stimuli involving any of the senses, e.g. vision or taste/smell, and can occur in a specific domain or in a number of the senses [80]. Children on the autistic spectrum, who are often sensory sensitive and can become selective eaters [67], have less dietary variety [53], have more problems with textures, reject more foods [81] and are more likely to want specific presentation of foods and specific utensils, when compared to controls [67,81,82]. Though these children can suffer physiological problems from early infancy, selective eaters generally begin to have difficulties with food from around 18 months of age (neophobic period) and can continue to be selective eaters for many years [53,67,81,82]. Furthermore, in a non-clinical sample, Coulthard and Blissett [83] found that parental consumption of fruit and vegetables related to their child's consumption *unless* the child had high levels of sensory sensitivity.

Potential Influence in Later Life

The proposal within this paper argues that a food-based, perceptual disgust response begins in late infancy as a result of food neophobia. If food-related anxiety towards the end of infancy can result in food-based disgust responses, then future food-related anxieties should also have the capacity to increase the propensity for an individual to demonstrate food-based disgust rejections. It is likely that rejections of known and accepted foods do occur on occasion in adulthood as foods that seem intuitively aversive, are sometimes rejected due to their visual properties. Cardello [84] found that as the level of concern about a food increased, the rating for how liked a food was decreased. An everyday example of this could be the propensity for consumers to reject non-prototypical fruit and vegetables when shopping [85]. This seems to be a normal response and causes just enough anxiety to reject the food presented and opt for the more 'prototypical' examples. While the foods are cognitively known to be equally edible and they are used for food production as ingredients, their visual appearance makes the thought of consuming them less desirable.

OVERVIEW

Rozin and Fallon [25] show that, just the prospect of consuming a disgusting stimulus, is enough to result in a disgust response and, furthermore, that the substance can contaminate an otherwise acceptable items. The proposal presented here suggests that the rejection of some new and previously accepted foods, on sight, could also be a disgust response but one that is perceptual, as opposed to cognitive, and specific to food, i.e. a fly will not cause the same reaction. The catalyst is the increase in anxiety/fear towards foods during the onset of neophobia which results in an increased focus on the perceptual features of the food offered to the child, as well as an increased potential for a disgust response towards this anxiety provoking stimulus. As a result, those foods that i) do not match learnt, perceptual expectations, or, ii) are perceived to have an aversive taste/texture, are rejected on sight, prior to being tasted.

POSSIBLE IMPLICATIONS

It is suggested here that the rejection of some new and previously accepted foods are likely to be a normal occurrences towards the second year of life and that increased sensory sensitivity and neophobia may further increase the likelihood of dietary narrowing around this time. In order to limit the impact of these factors, infants should be given opportunities for a wide variety of early food learning during the first year of life, including breastfeeding where possible, wide exposure to tastes and textures during age appropriate stages [86] and through modelling adults and peers [1,4,16-

18]. This may help in widening children's accepted food categories, result in fewer prototypical expectations of foods and fewer concerns over texture.

However, if new or previously accepted foods are rejected then pressure to eat them should be limited. Modelling, exposure, widening of categories and the reduction of neophobia over time should allow for the foods to be introduced, if pressure to eat is avoided. Pressure to eat is likely to increase feelings of disgust, increase refusal and may lead to longer term rejections [61,62]. As children's early food rejections are most commonly reported to be fruit [3] and vegetables [45,47], 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 [87], aversions could be detrimental to later health.

If pressure to eat inflames the disgust response, the mediating factor is likely to be increased anxiety. Therefore, lowering anxiety may in the rejected food being 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. A study by Farrow and Blissett [88] 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 [89], 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 [90]. It may be that parental responsiveness could help to lower anxiety during the neophobic period. Understanding what contributes to the narrowing of children's dietary variety can lead to appropriate interventions to improve long term health via increased dietary variety [9] and to lower parental concern.

FUTURE RESEARCH

Further research has to confirm a number of elements in order to support this proposal. Firstly, it needs to be shown that, during infancy, children find perceptual changes between food servings salient and these may result in rejection. One option could be to investigate the eating habits of children who are visually impaired. This may give my help in delineating between those 'picky' eating behaviours that are related to visual properties of food and those that are not. Secondly, it should be investigated 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. If these elements can be supported in future research, then the proposal presented here that a perceptually based, food-related disgust occurs in early childhood would be supported.

Further, the hypothesis that an increase in food-based anxiety may result in a 'reappearance' of these early food rejections in later life should be examined. Currently research into selective eaters, who seem to develop problems at the start of the neophobic period, have anxiety towards foods, and who can continue to have problems for many years, seem to eat a specific range of foods often consisting mainly of carbohydrates [53,67,82]. 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.

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