

Food neophobia in humans

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Introduction

Food neophobia, a reluctance to ingest novel foods, is a characteristic of omnivorous animals, including humans. Such organisms, exposed to the hazards of an environment in which many food sources may be toxic, approach novel foods with caution, eschewing them in favor of familiar foods whenever possible. It has been suggested that food neophobia is a conservative force, operating to keep the organism's feeding behavior "locked in on a safe track" by preventing its taste preferences from straying from familiar foods known to be harmless (Schulze & Watson, 1995, p. 230).

Bases for rejection of foods. Rozin and Fallon's (1980; Fallon & Rozin, 1983) taxonomy of the bases for rejection of foods provides a useful starting point for the discussion of the rejection of novel foods by humans. These researchers have proposed that in humans there are three main bases for rejection of a food: 1) *dislike* of its sensory characteristics; 2) *danger*, a fear of negative consequences of eating it; and 3) *disgust*, arising from the idea of the food's nature or origin. While Rozin and Fallon focused on familiar foods, there is evidence for the relevance of each of these factors as a basis for rejection of novel foods as well.

In the case of *dislike*, Pliner, Pelchat, and Grabski (1993) found that participants expected novel foods to be less palatable than familiar ones, and beliefs about their palatability predicted willingness to taste them. *Danger*, as a motivation for rejecting a novel food is related to "learned safety," one of the classic notions in the literature on food selection in animals (Kalat & Rozin, 1973). According to this idea, only after a number of very limited exposures to a novel food in the absence of negative consequences, does the animal learn the food is safe and ingest significant quantities of it. Pliner et al (1993) found that participants rated the novel foods presented to them in the laboratory as slightly more dangerous than their familiar counterparts, and these ratings of

dangerousness predicted willingness to taste them. Rozin, Haidt, and McCauley (1993) suggested that *disgust* might serve to counter individuals' tendencies to approach novel foods, after finding a negative correlation between their Disgust Scale (Haidt, McCauley, & Rozin, 1994) and the Sensation Seeking Scale (Zuckerman, 1979), which assesses preferences for novel and exciting stimuli. Similarly, Pliner (unpublished data) found a strong positive correlation between scores on the Food Neophobia Scale (FNS), a measure of the trait of food neophobia, and the Disgust Scale.

Factors affecting food neophobia. While humans generally reject novel foods, there are large *situational differences* in the extent to which such neophobic behavior occurs. We will describe these shortly. In addition, there are also large *individual differences* in the extent of food neophobia. Thus, it is sometimes useful to characterize food neophobia as a personality trait, a continuum along which people can be located in terms of their stable propensity to approach or avoid novel foods. In this review we will sometimes be discussing food neophobia as a behavior involving rejection of a novel food or foods in a particular situation; at other times we will be referring to food neophobia as a personality characteristic involving a relative preference for familiar over novel foods that is stable over time and consistent across situations.

Measuring food neophobia. In keeping with the distinction between food neophobic behavior displayed at a particular time in a particular situation and the trait of food neophobia, we will describe measures of both--the former in this section and the latter in a later section of the chapter. In a typical study assessing neophobic behavior, participants see an array of foods, some novel and some familiar and are asked to indicate their degree of willingness to taste each later in the session, with the clear implication that their responses will determine which foods they will actually taste. Neophobia is defined in terms of the average willingness to taste the novel foods,

usually divided by the average willingness to taste the familiar foods, so as to take into account willingness to accept any food at all at that time and in that situation. Low scores on this “behavioroid” measure are indicative of high neophobia. Some investigators have defined behavioral neophobia as reported “willingness to eat more of” a particular novel food or in terms of ratings of liking for the taste, odor, or even appearance of a novel food.

Situational Factors Affecting Food Neophobia

Information

Indirect information about taste and beneficiality. Rozin (1988) has argued that foods that are accepted are usually those that (are expected to) taste good and those that are seen to be beneficial. It will be noted that these characteristics of food describe the opposites of two of the bases for rejection described earlier—namely dislike and danger. It might, therefore, be expected that any situational factor that induces the expectation of their opposite poles—good taste or beneficial consequences—might reduce neophobia. In several studies, participants have been presented with information intended to promote these expectations, finding that *good taste* information does increase willingness (Pelchat & Pliner, 1995; Martins, Pelchat & Pliner, 1997; McFarlane & Pliner, 1997; Tuorila, Meiselman, Bell, Cardello, & Johnson, 1994). For example, students in one of Pelchat and Pliner’s (1995) studies encountered a novel food in a cafeteria line; for some, the food was accompanied by a sign reading “9 out of 10 students said “tastes great!” The latter were more likely to sample a portion of the food than were appropriate controls. The evidence concerning the efficacy of inducing anticipation of *beneficial consequences* as a means for eliminating rejection of novel foods is more complicated. Pelchat and Pliner (1995) included a condition in which the novel food was accompanied by a sign saying “a good source of iron” and found no increase in the proportion of students accepting the food. Indeed, two studies found

that beneficial consequences information actually decreased the likelihood of trying novel foods (Koster, Beckers, & Houban, 1987; Woodward, 1945). However, information about the beneficial consequences of a food does seem to increase willingness to eat a novel food for individuals for whom this information is important or relevant (McFarlane & Pliner, 1997) or in a context where the new food is believed to be readily available (Martins et al, 1997). To complicate matters further, whereas providing information seems effective for some kinds of foods, it appears to be relatively ineffective for reducing rejections mediated by strong emotional reactions such as disgust. Martins et al (1997) found that neither taste information nor beneficial consequences information increased participants' willingness to taste novel animal foods.

Direct information about taste and beneficiality. Another means of providing information about a novel food relies on the individual's own experience. Here we refer to the literature on the "mere exposure" effect (Zajonc, 1968). Birch and her colleagues (Birch & Marlin, 1982; Birch, McPhee, Shoba, Pirok, & Steinberg, 1987) gave young children varying amounts of exposure to novel cheeses or fruits. After the exposure phase, the children were shown all possible pairs of foods and asked to choose the one they wanted to "eat more of" or they "liked the best." There was a positive effect of number of exposures on choice and liking. These results are typically interpreted in terms of "learned safety;" with repeated exposures individuals learn that the food is "safe" and does not produce negative gastrointestinal consequences. Other investigators, testing both infant and adult participants, have obtained similar results (Birch, Gunder, Grimm-Thomas, & Laing, 1998; Pliner, 1982; Zellner, Rozin, Aron, & Kulish, 1983)

Generalization of direct information. Aside from the safety argument described above, individuals anticipate that novel foods will have an unpleasant taste. Exposure to palatable novel

foods might help them realize that their negative expectations regarding novel foods are unfounded. That is, positive experiences with novel foods might generalize to other novel foods and decrease neophobia in a more general and enduring manner. Sullivan and Birch (1990) found that exposure affected children's preferences only for the specific food items exposed. However, a similar study by Pliner et al (1993) obtained very different results. After an exposure phase in which they tasted either a set of good-tasting novel foods or a similar set of familiar foods, adult participants chose from a set of *different* foods, both familiar and novel, which ones they would taste later. Participants pre-exposed to good-tasting novel foods chose more novel items than did the familiar-food controls. In a subsequent study, Loewen and Pliner (1999) provided 7- to 9-year-old and 10- to 12-year-old children with taste exposure to good-tasting familiar, good-tasting novel, or bad-tasting novel foods. For older children, exposure to the novel-good foods increased willingness to taste a different set of novel foods in comparison to the familiar-good control, while exposure to the novel-bad foods had no effect. For younger children, exposure to both novel-good and novel-bad foods decreased willingness to taste novel foods. Thus, to some extent, creating positive experiences with novel tastes seems to generalize to willingness to taste other novel foods.

Social Influence

In several studies, social influence had strong effects on acceptance of and liking for foods; the children in these studies followed the lead of a "model," liking and choosing the same foods (Birch, 1980a; Duncker, 1938; Marinho, 1940). These findings raise the question of whether social influence would also affect reactions to novel foods; specifically, would exposure to a model who accepts novel foods increase an observer's acceptance of such foods. In a study by Harper and Sanders (1975), children were more likely to accept a novel food if they saw their

mothers eat it first. Hendy (2002) examined the effect of trained peer models on preschoolers' willingness to accept novel foods, finding that only the girls were effective models. Hendy and Raudenbush (2000) showed that teachers could be effective models for preschoolers but only if they modeled "enthusiastically," making favorable comments about the novel foods, and not if they modeled silently. Hobden and Pliner (1995) found that adult participants were influenced by exposure to a neophilic model, although the reduced neophobia did not generalize to non-modeled foods.

Type of food

Several studies have shown that individuals are more likely to reject novel foods of animal origin than those not of animal origin (Martins, Pelchat, & Pliner, 1997; Pliner, 1994; Pliner & Pelchat, 1991). Further, participants' reactions to the novel animal foods resembled reactions to prototypical disgusting foods identified by Fallon and Rozin (1983) to a greater extent than did their reactions to the nonanimal foods. Interestingly, the finding of a greater rejection of novel animal (vs. nonanimal) foods did not replicate in a group of children ranging in age from 5 to 11 (Pliner, 1994). Since a study by Fallon, Rozin, and Pliner (1984) showed that disgust, as a category of rejection, had not fully achieved adult levels even in children eight to twelve years of age, this finding is consistent with the notion that rejection of novel animal foods is mediated by disgust.

Studies on neophobia have traditionally focused on "ethnic" foods, novel to one culture, but familiar in others. In addition to ethnic cuisines, Tuorila (2001) identified four other kinds of novel foods: functional foods, genetically modified products, nutritionally-modified foods, and organic foods. The bases of rejection of these other "kinds" of novel foods might be different than those related to unwillingness to eat ethnic foods. Although much more experimental

research is needed, available data support this proposition. For instance, there is evidence suggesting that willingness to try ethnic novel foods is related to scores obtained on the Food Neophobia Scale (FNS) to be discussed later. However, Tuorila and her colleagues (Tuorila, Lahteenmaki, Pohjalainen, & Lotti, 2001) found little relationship between willingness to try functional foods and scores on the FNS, while Hursti and Magnusson (2002) found that attitudes toward organic and genetically-modified foods were not related to FNS scores. Also, Backstrom, Pirttila-Backman and Tuorila (2003) found that, although subjects in their study were reluctant to consume all kinds of novel foods, organic and ethnic foods were described in positive terms while biotechnological foods were associated with negative adjectives and metaphors (see also Cardello, 2003; Koivisto Hursti & Magnusson, 2003; and Magnusson & Hursti, 2002, for data pertaining to negative attitudes towards food processing technologies). Furthermore, it is also the case that willingness to try novel ethnic foods seems to show a different relation with age than does willingness to try the other kinds of novel foods. While many studies show that people become more willing to try novel ethnic foods as they get older (e.g., McFarlane & Pliner, 1997), people seem to become more reluctant to eat the other kinds of novel foods as they get older (de Jong, Ocke, Branderhorst, & Friele, 2002; Hursti & Magnusson, 2002)). Given these differences, it might be expected that different kinds of novel foods might be differentially susceptible to the effects of different situational variables; however, there are no data available.

Amount of novelty in the situation

In a classic study, Archer and Sjoden (1979) found that rats were much more likely to accept a novel food when the surrounding environment was relatively familiar than when there were several novel cues present. Harper and Sanders (1975) found that young children were more likely to accept a novel food from their mothers than from an unfamiliar experimenter. E.

Rozin and P. Rozin's (1981) account of the functions of flavor principles, the characteristic seasonings used in various cuisines (E. Rozin, 1973), suggests that one such function is to facilitate the introduction of novel staple foods into a culture by adding sufficient familiarity to decrease the neophobia ordinarily produced by a new food. Stallberg-White and Pliner (1999; Pliner and Stallberg-White, 2000), examining flavor principles at the individual level, predicted and found that adding a familiar flavor to novel foods increased the willingness of both adults and children to taste them.

Arousal

Both the animal and the human literatures indicate that strong arousal produces a decrement in novelty preference. Making predictions from optimal level of arousal theories (e.g., Revelle, Anderson, & Humphreys, 1987), Pliner and colleagues (Pliner & Loewen, 2002; Pliner & Melo, 1997) found a negative relation between willingness to taste novel foods and manipulated arousal. In addition, Pliner and Melo found that manipulated arousal interacted with individual differences in sensation seeking, often considered to be a measure of optimum level of arousal. Pliner, Eng, and Krishnan (1995) manipulated both fear and hunger and assessed willingness to try novel foods. In the condition in which arousal was presumably highest (high fear-high hunger), participants showed the greatest reluctance to try the novel foods. The findings in the previous section showing that willingness to try novel foods is greatest in situations in which the situation is otherwise relatively familiar are compatible with the arousal findings, if one simply assumes that arousal in a familiar situation is likely to be low (in comparison to a situation in which there is a large amount of novelty).

Individual Differences in Food Neophobia

Measures of individual differences

Although neophobia is a general characteristic of omnivores, there are clearly individual differences in the extent of it. To measure such individual differences, Pliner and Hobden (1992) developed the Food Neophobia Scale (FNS), a ten-item questionnaire consisting of such face valid items as “I don't trust new foods.” Another approach was taken by Frank and his colleagues (Frank & Van der Klaauw, 1994; Raudenbush, Schroth, Reilley, & Frank, 1998), on whose revised Food Attitude Scale (FAS-R) participants' rated willingness to taste those foods on a presented list that they have never tried is the measure of food neophobia. To assess food neophobia in children, Loewen and Pliner (2000) developed the Food Situations Questionnaire, on which children rate their feelings about trying particular novel foods in particular situations.

All three measures have been extensively validated. The FNS predicts choice of and rated willingness to eat novel foods both in and out of the laboratory (Flight, Leppard, & Cox, 2003; Martins et al, 1997; McFarlane & Pliner, 1997; Pliner & Hobden, 1992; Raudenbush & Frank, 1999; Raudenbush et al, 1998), familiarity and experience with relatively exotic foods and “foreign” cuisines (Flight et al, 2003; Pliner & Hobden, 1992), willingness to explore food odors about which little information has been provided (Raudenbush et al, 1998), and the serving of relatively uncommon foods at family mealtime (Hursti & Sjoden, 1997; Koivisto & Sjoden, 1996). Scores on the FAS/FAS-R are related to number of novel foods rejected on a questionnaire, the number of foods participants report having tried in the past, and a set of face valid questions querying reactions to novel foods (Frank & van der Klaauw, 1994; Raudenbush et al, 1998). In addition, the FNS and the FAS-R are highly correlated with each other ($r = .73$; Raudenbush et al, 1998). The FSQ predicts children's willingness to taste unfamiliar foods in the laboratory (Loewen & Pliner, 2000) and is significantly related to parents' ratings of their children's neophobia on the FNS.

Correlates of individual differences in food neophobia

Reactions to familiar and novel foods. Both the Pliner and the Frank groups have provided evidence suggesting that food neophobia and finickiness or pickiness (a tendency to reject familiar foods (Potts & Wardle [1998]) are distinct, although related, constructs. Pelchat and Pliner (1986) found that the two emerged as separate factors in mothers' reports of their children's eating behavior. Kauer, Pelchat, and Rozin (unpublished data) found that, although pickiness and neophobia items loaded on the same factor, when this factor was itself factor-analyzed, the finickiness and neophobia items separated. In Galloway, Lee and Birch's (2003) study of 7-year-old girls, food neophobia was only modestly related to pickiness and had different predictors. Raudenbush, van der Klaauw, and Frank (1995) factor-analyzed a set of questions pertaining to food and eating, obtaining three distinct factors, one consisting of items describing reactions to novel foods, labelled neophobia (e.g., "I enjoy trying unusual foods") and another describing negative reactions to foods in general, labelled finickiness (e.g., "I find many foods distasteful"). In a regression analysis, using scores on the neophobia and finickiness factors to predict the number of "won't try" responses on the FAS (their original neophobia measure), they found the neophobia but not the finickiness factor to be a significant predictor. In a similar regression analysis, this time using the two factor scores to predict numbers of food likes and dislikes among familiar foods on the FAS, they found the finickiness but not the neophobia score to be a significant predictor. Taken together, these results strongly suggest that willingness to try novel foods (neophobia) and dislike for many familiar foods (finickiness) are distinct responses.

In support of this distinction, both groups have found that their measures of neophobia are related to willingness to taste novel foods but do not predict willingness to taste familiar

foods or that the relationship between the neophobia measures and willingness is much stronger for novel than for familiar foods. Raudenbush and Frank (1999) carefully ensured that the novel and familiar foods they offered were equally familiar to high and to low scorers on the FNS, and found that the groups differed only in their willingness to taste the novel foods. In order to examine the relations between food neophobia as measured by the FNS and various reactions to food, Pliner (unpublished data) computed correlations between FNS scores and these variables obtained in the studies from her laboratory and then averaged them, weighting each correlation by the N on which it was based. The average correlation between FNS scores and behavioroid measures of willingness to try novel foods was $-.41$, while the analogous correlation for familiar foods was only $-.09$. These data can be seen in Table 1. Furthermore, neophobia is not only related to willingness to try novel foods, but also to expected liking for novel foods (Pliner & Hobden, 1992; Raudenbush & Frank, 1999; Tuorila, Meiselman, Bell, Cardello, & Johnson, 1994; Tuorila, Andersson, Martikainen, & Salovaara, 1998). For studies from the Pliner lab, the average correlation between FNS scores and expected liking for novel foods was $-.34$, while the analogous correlation for familiar foods was only $-.01$. Further, several studies have found no relation between scores on food neophobia measures and ratings of liking for familiar foods, actually tasted and/or rated from memory (Pliner & Hobden, 1992; Pliner, Lahteenmaki, & Tuorila, 1998; Potts & Wardle, 1998 [Study 2]; Raudenbush et al, 1998; Pliner & Loewen, 1997; but see Arvola, Lahteenmaki, & Tuorila, 1999; Potts & Wardle, 1998 [Study 1]). Again, examining correlations from several studies involving many participants, Pliner found an average correlation of $-.02$ between FNS scores and liking for familiar foods actually tasted. However, the data relating food neophobia and liking for novel foods *actually tasted* are not straightforward. Several studies have demonstrated no relation between the two (Pliner &

Hobden, 1992), while others have demonstrated substantial relations between them (Pliner et al, 1998; Pliner & Loewen, 1997). Once again averaging correlations from several studies, Pliner found that FNS scores were moderately correlated with liking for novel foods (mean $r = -.22$). In summary, we believe that the pattern of relationships warrants treating neophobia and finickiness as separate constructs. Food neophobia, as measured by the FNS and other measures of neophobia, is strongly related to individuals' reactions to novel foods but has little to do with their reactions to familiar foods.

Other food- and eating-related correlates of food neophobia. Raudenbush et al (1995) examined several other potential food- and eating-related correlates of food neophobia, finding a modest positive correlation between FAS "won't try" responses and scores on the Eating Attitudes Test, a measure of the symptoms of anorexia nervosa (EAT; Garner & Garfinkel, 1979) but no correlation between the FAS and scores on the Eating Disorder Inventory, a multidimensional eating disorder inventory (EDI; Garner, Olmstead, & Polivy, 1983), or scores on the Restraint Scale, a measure of dieting (Herman, Polivy, Pliner, & Threlkeld, 1978). In a series of interesting studies, the Frank group has also examined the relation between food neophobia (as measured by the FAS/FAS-R and the FNS) and hedonic evaluations of olfactory stimuli. They found that FAS scores are negatively correlated with rated pleasantness of the odors of familiar but concealed foods (Raudenbush et al, 1995) and that FNS scores are negatively correlated with rated pleasantness of odorant solutions (Raudenbush et al, 1998).

Sensation seeking. A number of studies have examined the relation between food neophobia and the Sensation Seeking Scale, a measure of general willingness/unwillingness to approach novel, exciting, and/or complex stimuli (Zuckerman, 1979). Several studies have shown that one or more of its subscales are negatively related to trait food neophobia measures

(Loewen & Pliner, 2000; Pliner & Hobden, 1992; Raudenbush et al, 1995; Walsh, 1993), to reported food attitudes (Terasaki & Imada, 1988), and to behavioral measures of neophobia (Otis, 1984). Food neophobia has also been shown to be related to a more general reluctance to approach novel stimuli, including unfamiliar people, places, and activities (Pliner and Hobden, 1992; Raudenbush et al, 1995).

Gender differences. Gender differences in food neophobia might be expected, given previous research that has demonstrated differences between males and females on such related variables as taste preferences (e.g., Desor, Greene, & Maller, 1975), food preferences (e.g., Logue & Smith, 1986), and food aversions (e.g., Babayan, Budayr, & Lindgren, 1966). However, most research with the FNS, the FAS, and the FSQ has produced no differences (Koivisto & Sjoden, 1996; Pliner and Hobden, 1992; Loewen & Pliner, 2000; Tuorila et al, 1998; Meiselman et al, 1999). When actual neophobic behavior, as opposed to self-reported usual behavior is the measure, gender differences also fail to appear (McFarlane and Pliner, 1997; Pliner, 1994). There are some exceptions, however. Using the FAS, Frank and Van der Klaauw (1994) found that women reported more “won’t try” responses than men, and Alley and Burroughs (1991) found that men were more likely than women to report seeking unusual and new foods (see also Backstrom, Pirttila-Backman, & Tuorila, 2003; Cardello, 2003; Magnusson & Koivisto Hursti, 2002, for gender differences in attitudes towards other kinds of novel foods). In contrast, in two large Scandinavian samples, Tuorila et al (2001) and Hursti and Sjoden (1997) found higher FNS scores in men than in women.

Age differences. The data on age differences in food neophobia are difficult to describe in any simple way. The various studies have used vastly different age ranges and age categories, different methods of testing for differences, and different measures of neophobia. When one

examines actual neophobic behavior, it appears that neophobia declines with age. Younger children accept fewer novel foods than older ones (Pliner and Loewen, 1997; Loewen & Pliner, 2000); junior high school students accept fewer novel foods than senior high school students (Pelchat & Pliner, 1995); and younger adults accept fewer novel foods than older adults (McFarlane & Pliner, 1997; Pelchat, 2000; Otis, 1984). There is, however, one clear exception; Harper and Sanders (1975) found that 1 ½ year olds were more likely to accept a novel food than were 3 ½ year olds. This exception is interesting in light of Cashdan's (1994) hypothesis that there is a critical period for learning which foods are edible and that this period should occur during early childhood while the child is still protected by the parents. Accordingly, she predicted that food neophobia should be lowest in children younger than 24 months. Confirming this prediction, she found, in a retrospective survey of parents of one- to ten-year-old children, that the children were most accepting of novel foods at age two, with neophobia increasing sharply from two to four. However, consistent with the data reported earlier, neophobia decreased from ages four to ten.

When one examines the relation between age and scores on various trait measures of food neophobia, there are many similar findings. In five student samples with age ranges of at least 10 years, FNS scores showed modest negative correlations with age (Pliner & Hobden, 1992); a group of children had higher FNS scores than their parents (Hursti & Sjoden, 1997; Koivisto & Sjoden, 1996), and younger children had higher scores than older ones (Hursti & Sjoden, 1997; Koivisto & Sjoden, 1996; Pliner and Loewen, 2002); in a longitudinal study mothers rated their children's willingness to eat novel foods as lower at 34 months than at 84 months (Carruth & Skinner, 2000 #3821). However, in several studies there were no differences between 7-9 and 10-12 year olds (Pliner, 1994 #1920; Loewen & Pliner, 2000 #1894). In the most important

exception to the general decline in food neophobia scores with age, Tuorila et al (2001) tested a sample of Finns ranging in age from 16 to 80. Scores increased slightly but steadily until age 65 and then increased sharply in the 66-80 age group. Although this finding is something of an outlier, it is difficult to dismiss, given that the sample upon which it is based is both large and representative.

Demographic variables. The relations between food neophobia and several other demographic variables have been examined. In two studies, individuals living in rural areas were more neophobic than their more urban counterparts (Flight et al, 2003; Tuorila et al, 2001). In one of these studies (Tuorila et al, 2001) education was negatively related to FNS scores, while, in the other, a measure of socioeconomic status, based on education, was unrelated to food neophobia scores (Flight et al, 2003).

Family Resemblance in Food Neophobia

Parents play an important role in the development of children's food habits. Several studies have examined family resemblance in terms of *food preferences* (e.g. Birch, 1980b; Logue *et al.*, 1988; Pliner, 1983; Pliner & Pelchat, 1986; Rozin, Fallon, & Mandell, 1987). Overall, these studies have shown only modest relationships between parents and their children with respect to food preferences, although similarities between parents and their children seem to increase as children get older (Birch, 1980b; Logue *et al.*, 1988). Resemblance appears to be stronger between siblings than between children and their parents (Pliner & Pelchat, 1986; Rozin & Millman, 1987). With regard to food neophobia, Pliner (1994) found a significant but modest relationship ($r=.31$) in neophobia scores between children and their mothers (see also Koivisto & Sjoden, 1996). Hursti and Sjoden (1997) found similar results using parental ratings of child food neophobia and an *ad hoc* Food Frequency Questionnaire. Galloway et al (2003) found that

mothers', but not fathers', FNS scores were related to a trait measure of food neophobia in their daughters.

Mechanisms underlying food neophobia

Wong (1995) notes that "there have not been many systematic attempts to uncover the mechanisms of food neophobia." One possibility is suggested by the animal research on the effects of early pre-exposure to novelty in various modalities on subsequent reactions to novelty. Some of the research shows that pre-exposure to novel foods increases subsequent acceptance of different novel foods (Braveman, 1978; Capretta, Petersik, & Stewart, 1975). Another set of studies demonstrates that early pre-exposure to novel environmental stimuli (including handling) increases the willingness of adult rats to explore novel environments (e.g., Levine, Haltmeyer, Karas, & Denenberg, 1967; Weinberg, Smotherman, & Levine, 1978). Interestingly, there are also cross-modality effects. Weinberg et al (1978) found that early handling increases consumption of a novel food by adults, and Braveman (1978) found that pre-exposure to novel flavors increases exploration of a novel environment by adults. Minor, Dess, Ben-David, and Chang (1994) found that individual differences in open field exploration predicted neophobic responses to a novel saccharine solution. Braveman (1978) postulated that these non-specific effects of pre-exposure on neophobia may be mediated by reduced emotional responsivity. In other words, pre-exposure to varied stimuli, including food stimuli, produces animals that are less emotionally responsive, and these animals are less neophobic in many domains, including the food domain.

Some of the data on individual differences in humans are consistent with these findings and theorizing. First of all, there is evidence for the same kind of cross-modal seeking or avoidance of novel stimuli as Minor *et al* (1994) observed. Raudenbush and Frank (1999)

reported significant correlations between measures of willingness to try novel foods and willingness to engage in novel activities, while Pliner and Hobden (1992) reported correlations between scores on the Food Neophobia Scale and scores on the General Neophobia Scale, a measure of willingness to approach novel people and situations. As noted earlier, several studies have shown that one or more of the subscales of the Sensation Seeking Scale (Zuckerman, 1979), a measure of willingness/unwillingness to approach novel, exciting, and/or complex stimuli, are negatively related to food neophobia measures (Pliner & Hobden, 1992; Raudenbush et al, 1995; Walsh, 1993).

With respect to the role of anxiety, Pliner and Hobden (1992) reported several studies in which they obtained small but significant relations between the FNS and trait anxiety (STAI-Trait; Spielberger, Gorsuch, & Lushene, 1970) in adults. Pliner and Loewen (1997), examining temperament in children, found that emotionality was significantly related to food neophobia. Galloway et al (2003) found a highly significant correlation between a trait measure of food neophobia and anxiety. It should be noted, however, that such a relation has failed to materialize in some studies [Potts & Wardle, 1998; Raudenbush et al, 1995).

Consistent with a general anxiety-mediation notion is the common finding that anxiolytic drugs, such as chlordiazepoxide, increase the intake of novel foods in rats (e.g., Britton, Koob, River, & Vale, 1982; Cooper, Burnett, & Brown, 1981; Hodges, Green, Crewes, & Mathers, 1981). Indeed, degree of food neophobia is often used as a screen to assess the effects of benzodiazepine-like drugs (Poschel, 1971). The importance of anxiety as a mediator of food neophobia in humans can also be seen in the results of studies that involve acute manipulations of anxiety and assess state (as opposed to trait) neophobia. Pliner et al (1995) found that increasing anxiety, by means conceptually unrelated to eating or food, increased food neophobic

behavior. In another study (Pliner et al, 1993) participants above the median in state anxiety were willing to taste fewer novel foods than their counterparts below the median. Thus, converging evidence points to a role for anxiety mediation in food neophobia.

Clinical Implications of Food Neophobia

Effects on health

Given that rejection of novel foods is likely to decrease diet breadth, it might be expected that there would be nutritional consequences of food neophobia. Galloway et al (2003) found that food neophobia was negatively related to consumption of vegetables in seven-year-old girls. Similarly, Cooke, Wardle, Gibson, Sapochnik, Sheiham, and Lawson (2004) found that food neophobia was negatively related to the consumption of fruit and vegetables in pre-school children. Falciglia, Couch, Gribble, Pabst, and Frank (2000) compared three groups of children (neophobic, neophilic, and average) and found that those in the first group were less likely to meet the recommended value for vitamin E than the others. In addition, an overall Healthy Eating Index score was significantly lower for the neophobic group, who also had a higher intake of saturated fat and less food variety than children in the other two groups.

Treatment of food neophobia

Because food neophobia, at least in extreme cases, might compromise health, devising means of reducing it would clearly be desirable. In a sense, the previous section on *situational differences in food neophobia* suggests possible means for interventions. That is, it would be expected that such situational manipulations as providing information, exposure to novel foods, presentation of novel foods in familiar contexts, and so on, might lead to a general reduction in neophobic behaviors. In more clinical settings, successful treatments of food neophobia in children (Singer et al., 1992) and adults (Marcontell, Laster, and Johnson, 2003) have taken the

term “neophobia” literally and adopted a phobic conceptualization of unwillingness to eat novel foods. Accordingly, treatments have involved a combination of techniques traditionally used with anxiety-related disorders, including relaxation training, development of a “feared foods” hierarchy, systematic desensitization, cognitive restructuring, modeling, as well as nutritional counseling, education and in vivo exposure to feared foods. The idea is to gradually expose the individual to novel foods, while modeling appropriate eating behavior, challenging negative cognitions (i.e., negative expectations regarding taste, texture, or smell), and preventing avoidance. Generalization of reduction in neophobic behavior is achieved by assigning homework and moving the sessions from the clinic to restaurants. Blissett and Harris (2002) added a paradoxical intervention to increase acceptance of novel foods with a child suffering from feeding problems. Parents were advised to introduce new foods as “special,” “restricted” or “only for grown-ups”.

Conclusion

Although food neophobia has clearly been adaptive for our species, it could be argued that culture has taken over much of the protective function of food neophobia. Except in rare circumstances, the culture prevents encounters with dangerous ingestibles by removing them from the immediate environment and/or by labeling them as unsafe. In a sense, then, food neophobia may have outlived its usefulness. Indeed, as we have shown, it may be that the relatively neophobic among us might be at some nutritional risk. More research is clearly warranted to determine whether this is true. If so, then it will be advantageous to develop more efficacious techniques for reducing it.

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Table 1: Mean correlations between scores on the Food Neophobia Scale and reactions to novel and familiar foods

Type of food	Measure		
	Willingness to try	Expected liking	Actual liking
Novel	-.41 (11, 1322)	-.37 (5, 318)	-.22 (7, 556)
Familiar	-.09 (11, 1322)	-.01 (3, 269)	-.02 (10, 567)

Note: The first number in parentheses in each cell refers to the number of correlations averaged to produce the mean; the second refers to the total number of participants involved in all the correlations averaged.