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## Adult picky eating: Phenomenology, taste sensitivity, and psychological correlates

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### Abstract

**Objective:** To explore psychosocial correlates of picky eating in adults, document differences in the taste sensitivity of picky and non-picky eating adults, and examine behavioral characteristics of this understudied phenomenon.

**Method:** In Study One, 489 participants completed a survey on food choice and habits, including questions that asked participants to self-identify as picky eaters. Picky and non-picky eaters were compared on their rates of endorsement of a range of food selection behaviors and attitudes. In Study Two, participants who identified as either picky or non-picky responded to questionnaire measures of obsessive compulsive disorder, depression, disordered eating symptoms, disgust sensitivity, and food and general neophobia. Participants also rated the intensity of bitter and sweet solutions at three concentrations on a Labeled Magnitude Scale.

**Results:** In Study One, picky eaters were more likely to endorse a variety of anomalous eating behaviors and attitudes towards food, including rejection of foods based on sensory characteristics (taste, color, texture). Picky eaters were less likely to endorse enjoyment of eating, and more likely to report that they were unhealthy eaters. In Study Two, picky eaters had significantly higher OCD symptoms, disgust sensitivity, and food neophobia than non-picky eaters, and were more likely to score within the clinical range of depression symptoms, but did not have higher scores on measures of disordered eating or general neophobia. Picky eaters rated both bitter and sweet tastants as more intense than did non-picky eaters.

**Discussion:** Implications of findings for the future study of the correlates and mechanisms of Avoidant/Restrictive Food Intake Disorder are discussed.

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DSM-5 includes a new diagnosis for children and adults whose restrictive food selection leads to compromised energy intake (APA, 2013). To be diagnosed with Avoidant/Restrictive Food Intake Disorder (ARFID), an individual must experience significant weight loss, nutritional deficiency, dependence on nutrition/calorie supplements or enteral feeding, or marked interference with psychosocial functioning caused by one of three types of feeding disturbance. These include “apparent lack of interest in eating of food, avoidance based on the sensory characteristics of food, or concern about aversive consequences of eating” (APA, 2013). Of particular interest in the present investigation is the second type

of disturbance, restricted or limited food intake in relation to the sensory features of food. This restriction manifests behaviorally as “picky” eating (APA, 2013). Picky eating has been defined as an aversion to, and usually refusal to eat, a wide variety of commonly accepted foods, even after sampling them (e.g., Chatoor, 2009). Food neophobia, a general refusal to try unfamiliar foods, is a distinct though commonly co-occurring phenomenon (e.g., Galloway, Fiorito, & Lee, 2005).

Pickiness and neophobia in infants and children have been hypothesized to be related to, among other things, anxious arousal (Rogov, Masty, & McKay, 2011), negative experiences with food (i.e. vomiting, choking, allergic reaction, force-feeding; Bryant-Waugh, Markham, Kreipe, & Walsh, 2010; Pelchat & Pliner, 1986), insufficient exposure to novel flavors (e.g., Galloway, Lee, & Birch, 2003; Gerrish & Mennella, 2001; Pelchat & Pliner, 1986), and over-sensitivity to tastes, smells, and textures in food (e.g., Chatoor, 2009; Smith, Roux, Naidoo & Venter 2005). Childhood picky eating is concurrently associated with internalizing psychopathology (Hafstad, Abebe, Torgersen, & von Soest, 2013a; Jacobi, Agras, Bryson, & Hammer, 2003; Jacobi et al., 2008; Mascola et al., 2010; Micali, Simonoff, Elberling, Rask, Olsen, & Skovgaard, 2011; Pelchat & Pliner, 1986). Some have speculated that behavioral rigidity is a factor in the eating habits of typically developing picky eaters; parents of toddler- to school-aged picky eaters report that their children have highly specific and in some cases ritualized requirements for the preparation and presentation of their preferred foods (Jacobi 2003; 2008), and rates of picky eating in autism, a disorder characterized by cognitive and behavioral rigidity, are extremely high (Ledford & Gast, 2006). The extent to which these factors jointly and independently contribute to picky eating in childhood and beyond is largely unknown.

There is evidence that subclinical pickiness is a relatively stable individual difference from early childhood to young adulthood (e.g. Marchi & Cohen, 1990; Mascola, Bryson, & Argas, 2010; Nicklaus, Boggio, Chabanet, & Issanchou, 2005). Broad individual differences in pickiness, food neophobia, and dietary variety-seeking have been documented in American and Canadian adults (e.g. Frank & van der Klaauw, 1994; Nicklaus et al., 2005; Pliner & Hobden, 1992), although relatively little is known about the nutritional and psychosocial correlates of subclinical picky eating in adults. In samples of undergraduates, reported liking for a smaller number of different foods and greater unwillingness to try new foods have been related to increased sensitivity to tastants and odors, lower hedonic ratings for odors, and to fewer sensation-seeking traits (Frank & van der Klaauw, 1994; Raudenbush; van der Klaauw, & Frank, 1995). One recent study of a large, web-based sample of adults in the US, UK, Canada, and Australia, found that picky eaters were characterized by self-reported food neophobia and sensitivity to the smell and texture of food (Wildes, Zucker, & Marcus, 2012). Adults classified as picky eaters on the basis of self-reported neophobia and sensitivity to food smell, taste, and texture, in addition to extreme responses to the question “do you consider yourself a picky eater,” reported higher levels of quality of life impairment related to eating, and were almost twice as likely to have clinically significant symptoms of OCD, compared to people with normal eating habits (Wildes et al., 2012). Individuals classified as picky eaters (both with and without comorbid eating disorder symptoms) reported greater social anxiety related to eating than typical eaters and individuals with eating disorder symptoms but no picky eating. (Wildes et al.,

2012). These findings are largely consistent with the larger literature on the phenomenology and correlates of picky eating in childhood.

There has been little empirical exploration of impairment related to picky eating in adults. Childhood picky eating has consistently been associated with interference with family functioning around mealtimes, with parents reporting conflict with the child and with each other over the child's eating habits, and accommodation of picky eating by preparing separate meals for the child (e.g., Crist & Napier-Philips, 2001; Jacobi et al., 2003; 2008; Mascola et al., 2010). Parents of picky eaters are also more likely to report pressuring their children to eat, a feeding style which has been both experimentally and prospectively associated with lower child BMI, reduced intake, and the development of food dislikes, although the directionality of the relationship between parental pressuring and picky eating is currently unknown (Ventura & Birch, 2008).

Picky eating in both children and adults has been identified as a perceived barrier to healthy eating across a range of racial and socioeconomic groups (e.g., Greder, Slowing, & Doudna, 2012; Kumar, 2013; Lipman, Schucker, Ratcliffe, Holmberg, Baier, & Deatricks, 2011; Yelmokas, McDermott, Hey, Teaford, & Minarik, 2009). Picky eating may interfere most significantly with ability to adhere to recommendations concerning intake of plant-based foods. Several groups have reported that children who are classified by their parents as picky eaters eat fewer servings of fruits and vegetables than their non-picky peers (Galloway et al., 2005; Horodyski, Stommel, Brophy-Herb, Xie, & Witherspoon, 2004).

Notably, most concurrent and longitudinal studies have not reported a relation between childhood picky eating and cognitive or physiological symptoms of disordered eating in childhood, adolescence, or young adulthood (e.g., Hafstad, von Soest, & Torgersen, 2013b; Jacobi, Schmitz, & Agras, 2008; Kottler, Cohen, Davies, Pine, & Walsh, 2011; but see Marchi & Cohen, 1990). In a latent class analysis on a large sample of adults who responded to measures of picky eating (e.g., eating from a narrow range of foods, rejecting foods based on sensory characteristics) and measures of eating disorder cognitions (e.g., fear of fatness, excessive concern with body shape) and behaviors (e.g., bingeing, purging, restricting), Wildes and colleagues (2012) found that picky eating behaviors formed a class distinct from disordered eating cognitions and behaviors, while a third latent class comprised individuals with both picky and disordered eating behaviors. Taken together, these findings suggest that picky eating is behaviorally and etiologically distinct from disordered eating associated with anorexia nervosa, bulimia nervosa, and binge eating disorder (Wildes et al., 2012).

We attempted to extend the literature on the presence and features of childhood picky eating into a diverse sample of adults. In Study 1, participants were asked to self-identify as picky eaters, and then to respond to a questionnaire on their food selection and eating habits. In Study 2, a subsample of participants from Study 1 who self-identified as picky or not picky was recruited for laboratory-based testing where they were asked to rate the intensity of bitter and sweet tastants. We hypothesized that picky eaters would rate both bitter and sweet taste stimuli as more intense than non-picky eaters (Frank & van der Klaauw, 1994). Participants were also given questionnaire measures of obsessive compulsive disorder, disordered eating, and depression, as well as disgust sensitivity and food and general

neophobia. We predicted differences between picky and non-picky eaters on measures of internalizing psychopathology and food neophobia, but not on measures of disordered eating. To our knowledge there is no published research as yet linking picky eating to disgust sensitivity; we hypothesized that picky eaters would be more disgust sensitive than non-picky eaters, based on unsystematic observations in the literature (e.g., Bryant-Waugh et al., 2010).

## Study 1

### Methods

**Participants.**—The data were collected between 1999 and 2001. Participants in this study were drawn from two sources. First, people were solicited at a local county courthouse as they waited to participate in jury selection. About 50% of the individuals in the pool volunteered to fill out the questionnaire. Second, advertisements were posted online through the University of Pennsylvania Usenet and on other Philadelphia area message boards. Participants were all living in the United States. The subsamples are combined in our analysis, although the courthouse sample was somewhat older, lower in socioeconomic class, and lower in education. Our principal interest was in obtaining a broad sample and comparing specific eating behaviors of picky vs. non-picky eaters; our interest was not primarily to estimate the prevalence of picky eating, or of the specific feeding behaviors, in the American population.

A total of 489 participants completed the questionnaire; 57% were recruited from the jury pool (data on sample membership was missing for 1 participant, 0.2% of the overall sample; See Table 1 for sample demographics). Participants responded to two questions about picky eating: “I am unusually picky about the foods that I eat,” and “Others consider me a picky eater.” For the analyses presented below, participants who responded “True” to “I am unusually picky about the foods that I eat” were classified as picky eaters, and participants who responded “False” to both items about picky eating were classified as non-picky eaters. Thirty-eight participants (8% of the sample) who answered “True” to “Others consider me a picky eater” but did not consider themselves to be picky were excluded from the analyses. Of those remaining in the final sample, 35.5% of participants were classified as picky and 64.5% were classified as non-picky. The samples did not differ in age or in proportion of men and women. The mean age of picky eaters was 35.5 years ( $SD = 13.69$ ), whereas the mean age of non-picky eaters was 37.15 ( $SD = 13.80$ ),  $t(432) = -1.24$ ,  $d = 0.12$ ,  $p = .22$ . The picky sample was 69.9% female, whereas the non-picky sample was 63.5% female;  $\chi^2(1) = 1.61$ ,  $\phi = .06$ ,  $p = .20$ . Demographics for the Study 1 sample are presented in Table 1.

Three questions addressed potential reasons for food refusal or unusual food selection/rejection behaviors other than picky eating. These included “I am often on a diet to lose weight,” “My choice of foods is influenced by religious practices (for example, kosher), nutritional or health concerns (for example, low-salt diet), or ethical considerations (for example, vegetarian diet),” and “I have food allergies or medically imposed dietary restrictions.” Picky eaters were more likely to report being on a diet to lose weight and to endorse medical restrictions on their diets (although neither difference was significant when corrections for multiple hypothesis testing were applied; see below, Results). Sensitivity

analyses were conducted excluding participants who endorsed these restrictions.<sup>1</sup> Results did not differ notably in magnitude, direction, or significance between the two analyses, so results from the full sample (from which the Study 2 subsample was drawn) are presented in Table 2 and discussed below.

The research was approved by the Institutional Review Board of the University of Pennsylvania, and informed consent was obtained from all participants in both studies.

**Materials.**—Participants responded to a 63-item questionnaire assessing their food selection and eating behaviors, some of which assessed behaviors and experiences associated with picky eating in children and adults (e.g., Crist & Napier-Phillips, 2001; Jacobi et al., 2003; 2008; Rozin, 1989; Wildes et al., 2013). These questions were all in True/False format. Results for 39 of the 63 questions are presented below. Several questions were excluded because they did not correspond to picky eating-related behaviors in the present literature and we had no hypotheses of interest (e.g., “I reject raw tomatoes”), and several were excluded because they were broadly worded in a way that made their interpretation ambiguous (e.g., “I eat a certain food/beverage with every meal”). Chi square analyses comparing picky and non-picky eaters’ responses to these items are available from the corresponding author.

**Procedure.**—Courthouse participants completed the questionnaire on paper, while waiting to be called for an interview for participation in a jury. Internet participants completed an online form. Jury respondents were asked not to discuss their questionnaire with others until they (and others) had completed it. If participants were interested in participating in the paid follow-up (Study 2), they were asked to provide contact information.

## Results

Chi square analyses were used compare the proportion of “True” responses to items related to food selection behaviors and preferences among picky vs. non-picky eaters. Cases with missing data were excluded listwise from the chi square analyses. The full text of each question, along with the results of the analyses and uncorrected p-values, is presented in Table 2. The 39 items associated with picky eating are grouped conceptually. Because multiple hypotheses tests were conducted, alphas were adjusted for multiple hypothesis tests (Holms, 1979). Below, we highlight those items where group differences remained significant after this correction was applied.

**Narrow range.**—After correction, significantly more self-identified picky eaters reported eating from a range of 10 or fewer foods, and were more likely to report rejecting a whole food group, though the latter effect was smaller.

**Neophobia.**—Picky eaters were significantly more likely to report that they disliked trying new foods, with a moderate effect size.

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<sup>1</sup>Results from this sensitivity analysis are available from the corresponding author.

**Sensory rejection.**—Picky eaters were more likely to report rejecting foods that were bitter or sour, but not sweet or salty. Picky eaters were more likely to report rejecting foods of certain colors, though not to report a preference for certain colors. Picky eaters were significantly more likely to report rejecting foods with a “slimy or slippery” texture, a difference associated with a moderate effect size. Picky eaters were also more likely to respond affirmatively to a more general question asking if they rejected any specific texture in food, though this effect was smaller than the effect associated with a specific texture.

**Contact or mixing.**—Picky eaters were more likely to endorse a range of behaviors associated with avoiding contact between different foods and rejection of foods involving a mixture of tastes and/or textures. Picky eaters were significantly more likely to report rejecting foods that are mixed or combined, and foods with “lumps.” These group differences were associated with moderate effect sizes. Picky eaters were also more likely to report rejecting foods with sauces, and dessert items with raisins or nuts, though these differences were associated with small effect sizes. Picky eaters were significantly more likely to report rejecting foods with hidden ingredients (e.g., ravioli, dumplings) although it is unclear if this reflects avoidance of combined tastes/textures or concern that the hidden ingredients might be novel or disliked. Picky eaters were significantly more likely to report avoiding contact between different foods on the plate and rejecting foods that had touched on the plate.

**Repetition or ritualization.**—After correction, picky eaters were not more likely than non-picky eaters to endorse rituals around eating or a highly repetitive diet, with the exception of a preference for eating with a specific person, in a special place, or with specific plates/utensils, a small effect. However, picky eaters were significantly more likely to reject a food that had been touched by another person, and this difference was associated with a moderate effect size.

**Interest in food/social eating.**—Picky eaters were more likely to report worrying that there would be nothing for them to eat when invited out to dinner, with a moderate-large effect. Picky eaters were also less likely to report organizing their leisure activities around food and eating and to report leaving a clean plate, and more likely to report forgetting to eat when busy or preoccupied. Although there were small and significant effects, after corrections for multiple tests were applied, picky and non-picky eaters did not significantly differ in their report of looking forward to eating or considering eating to be “one of the most important pleasures” in life. Picky- and non-picky eaters did not differ in their report of having fond memories of family food occasions or childhood memories of tension around family mealtimes.

**Healthy eating.**—Picky eaters were significantly less likely to consider themselves “healthy eaters.” After corrections were applied, picky and non-picky eaters did not differ on report of dieting to lose weight, or on specific “healthy” eating behaviors (reported preference for “health food,” or choosing the low- or non-fat versions of foods over the full-fat versions). Before corrections for multiple tests were applied, picky eaters were more likely to report dieting to lose weight, whereas non-picky eaters were more likely to report



a specific weight-loss behavior, choosing low- or non-fat foods. However, these effects were small.

## Study 2

### Methods

**Participant Selection.**—Participants who agreed to be re-contacted after Study 1 were contacted in a randomized order. Approximately half of the Study 1 participants (55.4%) agreed to be recontacted for Study 2. Participants who agreed to be recontacted were no more or less likely to self-identify as picky eaters than those who did not ( $\chi^2(1) = 0.02$ ,  $\phi = .01$ ,  $p = .89$ ), nor did the two groups differ in the mean percentage of the 39 eating behaviors endorsed as “True” ( $t(449) = 1.73$ ,  $d = 0.17$ ,  $p = .08$ ). The two groups did not differ in the proportion of men and women ( $\chi^2(1) = 0.01$ ,  $\phi = -.01$ ,  $p = .92$ ), self-reported education attainment ( $t(378.37) = 0.54$ ,  $d = .05$ ,  $p = .58$ ), or socioeconomic status ( $t(384.85) = 0.03$ ,  $d < .01$ ,  $p = .97$ ). The group that agreed to be recontacted was significantly younger than the group that refused ( $t(432) = 5.16$ ,  $d = .50$ ,  $p < .001$ ).

In addition to responding “True” to the item “I am unusually picky about the foods I eat” for inclusion in the picky group and “False” to both picky-eating questions in the non-picky group, participants included in the picky-eating group responded “True” to at least one of the following questions considered highly consistent with picky eating (and associated with moderate-to-large effects in Study 1): “I do not like to try new foods,” “I eat from a very narrow range of foods (fewer than 10 different foods),” and “When I am invited to dinner, I worry that there may be nothing there that I can eat.”

### Materials.

**Intensity rating of taste solutions.**: The Labeled Magnitude Scale (LMS) (Green, Dalton, Cowart, Shaffer, Ranking, & Higgins, 1996) was used to rate overall intensity of the various stimuli. Participants were presented with a visual analogue scale for each stimulus, each on its own page. The scale was a vertical line, with magnitude labels (“barely detectable”, “weak”, “moderate”, “strong”, “very strong”) at intervals with the bottom and top endpoints labeled “no sensation” and “strongest imaginable.” Ratings on the LMS are converted to a 1–100 range (see Appendix A for the visual analogue scale used to make ratings).

The stimuli used in this portion of testing were of three types: tones, weights, and taste solutions. Participants were first trained in the use of the LMS using tones varying in pitch; tone intensity ratings were checked to ensure that the participants were using the scale correctly. Next, to adjust for individual differences in the use of the rating scale, participants were also asked to rate three weights on the same scale. The mean of these ratings was used to normalize intensity ratings for the tastants.

The compounds used as taste stimuli were quinine sulfate and sucrose, each in three concentrations. The concentrations were chosen based on previous work done in the Taste and Smell Clinic at the Monell Chemical Senses Center (Cowart, 1989). The concentrations of taste compounds used for quinine were:  $1.8 \times 10^{-5}$  M (Low),  $5.6 \times 10^{-5}$  M (Medium),  $1.8 \times 10^{-4}$  M (High), and for sucrose were: 0.1 M (Low), 0.32 M (Medium), and 1.0 M

(High). Both sucrose and quinine concentrations will be referred to as Low, Medium, and High throughout this paper. Participants were instructed not to eat or drink anything other than water for the hour preceding the testing session.

Weights were used to normalize LMS ratings because these judgments should not be related to either taste or smell. Weights were visually identical and were made with sand-filled plastic bags at the bottom of small, handled shopping bags. All weights were relatively light so the least strong participants would not experience any as very heavy. The weights used were 148 g., 551 g., and 1.05 kg.

**Psychological tests.:** The Disgust Scale (Haidt, McCauley, & Rozin, 1994) is a standard 32 item measure of trait-level tendencies to experience disgust. It includes measures of food-related and other types of disgust. The Padua Inventory (Sanavio, 1988) is a standard measure of OCD symptomatology. The Beck Depression Inventory-IA (short form; BDI-IA) (Beck, Steer, & Garbin, 1988) assesses the degree to which the respondent experiences a variety of core depression symptoms. The Eating Attitudes Test (EAT-26) (e.g., Garner, Olmsted, Bohr, & Garfinkle, 1982) is a widely used standardized measure of the symptoms and concerns characteristic of anorexia nervosa and bulimia nervosa. The Dutch Eating Behavior Questionnaire (DEBQ) (Van Strien, Frijters, Bergers, & Defares, 1986) is a measure of reasons for overeating. The General and Food Neophobia Scales are brief, standard measures of neophobia (Pliner & Hobden, 1992).

## Results

**Sample characteristics**—The picky group ( $N = 16$ ) was 56% female and had a mean age of 22.56 ( $SD = 5.92$ ). The non-picky group ( $N = 18$ ) was 65% female and had a mean age of 31.00 ( $SD = 9.77$ ). The picky group was significantly younger than the non-picky group ( $t(32) = 2.98$ ,  $d = 1.06$ ,  $p = .01$ ). The groups did not differ in the proportion of men and women ( $\chi^2(1) = 0.68$ ,  $\phi = -.07$ ,  $p = .41$ ) or on self-reported educational attainment:  $t(31) = 1.60$ ,  $d = 0.57$ ,  $p = .07$ .

Participants self-reported their height and weight, which was used to calculate BMI scores. The picky and non-picky groups did not differ on their BMI scores:  $t(32) = -0.19$ ,  $d = .07$ ,  $p = .85$ .

### Sensory Testing

**Taste intensity rating.:** Separate two-way mixed-model ANOVAs were performed on participants' normalized intensity ratings for quinine and sucrose with condition (Picky and Non-picky) serving as the between-subject variable and concentration (Low, Medium, High) serving as the within-subjects variable. Because the groups differed in mean age, age was added as a covariate.

For quinine intensity, there were main effects for condition (picky eater status) ( $F(1, 30) = 5.38$ , partial  $\eta^2 = 0.15$ ,  $p = .03$ ) and quinine concentration ( $F(2, 30) = 6.52$ , partial  $\eta^2 = 0.18$ ,  $p = .03$ ). The interaction of quinine concentration and condition was significant ( $F(2, 30) = 3.40$ , partial  $\eta^2 = 0.10$ ,  $p = .04$ ), suggesting that not only did picky eaters have enhanced sensitivity across quinine concentrations, their intensity ratings increased at a steeper slope



than did those of the non-picky eaters (see Figure 1). There was no main effect of age ( $F(1, 30) = 0.08$ , partial  $\eta^2 = .003$ ,  $p = .78$ ), and age did not interact with quinine concentration ( $F(2, 30) = 0.22$ , partial  $\eta^2 = .01$ ,  $p = .62$ ).

Similar results were found for intensity ratings of sucrose, using the same statistical analysis. A main effect was detected for picky eater status, with picky eaters making higher intensity ratings ( $F(1, 30) = 5.70$ , partial  $\eta^2 = 0.16$ ,  $p = .02$ ). There was a non-significant trend, associated with a small-moderate effect, towards a main effect for concentration: ( $F(2, 30) = 2.47$ , partial  $\eta^2 = 0.08$ ,  $p = .09$ ). However, the interaction between concentration and condition was small and non-significant:  $F(2, 30) = 1.40$ , partial  $\eta^2 = 0.06$ ,  $p = .25$ . These findings suggest that while picky eaters rated the intensity of sucrose as higher across concentration levels, their intensity ratings increased at the same rate (slope) as those of the non-picky eaters (see Figure 2). There was no main effect of age ( $F(1, 30) = .01$ , partial  $\eta^2 < .001$ ,  $p = .92$ ), nor did age interact with sucrose concentration ( $F(2, 30) = 0.73$ , partial  $\eta^2 = .02$ ,  $p = .49$ ).

### Psychological tests

**Disgust scale.:** The picky group was more disgust-sensitive than the non-picky group, with a large between-groups effect. Because the groups differed in age, univariate analyses of variance were computed for the effect of picky eating on each dependent variable, with age as a covariate. Picky eater status remained a significant predictor of disgust sensitivity when age was statistically controlled:  $F(1, 30) = 5.19$ , partial  $\eta^2 = .15$ ,  $p = .03$ .

**Padua Inventory.:** There was a large and significant difference between the groups in their scores on the Padua Inventory for obsessions and compulsions. The developer of the Padua Inventory published clinical means of 83.6 ( $SD = 34.8$ ) for males and 98.6 ( $SD = 32.3$ ) for females (Sanavio, 1988). Four of the 16 picky participants (25%) scored within one standard deviation of the clinical mean for their gender, whereas none of the non-picky participants scored within this range. Although the effect size for the difference in distribution was moderate, it did not rise to statistical significance ( $\chi^2(1) = 3.51$ ,  $\phi = .33$ ,  $p = .10$ , Fisher's Exact Test). Picky eater status was a significant predictor of score on the Padua Inventory when age was statistically controlled:  $F(1, 30) = 17.78$ , partial  $\eta^2 = .37$ ,  $p < .001$ .

**Beck Depression Inventory-IA, short form (BDI).:** There was a large, significant difference between groups for scores on the BDI. On the BDI-IA short form, a score of 0–4 is scored as absent or minimal depression, a score of 5–7 represents mild depression, a score of 8–15 represents moderate depression, and scores above 16 represent severe depression (Beck et al., 1988). In the present sample, the non-picky group mean ( $M = 1.41$ ,  $SD = 1.54$ ) is within the range of absent or minimal depression, whereas the picky group mean ( $M = 5.25$ ,  $SD = 4.42$ ) is scored as mild depression. In the present sample, 9 out of 16 participants in the picky group (56%) scored within the clinical range, three (33%) in the mild range and six (67%) in the moderate range. In contrast, none of the 17 non-picky eaters qualified as moderately depressed, and only one (6%) met the cut-off for mild depression. The proportion of picky eaters scoring above the clinical cut-off for mild depression was significantly greater than the proportion of non-picky eaters ( $\chi^2(1) = 6.44$ ,  $\phi = .44$ ,  $p = .02$ ,

Fisher's Exact Test). Picky eater status was a significant predictor of BDI score, controlling for age:  $F(1, 30) = 14.33$ , partial  $\eta^2 = .32$ ,  $p = .001$ .

**Eating Attitudes Test (EAT-26):** As shown in Table 3, the picky group mean (8.63,  $SD = 8.16$ ) was higher than the non-picky group mean (4.06,  $SD = 4.90$ ;  $t(31) = -2.06$ ,  $d = 0.79$ ,  $p = .058$ ), a marginally significant difference, though the between-groups effect size was moderate to large. Both group means were well below published means for clinical groups of women with anorexia (36.1,  $SD = 17$ ); both group means were more comparable to that of a nonclinical, comparison group of women (9.9,  $SD = 9.2$ ; Garner et al., 1982). Picky eater status was a significant predictor of EAT-26 score with age statistically controlled, although the effect was small:  $F(1, 30) = 4.65$ , partial  $\eta^2 = .13$ ,  $p = .04$ .

**Dutch Eating Behavior Questionnaire (DEBQ):** There were no significant differences between the picky and non-picky means on any of the three subscales (See Table 3). When controlling for age, picky eater status was not a significant predictor of DEBQ score:  $F(1, 30) = 0.82$ , partial  $\eta^2 = .03$ ,  $p = .37$ .

**Food Neophobia Scale & General Neophobia Scale:** There was a large significant difference between the groups in their scores on the Food Neophobia Scale, with the picky group having a much higher mean score than the non-picky group. When age was statistically controlled, picky eater status was a strong and significant predictor of food neophobia score:  $F(1, 31) = 66.63$ , partial  $\eta^2 = .69$ ,  $p < .001$ . There was no significant difference between the picky and non-picky groups on the General Neophobia Scale (Table 3). However, with age controlled, picky eater status was a predictor of general neophobia, with a small effect size:  $F(1, 31) = 5.33$ , partial  $\eta^2 = .15$ ,  $p = .03$ .

## Discussion

In the first study, we find that 35.5% of our sample consider themselves picky eaters, and that picky eaters are more likely to be characterized by a range of anomalous food choices or habits, many of which have been previously linked to picky eating in children and adults. These can be loosely categorized as rejection of foods based on their sensory properties (including appearance, texture, and taste), and rejection due to contact between foods, mixtures of flavors, or contamination by other people. In addition, self-identified picky eaters were more likely to report anxiety about having anything to eat when invited over for dinner. Picky eaters were also less likely to believe themselves to be healthy eaters compared to non-picky participants.

In Study 2, self-identified picky eaters rated both sweet and bitter flavors as more intense than non-picky eaters, partially replicating findings by Frank & van der Klauww (1994). Picky eaters also endorsed more symptoms of depression and OCD than non-picky eaters. These findings are consistent with the literature on the internalizing correlates of childhood picky eating, and findings in adults suggesting that picky eating is associated with higher rates of clinical OCD symptoms compared to typical eating (e.g., Jacobi et al., 2008; Wildes et al., 2012). Picky eaters endorsed greater food neophobia, but not general neophobia, than non-picky eaters. This is particularly striking given the substantial correlation between

food and general neophobia in an unselected reliability sample (Pliner & Hobson, 1992). Picky eaters in our sample trended towards higher scores on a measure of eating-disordered cognitions related to weight and body shape, although they did not score higher on a measure of over-eating-related cognitions. Wildes and colleagues (2012) identified two latent classes of picky eaters; those with and those without comorbid eating disorder symptomatology. Although picky eating and disordered eating have been shown to be separable, our study offers support for some degree of symptom overlap. However, it should be noted that scores for both picky and non-picky eaters were well below published clinical means on the EAT-26, and that the groups did not differ in BMI (Garner et al., 1982). Finally, picky eaters were higher in disgust sensitivity than non-picky eaters. To our knowledge this is the first time a relationship between sensitivity to disgust and picky eating has been demonstrated empirically.

Study 2 measured sensitivity to bitter and sweet tastes as a correlate and potential mechanism of picky eating. However, there is evidence from research on picky eating in children to suggest that rejection might also be based on hypersensitivity to texture (e.g., Carruth, Ziegler, Gordon, & Barr, 2004; Chatoor, 2009; Smith et al., 2005). Furthermore, converging neuroimaging and self-report research in humans suggests that texture strongly influences perceptions of flavor (e.g., Auvray & Spence, 2008). In Study 1, picky eaters were more likely than non-picky eaters to report rejecting foods with a “slimy” texture, and picky eaters were more likely to endorse rejecting foods based on their texture more generally. Whether texture sensitivity is limited to young childhood or remains an important feature of adult picky eating still needs to be established.

Future research should also examine whether the higher intensity ratings for sweet and bitter in our picky eating sample results from increased taste sensitivity or from a stronger affective reactivity to taste. The latter would suggest that there is not a physiological difference between picky and non-picky eaters, but that the different response to tastants and textures arises at a post-sensory level. This is reminiscent of the data on liking for capsaicin-containing foods such as chili peppers; individuals who like chili peppers seem to get the same input to their brain as those who do not; the difference seems to be in how the brain interprets the input (Rozin, 1990).

Convergent with prior studies across the developmental spectrum, the present research found that a group of self-identified adult picky eaters scored higher than non-picky eaters on measures of OCD symptomatology and depression, and were more likely to be in or near the range of scores considered clinically significant. Future research should examine eating behaviors in these clinical populations and explore the relative contribution of eating disturbances in the context of internalizing and externalizing psychopathology to distress and impairment, with the goal of targeting picky eating for intervention in these populations if picky eating is found to account for distress and impairment beyond that caused by other forms of psychopathology. The directionality of this relationship should also be established. It may be the case, for instance, that picky eating is a behavioral manifestation of the elevated OCD traits or depression symptoms found in the picky eating subsample. It may also be the case that picky eating and OCD share underlying personality risk factors, such as behavioral or cognitive rigidity.

The role of disgust sensitivity in picky eating and food selection is an area that should also be studied further. Although elevated sensitivity to disgust has been found in individuals with OCD (e.g., Berle & Phillips, 2006) and anorexia nervosa (e.g., Troop, Treasure, & Serpell, 2002), to our knowledge our research is the first to link disgust sensitivity to self-identified pickiness. Follow-up research from our group will explore disgust sensitivity as a potential mechanism of highly selective eating and whether disgust sensitivity is a unique predictor of picky eating in a model that includes OCD and eating disorder symptoms.

### Limitations

The proportion of our sample classified as picky (35.5%) is greater than the estimates derived from previous community samples of school-aged children, which estimate a point prevalence between 8 and 22% (e.g., Mascola et al., 2010; Jacobi et al., 2008). These authors used a 5-point Likert scale for parents to rate the degree to which their children were picky eaters, and only participants whose parents reported that they were “Always” or “Almost always” picky were classified as picky eaters for the purposes of their analyses. Other groups have also used extreme responses to Likert-type scales to classify picky eaters (e.g., Carruth et al., 2004; Jacobi et al., 2003; Wildes et al., 2012). It may be the case that our research identified a larger number of picky eaters because of the True/False format of the selection item. However, to the extent that we likely sampled a broad range of picky eating, from very mild to potentially quite extreme, any differences we identify between our groups will likely be robust and replicable in more stringently-selected samples. In such samples, we would expect larger effect sizes for group differences or dependence of binary variables. Indeed, the group differences demonstrated In Study 2 on measures of depression and OCD symptomatology, food neophobia, and disgust sensitivity were quite large.

Although the picky eating sample was significantly younger than the non-picky sample In Study 2, picky and nonpicky eaters in the full Study 1 sample did not differ in age. Therefore, it appears that the age difference in the Study 2 sample was due to sampling bias and is not explained by developmental changes in dietary flexibility across adulthood.

A significant limitation of the present study is that we failed to directly assess distress or health/psychosocial impairment related to picky eating. One reason that picky eating is of increasing interest to researchers is that it may reflect a sub-clinical manifestation of Avoidant/Restrictive Food Intake Disorder (e.g., Wildes et al., 2012). In order to meet criteria for a diagnosis of ARFID, individuals must experience clinically significant distress or nutritional deficiency/undesired weight loss due to their highly selective diets. The proportion of picky eaters whose selective and restrictive diets cause clinically significant distress and impairment remains unclear.

As noted above, the majority of empirical research on picky eating has used self-reported pickiness (or parent-reported pickiness for children) on scales which ask directly about “picky eating.” To our knowledge, it has not been empirically demonstrated that there is a commonly agreed-upon lay definition of what it means to be a “picky eater,” and there may be important individual differences in how this concept is defined. Indeed, Jain, Sherman, Chamberlin, and Whitaker (2004) found that among low-income, inner city African American women, the definition of picky eating in children was somewhat variable

and generally did not suggest that a child was difficult to feed or ate from a narrow range of foods.

Study 1 was a hypothesis-generating exploration of behaviors associated with picky eating. It was not designed to be an exhaustive list or an organized classification of the behavioral manifestations of picky eating (e.g., neophobia, eating from a narrow range of foods, repetitive eating, eating rituals, and rejection of foods based on their taste, texture, and color) or of the correlates of picky eating (e.g., worry about dining outside the home, self-perceived unhealthy eating). Rather, we hope that this research will suggest fruitful directions for future study, as In Study 2, which explored an isolated aspect of picky eating behavior, sensitivity to taste. As noted above, however, the intensity rating scale used In Study 2 did not allow us to differentiate between two alternate hypotheses; that picky eaters have a more sensitive sense of taste, or that that factors downstream of taste perception, such as the hedonic reaction to taste or oral stimuli in general, contribute to their higher intensity ratings. Clarity about this important issue should be sought next.

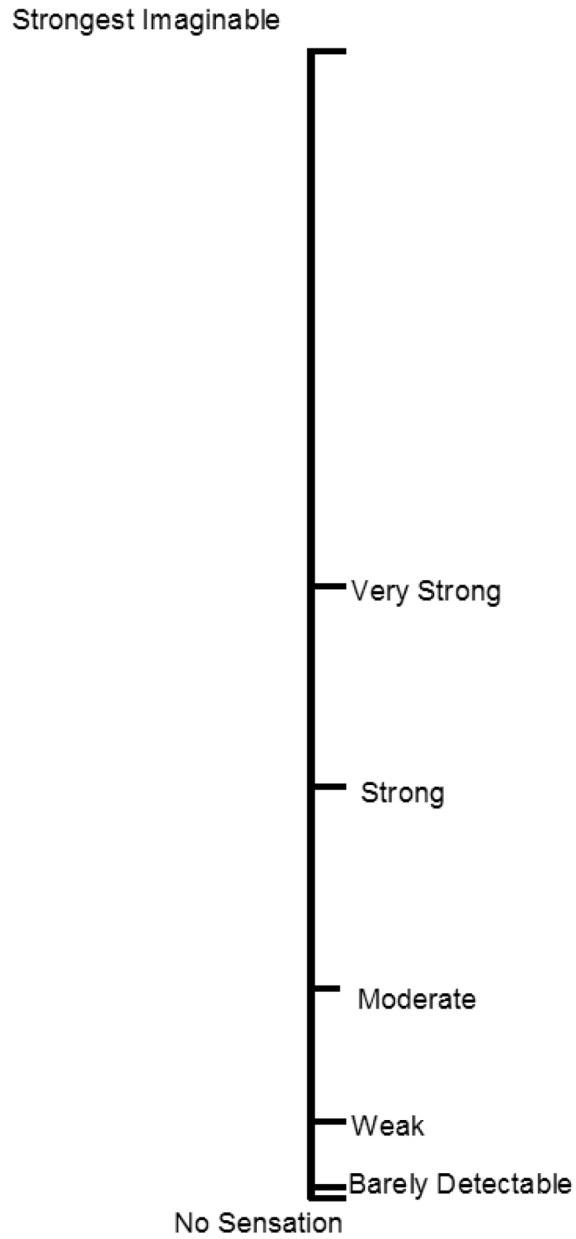
There is a need to explore the effect of picky eating on quality of life, nutritional status, and social functioning. Although there is some suggestion from Study 1 that picky eaters experience impairment in social functioning specific to eating (concerns about having nothing to eat when invited to meals, placing less emphasis on food-related leisure activities) and in health (self-perceived “healthy eating”), the effect of picky eating behaviors on health outcomes and social functioning requires additional direct assessment, and as does the relationship between distress and picky eating.

We hope that our preliminary findings encourage further research on the correlates and behavioral manifestations of picky eating. A greater understanding of the phenomenology of sub-clinical dietary selectivity may yield insights into the diagnosis and classification of ARFID, a so-far understudied disorder whose prevalence and public health burden is as yet unexplored. Given the relatively high rates of sub-clinical picky eating reported in the existing literature, there is a pressing need to identify individuals whose picky eating habits are severe enough to cause clinically significant distress and impairment. By reliably identifying and classifying picky eaters across the developmental span, psychologists, physiologists, and sensory and food scientists can begin understand the mechanisms of dietary selectivity based on the sensory properties of food. These insights may inform both tertiary interventions for individuals whose picky eating causes them to meet criteria for ARFID, and primary interventions to overcome sensory rejection of commonly disliked foods, such as vegetables, in adults and children.

## Disclosures

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## Appendix A



Labeled Magnitude Scale used In Study 2 to rate stimulus intensities. The scale measures 100mm, and ratings were converted into a range of 0–100.

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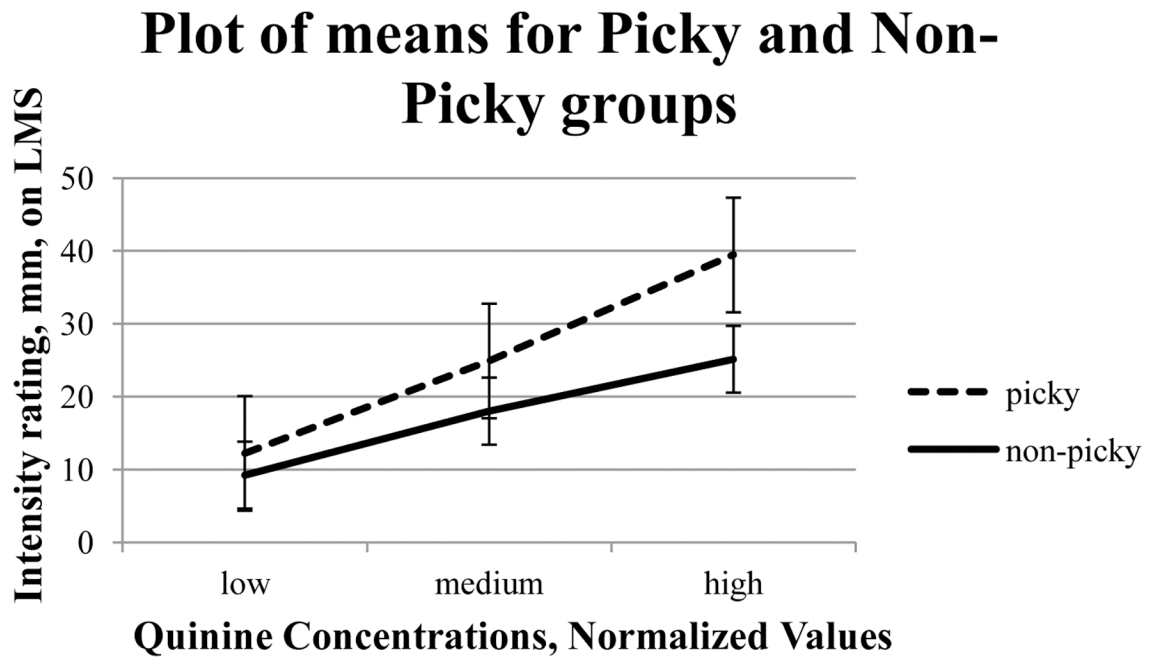
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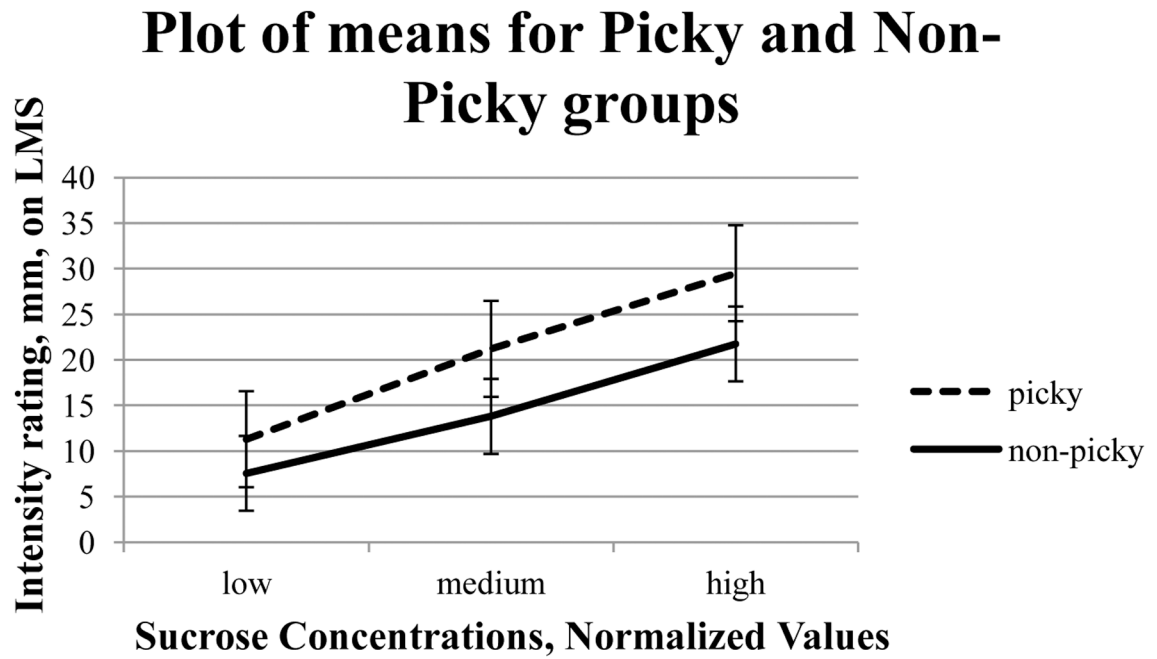
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### Highlights

- Picky eaters endorse unusual eating behaviors such as rejecting mixed or lumpy foods
- Picky eaters are more likely than peers to reject foods based on sensory properties
- Picky eaters score higher than peers on measures of OCD and depression
- Picky eaters experience sweet and bitter tastants as more intense than peers



**Figure 1.** Intensity ratings of sucrose taste solutions on the Labeled Magnitude Scale (0–100). Error bars display standard error.



**Figure 2.** Intensity ratings of sucrose taste solutions on the Labeled Magnitude Scale (0–100). Error bars display standard error.



**Table 1.**

## Demographics of samples In Study 1

		<b>Full sample N = 451</b>	<b>Jury pool N = 263</b>	<b>Online N = 187</b>
Gender	Female	62.5% N= 282	62.7% N= 165	62.6% N= 117
	Male	32.2% N= 145	30.8% N= 81	34.2% N= 64
	Missing data	5.3% N= 24	6.5% N= 17	3.2% N= 6
Age		<i>M</i> = 36.56 <i>SD</i> = 13.77 N= 434	<i>M</i> = 41.88 <i>SD</i> = 12.87 N= 250	<i>M</i> = 29.32 <i>SD</i> = 11.48 N= 184
Race/ethnicity	White	54.3% N= 245	42.2% N= 111	71.7% N= 134
	African- American	19.7% N= 89	31.2% N= 82	3.7% N= 7
	Missing/Other	26% N= 117	26.7% N= 70	24.5% N= 46
Education	Some high school	2.4% N= 11	4.2% N= 11	N= 0
	High school graduate/GED	19.7% N= 89	30.4% N= 80	4.8% N= 9
	Some college	29.0% N= 131	26.2% N= 69	33.2% N= 62
	College degree	13.3% N= 60	11.8% N= 31	15.5% N= 29
	Some post-baccalaureate study	11.1% N= 50	7.6% N= 20	16.0% N= 30
	Graduate/professional degree	19.7% N= 89	13.7% N= 36	28.3% N= 53
	Missing data	4.7% N= 21	6.1% N= 16	2.1% N= 4
Socioeconomic Status	Lower middle and lower class	17.0% N= 77	19.0% N= 50	14.4% N= 27
	Middle class	46.6% N= 210	51.0% N= 134	40.6% N= 76
	Upper middle and upper class	22.8% N= 103	14.1% N= 37	35.3% N= 62
	Missing data	13.5% N= 61	16.0% N= 42	9.6% N= 18

**Table 2.**

Proportion of picky and non-picky eaters endorsing anomalous eating behaviors

Item text	Percent endorsement		$\chi^2(1)$	$\phi$	<i>p</i>
	Picky	Non-picky			
<b>Other eating behaviors</b>					
My choice of foods is influenced by religious practices (for example, kosher), nutritional or health concerns (for example, low-salt diet), or ethical considerations (for example, vegetarian diet)	24% ( <i>n</i> = 154)	23% ( <i>n</i> = 290)	0.05	0.01	0.83
I have food allergies or medically imposed dietary restrictions	24 ( <i>n</i> = 158)	16 ( <i>n</i> = 288)	4.78	0.10	0.03
I am often on a diet to lose weight	30 ( <i>n</i> = 159)	19 ( <i>n</i> = 286)	6.17	0.12	0.01
<b>Narrow range</b>					
I eat from a very narrow range of foods (fewer than 10 different foods).	41 ( <i>n</i> = 160)	9 ( <i>n</i> = 291)	64.37	.38	<.001*
I almost always avoid one or more major group(s) of foods (for example, meat, vegetables, dairy products, starches/grains, sweets).	39 ( <i>n</i> = 157)	18 ( <i>n</i> = 289)	25.66	0.24	<.001*
<b>Neophobia</b>					
I do not like to try new foods.	40 ( <i>n</i> = 160)	12 ( <i>n</i> = 289)	48.12	0.33	<.001*
<b>Sensory rejection: taste</b>					
I almost always reject bitter foods, even if they are only slightly bitter.	47 ( <i>n</i> = 160)	30 ( <i>n</i> = 289)	13.12	0.17	<.001*
I almost always reject sour foods	39 ( <i>n</i> = 155)	17 ( <i>n</i> = 283)	25.87	0.24	<.001*
I almost always reject salty foods	33 ( <i>n</i> = 160)	20 ( <i>n</i> = 290)	8.20	0.14	.004
I almost always reject sweet foods	14 ( <i>n</i> = 160)	9 ( <i>n</i> = 291)	3.16	0.08	.08
<b>Sensory rejection: texture</b>					
I almost always avoid foods with a particular consistency (texture) (for example, foods that are crunchy, gelatinous, or very chewy).	29 ( <i>n</i> = 157)	16 ( <i>n</i> = 287)	10.24	0.15	.001*
I almost always reject foods that are slippery or “slimy” (for example, okra, oysters, soft boiled egg or fried egg)	58 ( <i>n</i> = 159)	25 ( <i>n</i> = 291)	46.45	0.32	<.001*
<b>Sensory rejection: appearance</b>					
I almost always reject only foods that are a particular color.	15 ( <i>n</i> = 158)	5 ( <i>n</i> = 290)	14.15	0.18	.001*
I almost always prefer to eat only foods that are a particular color.	11 ( <i>n</i> = 160)	4 ( <i>n</i> = 290)	7.20	0.13	.01
<b>Contact or mixing</b>					
I almost always reject foods that are mixed or combined (for example, peas and carrots, a sandwich with several things in it, things like tuna salad).	21 ( <i>n</i> = 159)	2 ( <i>n</i> = 290)	44.54	0.32	<.001*
I almost always reject foods with “lumps” in them (for example, a sauce with pieces in it or a stew), even if they are supposed to be that way (so this does not mean lumpy oatmeal or gravy)	25 ( <i>n</i> = 160)	5 ( <i>n</i> = 289)	39.54	0.30	<.001*
I almost always refuse foods that have “things” in them (for example, a cookie with raisins in it, a brownie with nuts in it)	19 ( <i>n</i> = 160)	7 ( <i>n</i> = 291)	13.69	0.17	<.001*
I almost always refuse foods with sauces on them (for example, pasta with tomato sauce, turkey with gravy)	8 ( <i>n</i> = 159)	1 ( <i>n</i> = 291)	11.42	0.16	.001*

Item text	Percent endorsement		$\chi^2(1)$	$\phi$	<i>p</i>
	Picky	Non-picky			
I almost always reject foods if there is something I can't see in them (for example, filled foods like eggrolls, dumplings, ravioli).	34 ( <i>n</i> = 160)	5 ( <i>n</i> = 290)	67.24	0.39	<.001*
I try not to let different foods touch on my plate.	30 ( <i>n</i> = 159)	12 ( <i>n</i> = 291)	22.26	0.22	<.001*
I almost always reject foods that have touched on the plate.	19 ( <i>n</i> = 149)	4 ( <i>n</i> = 282)	26.27	0.25	<.001*
<b>Ritualization/repetition</b>					
I almost always prefer to eat with a special person(s), in a special place or with special utensils/dishes.	17 ( <i>n</i> = 159)	7 ( <i>n</i> = 289)	11.06	0.16	.001*
I usually eat foods in sequence in the main course (for example, all peas first, then all mashed potatoes, etc.).	24 ( <i>n</i> = 159)	18 ( <i>n</i> = 290)	2.58	0.08	.11
I often eat foods in an unusual order (for example, dessert first).	16 ( <i>n</i> = 158)	10 ( <i>n</i> = 289)	3.22	0.09	.07
I eat the same meal for breakfast every day or most days.	47 ( <i>n</i> = 159)	45 ( <i>n</i> = 283)	0.07	0.01	.79
I eat the same meal for lunch every day or most days.	22 ( <i>n</i> = 158)	17 ( <i>n</i> = 288)	1.60	0.06	.21
I eat the same meal for supper every day or most days.	10 ( <i>n</i> = 159)	5 ( <i>n</i> = 288)	5.20	0.11	.02
Usually, I will not eat a food if I saw someone else touch it.	62 ( <i>n</i> = 157)	33 ( <i>n</i> = 287)	34.02	0.28	<.001*
<b>Interest in food/social eating</b>					
I look forward a lot to eating.	55 ( <i>n</i> = 159)	66 ( <i>n</i> = 289)	4.80	-0.10	.03
I often miss meals because I am preoccupied or busy and forget to eat.	52 ( <i>n</i> = 159)	35 ( <i>n</i> = 284)	11.79	0.16	.001*
When I go out, my activities often include food as a central focus.	39 ( <i>n</i> = 158)	7 ( <i>n</i> = 288)	13.30	-0.17	<.001*
Enjoying food is one of the most important pleasures in my life.	47 ( <i>n</i> = 158)	58 ( <i>n</i> = 288)	4.69	-0.10	.03
I prefer to leave a clean plate	50 ( <i>n</i> = 159)	70 ( <i>n</i> = 290)	17.49	-0.20	<.001*
When I am invited to dinner, I worry that there may be nothing that I can eat.	55 ( <i>n</i> = 159)	8 ( <i>n</i> = 290)	121.53	0.52	<.001*
I have fond memories of family food occasions.	70 ( <i>n</i> = 158)	75 ( <i>n</i> = 288)	1.50	-0.06	.22
My memories of meals with my family when I was a child include a lot of tension about what or how much I was eating.	24 ( <i>n</i> = 159)	22 ( <i>n</i> = 287)	0.15	0.02	.70
<b>Healthy eating</b>					
I am a healthy eater	42 ( <i>n</i> = 159)	63 ( <i>n</i> = 282)	19.21	-0.21	<.001*
I prefer to eat "health food."	41 ( <i>n</i> = 158)	45 ( <i>n</i> = 288)	0.55	-0.04	.46
I usually choose low- or no-fat foods over the full-fat version.	32 ( <i>n</i> = 158)	39 ( <i>n</i> = 289)	2.23	-0.07	.14

\* results significant after correcting for multiple hypothesis tests

**Table 3.**

Results of t-tests for sensory and psychological tests

	Means		<i>t</i> -value	df	<i>d</i>	<i>p</i>
	Non-picky ( <i>n</i> = 16)	Picky ( <i>n</i> = 18)				
<b>Sensory measures</b>						
Quinine intensity (mean) *	17.45	25.43	-2.48	22.48 <sup>†</sup>	0.88	.017
Sucrose intensity (mean) *	14.37	20.82	-2.75	23.30 <sup>†</sup>	0.97	.009
<b>Psychological tests</b>						
Disgust scale *	13.2	18.38	-2.62	31	0.93	.014
Padua Inventory (PI) *	14.88	49.97	-5.00	18.64 <sup>†</sup>	1.77	<.001
Beck Depression Inventory (short form) *	1.41	5.25	-3.29	18.41 <sup>†</sup>	1.17	.004
Eating Attitudes Test (EAT-26)	4.06	8.63	-1.97	31	0.70	.058
Dutch Eating Behavior Questionnaire (DEBQ)						
<i>Restraint</i>	2.52	2.21	-1.07	31	0.38	.29
<i>Emotional Eating</i>	2.35	2.29	0.19	31	0.07	.85
<i>Externality</i>	3.27	3.12	0.65	33	0.23	.52
Food Neophobia Scale *	19.41	47.50	-8.74	30.38 <sup>†</sup>	3.10	<.001
General Neophobia Scale	22.71	25.97	-0.93	31	0.33	.36

\* significant difference

<sup>†</sup> equal variances not assumed