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An investigation of flavor complexity and food neophobia

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ABSTRACT

The Food Neophobia Scale (FNS) measures reluctance to try novel foods. In describing foods, the term complexity is not well defined. The objective of this work was to assess the acceptability of familiar and novel foods, with varying levels of flavor complexity in both salty and sweet foods, by food neophobics and neophilics and to assess the effect of expectation (frame-of-reference effect) and familiarity on the acceptability of foods. FNS was administered to 864 subjects, who were classified to neophobic, or neophilic based on their FNS scores. Experiment 1, which was replicated twice, focused on four familiar foods, prepared in two versions, an original version and a more flavorful version. Subjects rated foods on complexity, acceptability and expectation. Neophilics gave significantly higher acceptability ratings to complex foods than bland foods and vice versa for neophobics. The different versions of foods did not always meet panelists' flavor expectations. Experiment 2 included eight commercial foods, four salty and four sweet, with two novel and two familiar foods used within each taste category/quality. One of the foods within the familiar or novel pairs was expected to be flavorful (e.g. chili is typically served as spicy) and the other expected to be bland. Subjects rated foods on complexity, acceptability, familiarity and expectation. Six out of the eight flavorful versions of foods were chosen by subjects as more complex. Significant factors were taste quality, novelty, expectation, and familiarity ($p < 0.05$). Overall, neophilics were more accepting of novel foods than neophobics. The significant interaction between expectation and neophobia suggests that neophobics and neophilics may have different expectations of foods. Although neophobia × complexity was not significant, the neophobics' acceptability ratings for bland versions were higher than for the flavorful versions.

1. Introduction

Food neophobia has been repeatedly measured using the Food Neophobia Scale (FNS), developed by Pliner and Hobden (1992) and validated by the former authors and Ritchey, Robert, Ulla-Kaisa, and Tuorila (2003). FNS measures reluctance or a resistance to try novel foods. Gender (Johns, Edwards, & Hartwell, 2011; Nordin, Broman, Garvill, & Nyroos, 2004), cultural influences such as place of upbringing in rural vs. urban or country of origin (Flight, Lepard, & Cox, 2003; Johns et al., 2011; Olabi, Najm, Baghdadi, & Morton, 2009; Ritchey et al., 2003), and age (Meiselman, King, & Gillette, 2010) also seem to play a part in food neophobia. Food neophobia could also affect the quality of diets (Cooke, Carnell, & Wardle, 2006; Knaapila et al., 2011).

An assessment of the acceptability of novel and familiar foods among food neophobics and neophilics promotes an understanding of the food choices and preferences of these two groups. Neophobics were less willing to try novel foods but neophilics had higher familiarity and willingness to try novel foods (Olabi et al., 2009). Moreover, willingness to try a novel or familiar food was significantly enhanced by an earlier contact with the food (Marples & Kelly, 1999; Olabi et al., 2009).

In the visual arts, Berlyne (1971) hypothesized how complexity can denote a higher level of visual sophistication. Successful attempts have been made to define visual complexity using descriptive analysis (Mielby, Jensen, Edelenbos, & Thybo, 2013). In describing foods, the term complexity is not well defined although it is commonly used in the wine industry albeit historically in a weakly defined manner (Meillon et al., 2010; Parr, Mouret, Blackmore, Pelquest-Hunt, & Urdapilleta, 2011. In flavor, stimulus complexity has been previously referred to as the number of odorants present (Jackson, 2002; Laska & Hudson, 1991, 1992) and the subject's ability to define the odor in a meaningful manner (Sulmont, Issanchou, & Koster, 2002). Flavor/odor complexity has been also described as a construct that is opposite to "easy to assign to a familiar category" (Jellinek, 1990). Flavor enhancers

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have been used to increase flavor complexity of foods (Hong, Kwon, & Kim, 2012).

One way to achieve flavor complexity is through the addition of spices. The consumption of spices has shown an upward trend in the U.S.A. over the last few years (CBI Tradewatch spices, 2013). Köster and Mojet (2007) observed that high-sensation seekers, who are usually neophiles, appear to have a stronger preference for novel and complex stimuli. The motivation of this study was to determine whether the same phenomenon is observed at the level of individual foods, where neophobics would be more accepting of blander (simple) versions of foods vs. more flavorful (complex) ones.

The use of a frame of reference or a reference standard is customary in descriptive analysis (Albenzio et al., 2013; Braghieri et al., 2012). In acceptability tests, the frame of reference is related to previous experiences with a regularly consumed product and the expected sensory quality of test product or simply the need for this type of product (Cardello & Sawyer, 1992). Any product that matches the existing expectation leads to assimilation and any product that does not match this expectation produces discomformation.

Understanding food preferences in individuals is an essential element for implementing and promoting positive changes in food habits. The objective of this work was to assess the acceptability of familiar and novel foods, with varying levels of flavor complexity, in both salty and sweet foods, by food neophobics and neophilics, and to assess the effect of expectation (frame of reference effect) and familiarity on the acceptability of the foods tested.

2. Materials and methods

2.1. Neophobia questionnaire

Students ($n = 241$) at California Polytechnic State University, San Luis Obispo (Cal Poly, SLO) were surveyed for Experiment 1, and an additional 623 students, staff and faculty were surveyed in Experiment 2, for a total of 864 subjects. The study was approved by the Institutional Research Board. Subjects were told that they were filling out a questionnaire on food preferences and that they would be selected at random to participate in taste sessions. All subjects filled out a slightly modified 10-item neophobia questionnaire (Pliner & Hobden, 1992) that included two additional questions about eating habits. The questionnaire was given to students in several large classes (Experiment 1), or sent as an online survey (Zoomerang) to faculty, staff and students (Experiment 2) who were selected based on their neo score. Pliner and Hobden (1992) obtained a mean of 34.5 and classified subjects to neophobic and neophilic based on a 1 standard deviation difference (11.9; SD) from the mean and this was replicated to a great extent in terms of mean and SD, by Olabi et al. (2009) in 1122 American and Lebanese college students. In the Pliner and Hobden study, participants were grouped into two categories: neophobic or neophilic. However, in this study, participants were classified based on their neophobia scores into one of five categories. The categories were based on a $>\pm0.5$ and $<\pm1.0$ SD (mildly) or $\geqslant\pm1.0$ SD (strongly) (positive for neophobic, negative for neophilic) difference from the mean of the Pliner and Hobden (1992). A neutral neophobia category included subjects who had a score of $\leqslant\pm0.5$ SD from the mean.

2.2. Preliminary trials

Fifteen preliminary trials were carried out over several months to select the best recipes based on replicability, ease of preparation, appropriate concentration of flavoring for distinguishing flavor complexity between the bland and complex versions of foods, and sample acceptability. Accordingly, commercial foods were mostly chosen while foods that required elaborate preparation were not considered for the experimental/regular taste sessions. Trials were conducted in the laboratory sections of the Food Fundamentals class in the of Food Science and Nutrition department at Cal Poly, SLO.

3. Experiment 1

3.1. Materials and methods

3.1.1. Stimuli

Four food stimuli were prepared in two versions, an original version and a more flavorful version. The addition of either a flavoring or a spice was used to increase the flavor complexity of the foods (Table 1). Samples were presented in 60 ml locally purchased containers and covered with lids labeled with a 3-digit random number. The recipes created and the amount of flavoring/spice added were based on the above preliminary trials. This experiment focused on foods that were familiar to the panelists.

3.1.2. Subjects

The participants who were classified as mildly or highly neophobic and highly neophilic (from the 241 surveyed subjects in Experiment 1) were contacted by e-mail and asked to attend two taste sessions. The mildly neophobic were contacted to secure enough neophobic subjects who are typically more reluctant to participate in taste sessions. Twenty-two college students (12 male, 10 female, age range = 18–26) from Cal Poly, SLO completed the taste sessions. Nine participants were neophobics and thirteen were neophilics.

3.1.3. Procedure

Taste sessions began with a 2-alternative forced choice (AFC) pretest (Lawless & Heymann, 2010). Subjects had to select the sample with a higher level of flavor complexity out of two soft drink samples (Sierra Mist™ with or without added lemon extract). Participants were given the samples as two lemonade samples and were asked to identify the one that is more complex. Participants who chose the more complex sample continued the taste session. Those who failed to choose the more complex sample were given another set and additional explanation about flavor complexity. In case, they failed again, they were thanked and excused from participating. Tomato soup and chili were heated for 15 s in a microwave (General Electric, JET 342G-001, 1100 W) and then presented to the panelists. The serving sequence was randomized among the panelists and the samples were labeled with 3-digit random numbers. Subjects were asked to rate the foods on complexity, acceptability and expectation. Acceptability was rated on a 9-point hedonic scale. Flavor complexity was assessed using a 2-AFC test and flavor expectation was rated on a 9-point category scale. The expectation question had end anchors of "low matching" to "high matching" as compared to what the panelists expected the flavor of the sample to be. Participants assessed the same foods in duplicate over two sessions, and were given a snack food after each session. Subjects were rewarded with gift certificates for an on campus grocery store upon the completion of the study.

3.1.4. Statistical analysis

Data obtained from the 2-AFC test were analyzed using the binomial table (Lawless & Heymann, 2010). An analysis of variance was performed using the PROC Mixed procedure in SAS® (SAS version 9.02, SAS Institute Inc., Cary, NC). The response variable was the acceptability of the foods. Main factors in the model were: neophobia level (neophobic vs. neophilic), flavor complexity (low