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Short communication

# The association between food cravings and consumption of specific foods in a laboratory taste test

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ABSTRACT

This pilot study tested the relation between food cravings and food intake in the laboratory. Participants ($n$ = 91; mean BMI = 35.1 kg/m$^2$) completed the Food Craving Inventory to measure cravings for sweets, fats, carbohydrates, and fast food fats, and a taste test consisting of four foods (jelly beans, M&M's®, regular potato chips, and baked low-fat potato chips). Thereafter, participants could eat the items *ad libitum*. Specific food cravings were significantly correlated with consumption of corresponding types of foods. The sweets scale correlated with M&M® and jelly bean intake, but not chip intake. The fats scale correlated only with intake of regular potato chips.



## Introduction

Research on food cravings has identified important associations between food cravings and BMI (White, Whisenhunt, Williamson, Greenway, & Netemeyer, 2002), binge eating (White & Grilo, 2005), gender (Lafay et al., 2001), and weight loss (Martin, O'Neil, & Pawlow, 2006). In addition, studies employing food diaries to measure food intake have reported associations between food craving and caloric intake (Hill, Weaver, & Blundell, 1991; Lafay et al., 2001). While some studies have explored food cravings and consumption of specific foods, namely chocolate (Polivy, Coleman, & Herman, 2005), the exact relation between cravings and the selection and consumption of various foods has not been reported. The pilot study reported herein was designed to test the relation between food cravings and consumption of specific foods in a controlled laboratory setting. It was hypothesized that specific food cravings would correlate with consumption of corresponding food categories.

## Method

### *Participants*

Participants were 91 overweight and obese (BMI > 29) individuals in a randomized clinical trial of medication for weight loss. Data for this report were collected at baseline of this trial at two of the seven sites, prior to treatment. The mean age of participants was 43.2 years (S.D. = 10.7); mean body mass index (BMI) was 35.1 kg/m$^2$ (S.D. = 2.8). The ethnic distribution was 73.6% ($n$ = 67) Caucasian and 26.4% ($n$ = 24) African American. The sample was 81.3% ($n$ = 74) female and 18.7% ($n$ = 17) male.

### *Procedure*

The study protocol was approved by the Institutional Review Boards of the Pennington Biomedical Research Center and the Medical University of South Carolina. All participants provided written informed consent.

Participants were instructed not to eat or drink anything containing calories for 8 h prior to the test meal. They were also asked to refrain from exercise for 24 h and alcohol for 48 h prior to the test meal. On the day of the test meal, participants completed a self-report measure of food craving, followed by a laboratory-based taste test of specific foods.

*The Food Craving Inventory* (FCI; White et al., 2002) is a 28-item self-report measure of specific food cravings. Craving is defined as "an intense desire for a specific food that is difficult to resist." Participants rate the frequency of cravings over the past 30 days on a 5-point Likert scale ranging from 1 ("not at all") to 5 ("nearly every day"). The FCI consists of four factors or scales measuring cravings for high fats (e.g., steak, fried fish, corn bread), carbohydrates/starches (e.g., rolls, baked potato, pasta), sweets (e.g., cake, cookies, chocolate, candy), and fast food fats (e.g., pizza,

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hamburgers). A total score is also calculated. Scale scores are means of the individual items loading on that scale, with higher scores indicating more frequent cravings for that particular food category (scores range from 1 to 5). The scales were identified through exploratory factor analysis and confirmed with confirmatory factor analysis. Importantly, items that load on the scales are not necessarily characterized by being high on a single macronutrient. For example, the high fats scale includes savory foods that are high in fat and protein (steak) and high in fat and carbohydrate (corn bread). The sweets scale includes items that high in sugar (candy) and high in fat and sugar (chocolate).

The reliability and validity of the FCI has been established (White et al., 2002). Moreover, the high fats scale has been found to distinguish obese from lean individuals (White et al., 2002) and the FCI scales have been found to be sensitive to calorie restriction or dieting, with craving scores decreasing during dieting (Martin et al., 2006).

*Laboratory-based taste test*. Test foods were measured into standard serving bowls and the exact weight of each food and the serving bowl was measured before each experimental session. Participants were presented with four types of food:

(1) Baked Lay's® potato chips (10 oz or 283.5 g, presented in a 2-L serving bowl).
(2) Jelly beans (10 oz, presented in a 1-L serving bowl).
(3) Regular Lay's® potato chips (10 oz, presented in a 2-L serving bowl).
(4) M&M's® chocolate candies (10 oz, presented in a 1-L serving bowl).

The four foods were selected for the following reasons. First, based on our experience in the Ingestive Behavior Laboratory, these are popular snack foods that do not require utensils to consume and the vast majority of people in our studies willingly consume these foods. Second, we attempted to identify popular snack foods that were similar to the foods that comprise the four scales of the FCI. The M&M's® and jelly beans are very similar to the foods in the sweets scale, and indeed the sweets scale includes the items "chocolate" and "candy." The two types of potato chips were selected because they were categorically similar food items (they were both potato chips), but their macronutrient composition differed in important ways. Specifically, the regular chips were high in fat (10 g and 60% of kilocalories or kcal from fat) and the baked chips were lower in fat (1.5 g and 13.6% kcal from fat), but both chips contained the same amount of protein (2 g). Hence, two similar foods items were presented, but the regular chips were more similar to items in the high fats scale of the FCI. Accordingly, we expected the regular chips to be more strongly related to cravings for high fats.

Participants were instructed to taste each food in the order presented (1–4 above), and to take at least one bite before answering questions about the taste of the each food. Participants were instructed to eat as much food of each type as they would like, and were instructed to rate the properties of the foods (i.e., sweetness, saltiness, pleasantness, bitterness, satisfaction) on a scale of 1–4. Participants were not provided with information about how the food items differ or their macronutrient content.

Participants were given 20 (±5) min to complete the task. Following the taste test, the serving bowls of each food were weighed after the participant left the testing setting and a difference score was calculated to determine the amount of each food the participant consumed. The number of kcal consumed of each food was calculated according to the following conversion rate: 3.9 kcal/g for baked potato chips, 3.5 kcal/g for jelly beans, 5.4 kcal/g for regular potato chips, and 5 kcal/g for M&M's®.

## Results

The hypothesis of this pilot study was that specific food cravings would correlate with consumption of corresponding food categories. Table 1 presents the correlations between specific food cravings and consumption of the foods in the taste test. Supporting the hypothesis, cravings for fats ($M = 2.4$, S.D. = 0.6) was significantly correlated with consumption of regular potato chips, but was not associated with the low-fat test items, namely baked chips and jelly beans. Cravings for sweets ($M = 2.8$, S.D. = 0.8) correlated significantly with consumption of jelly beans and M&M's®, but did not correlate with consumption of either type of chip. Craving for carbohydrates ($M = 2.4$, S.D. = 0.5) did not correlate significantly with consumption of any of the foods, and cravings for fast food fats ($M = 2.7$, S.D. = 0.7) correlated significantly only with M&M® consumption. The FCI total score ($M = 2.6$, S.D. = 0.4) was correlated with consumption of regular potato chips, M&M's®, and total food intake during the taste test.

## Discussion

This pilot study investigated the relation between food cravings and intake of specific foods in a laboratory setting. The results indicated that food cravings are significantly related to food intake, with specific food cravings correlating with the types of foods consumed. Cravings for fats were related to consumption of high-fat savory snack items (potato chips), which are similar to the items on the high fats scale of the FCI. Importantly, cravings for fats were unrelated to consumption of a low-fat version of the same item (baked chips). Similarly, cravings for sweets were positively associated with consumption of M&M's® and jelly beans, which are similar to the food items on the sweets scale of the FCI. Carbohydrate craving did not correlate significantly with consumption of any of the foods used in this study, even though the baked potato chips were high in carbohydrate. Further research is needed with a wider range of foods, but it is possible that the carbohydrates scale of the FCI is less predictive of food intake compared to the high fats, sweets, fast food fats, and total score.

The results suggest that cravings for specific categories of foods are related to the selection and consumption of similar foods. It should be emphasized that these results are from correlation analyses; although it could be argued that food cravings *cause* consumption, an equally plausible explanation is that repetitive consumption of specific foods (or food types) contributes to cravings for those types foods. Indeed, food cravings have been conceptualized as a conditioned expression of hunger, where food cravings are conditioned by pairing the consumption of a particular food with hunger (Gibson & Desmond, 1999; Zellner, Garriga-Trillo, Rohm, Centeno, & Parker, 1999). The results of a recent study support this hypothesis by demonstrating that cravings decrease during calorie-restrictive diets, with diets that restrict food variety being associated with larger decreases in

**Table 1**
Pearson correlation coefficients between food craving (FCI scales) and consumption (g) of specific foods

| FCI scales | Grams consumed | | | | |
|---|---|---|---|---|---|
| | Baked Lay's® | Jelly beans | Regular Lay's® | M&M's® | Total intake |
| High fats | −0.04 | −0.03 | 0.27** | 0.16 | 0.13 |
| Sweets | 0.01 | 0.20* | 0.13 | 0.19* | 0.20* |
| Carbohydrates | 0.02 | 0.10 | 0.14 | 0.13 | 0.14 |
| Fast food fats | 0.06 | 0.05 | 0.13 | 0.18* | 0.15 |
| Total score | 0.01 | 0.13 | 0.23* | 0.23* | 0.22* |

*Note*: $^{*}p < 0.05$, $^{**}p < 0.01$ (one-tailed).

cravings than diets offering more variety (Martin et al., 2006). In this case, it is possible that cravings decreased during the more restrictive monotonous diet because there were fewer opportunities for conditioning, since food intake was restricted and limited in variety. Further research is warranted to determine the temporality and/or causal relations between food cravings and food intake.

The results of this study should be interpreted in the context of its limitations. First, this was a pilot study that provides important preliminary results, but additional research is warranted that includes a wider selection of foods. Second, the study was conducted in a laboratory with overweight and obese participants. Therefore, it is unclear if food cravings correlate with the types of foods consumed habitually in free-living conditions, or if the results will generalize to lean individuals. Third, the food items on the FCI are somewhat limited in that varying cultural and/or geographic foods are not thoroughly represented. The FCI was developed and validated using a sample of individuals residing in the Southern United States (i.e., the same region as the current study) and, while certain foods on the FCI may be popular regardless of geographic region (e.g., chocolate), other foods may underestimate the true construct of food cravings due to their geographic specificity (e.g., gravy, corn bread). Therefore, future research on specific food cravings should investigate the utility of the measure with varied cultural and geographic groups.

The results of this pilot study suggest that cravings for specific types of foods are associated with intake of foods similar to those craved. Based on these preliminary data, future research is warranted to examine the association between food cravings and a wider array of food choices in both laboratory and free-living conditions.

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