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Rice deprivation affects rice cravings in Japanese people

Sakura Komatsu [a,b,*], Yasushi Kyutoku [b], Ippeita Dan [c], Kenjiro Aoyama [d]

[a] Organization for Advanced Research and Education, Doshisha University, 1-3 Tatara Miyakodani, Kyotanabe City, Kyoto 610-0394, Japan
[b] Research and Development Initiative, Chuo University, 1-13-27, Kasuga, Bunkyo-ku, Tokyo 112-8551, Japan
[c] Faculty of Science & Engineering, Chuo University, 1-13-27, Kasuga, Bunkyo-ku, Tokyo 112-8551, Japan
[d] Faculty of Psychology, Doshisha University, 1-3 Tatara Miyakodani, Kyotanabe City, Kyoto 610-0394, Japan

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ABSTRACT

Food cravings are known to vary among cultures. Cravings for rice, a Japanese dietary staple, have been reported for Japanese people. Deprivation of a craved food is known to increase the desire for it, but the effects of deprivation of rice have yet to be explored. Thus, in Study 1, we investigated whether and how rice deprivation for one day or three days causes rice cravings, whereas in Study 2 we examined the effects of deprivation of bread, another carbohydrate-rich food, for three days on bread cravings. Participants maintained a food diary and assessed daily frequencies of experienced a craving for the deprived foods during that day for one week. In both studies, participants in the deprivation conditions showed an increase in cravings for deprived foods during deprivation periods compared to the control condition. However, in Study 2, as opposed to Study 1, there was no significant difference in cravings between the deprivation and control conditions on the first day of deprivation. Additionally, participants in the deprivation conditions for both studies did not consume the deprived food more frequently after the deprivation period compared with their pre-deprivation consumption rates. Taken together, these studies revealed that the deprivation of rice leads to an acute increase in rice cravings, the deprivation of bread leads to a delayed increase in bread cravings, and neither leads to increased rice or bread consumption. The current combined study provides the first experimental evidence that cravings for a staple food are enhanced by its deprivation.

1. Introduction

Food cravings are defined as intense and difficult-to-resist desires to consume particular foods or food types (Weingarten & Elston, 1990, 1991). For example, it is a well-known phenomenon that pregnant women report strong and unusual desires for certain types of foods (Bayley, Dye, Jones, De Bono, & Hill, 2002). Also, it is documented that women in their pre-menstrual period frequently report similar experiences (Rozin, Levine, & Stoess, 1991). Cravings have been mainly studied in clinical settings due to their co-occurrence with binge eating (Gendall, Joyce, Sullivan, & Bulik, 1998), but as Weingarten and Elston (1991) suggested, food cravings are a normative rather than pathological phenomenon, particularly among females: In their study using a questionnaire, 97% of women and 68% of men reported having had cravings. Thus, it is apparent that a large proportion of the normal population experiences food cravings in some way or another.

Based on previous findings, food type and deprivation appear to be factors related to food cravings. As for food type, cravings have often been found for savory foods (Parker, Kamel, & Zellner, 2003) and sweet foods (Zellner, Garriga-Trillo, Rohm, Centeno, & Parker, 1999), and chocolate is most frequently reported to elicit cravings in Western countries, especially among women (Hill & Heaton-Brown, 1994; Rozin et al., 1991; Zellner et al., 1999; Weingarten & Elston, 1991). However, cravings are not limited to inessential and pleasurable foods: the types of food craved seem to differ among cultures, and cravings for the staple food rice have been reported in Japan (Komatsu, 2008; Komatsu, Tomono, & Aoyama, 2009).

Several studies have shown that deprivation induces cravings: In one study, individuals who did not allow themselves to eat a particular food (e.g., cereal, bagels, and pasta) for 5 days reported significant increases in desire for the corresponding food (Mann & Ward, 2001). In another, both low and high trait-level chocolate cravers had increased state-level chocolate cravings after deprivation (Moreno, Rodríguez, Martín, & Warren, 2012). Similarly, in a third study, carbohydrate-restricted participants experienced more cravings for carbohydrates than did either controls or

* Corresponding author at: Research and Development Initiative, Chuo University, 1-13-27, Kasuga, Bunkyo-ku, Tokyo 112-8551, Japan.
E-mail address: skomatsu@tamacc.chuo-u.ac.jp (S. Komatsu).

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protein-restricted participants, while protein-restricted participants reported more cravings for protein than did either the controls or the carbohydrate-restricted participants (Coelho, Polivy, & Herman, 2006). However, deprivation itself is not the single cause of cravings, but rather it interacts with dietary restraint. Polivy, Coleman, and Herman (2005) deprived dietarily restrained and unrestrained participants of foods containing either chocolate or vanilla. They found that only dietarily restrained individuals deprived of chocolate had more cravings for chocolate than the other individuals. In contrast, other studies have found that deprivation of specific nutrients could result in a reduction of food cravings. For example, Martin, O'Neil, and Pawlow (2006) demonstrated that obese participants who had very-low-calorie diets experienced a decrease in food cravings in general. In addition, Martin et al. (2011) reported that carbohydrate-restricted obese adults experienced reduced cravings for high-carbohydrate foods, while high-fat-restricted obese adults experienced reduced cravings for high-fat foods. However, it should be noted that participants of these studies were obese people and the duration of restriction was very long (over 11 weeks for Martin et al. (2006) and two years for Martin et al. (2011)).

Given the various findings on the effects of deprivation on food cravings produced by the studies cited above, it is difficult to predict what effect the deprivation of rice would have on a general population. As in the case of popular carbohydrate-based foods (Mann & Ward, 2001), the deprivation of rice may lead to cravings for rice itself, if it results in any cravings all. Alternatively, the craving effects could extend to carbohydrates in general as in the study on carbohydrate restriction by Coelho et al. (2006). It may even be possible that cravings be reduced upon deprivation of rice as in the study of carbohydrate-restricted obese adults by Martin et al. (2011). It should also be stressed that although the effects of deprivation have been studied for highly craved foods in Western culture, the logical extension of such studies may not be applicable to rice, which is a staple food in various East Asian countries, including Japan, and thus occupies a special position in the dietary lives of the people of those regions. On this basis, the first aim of this study was to examine the effect of rice deprivation on rice cravings. This is an important topic to explore because the association between deprivation of and cravings for rice has not been elucidated from the perspective of rice as a carbohydrate-rich food or from that of rice as a culture-specific staple food.

Previous studies have differed in their methodology regarding the deprivation period: First, Coelho et al. (2006) examined the effects of a three-day restriction of foods high in carbohydrates or high in protein on cravings and found that restriction of carbohydrates caused cravings for corresponding foods. Second, deprivation of neutrally liked food (rated at the neutral midpoint of a Likert-type scale ranging from 1 to 7) for five days caused cravings (Mann & Ward, 2001). Third, a one-week deprivation of chocolate caused cravings for it (Polivy et al., 2005). Likewise, Moreno et al. (2012) deprived participants of chocolate for two weeks to elicit cravings. To date, no studies have examined the duration of rice deprivation required to elicit cravings. Considering the role of rice as a staple and its nutritional value as a carbohydrate, we expect that the effects of deprivation would occur earlier relative to other often-craved foods. Thus, as the second aim of the study, we examined the effects of duration of deprivation, focusing on the effects of a relatively short period of deprivation of rice (i.e., one or three days).

Another aspect of cravings is the rebound effect, which causes increases in subsequent desire for and/or intake of a particular food after deprivation. For example, Polivy et al. (2005) demonstrated that dietarily restrained chocolate eaters who had been deprived of chocolate ate more chocolate than their non-deprived counterparts. Unrestrained participants did not exhibit the rebound effect regardless of the deprivation condition. Coelho et al. (2006) found carbohydrate-restrictors consumed more foods high in carbohydrates (croissants) while protein-restrictors did not consume more foods high in protein (chicken) after diet restriction. Moreno et al. (2012) showed that high-cravers ate more chocolate than low-cravers after deprivation of chocolate with somewhat inconsistent findings that non-deprived high-cravers ate the greatest amount of chocolate. Mann and Ward (2001) restricted participants' intake of a particular food and examined the rebound effects on desire and subsequent intake of the prohibited food, finding post-deprivation increment in desire, but not in actual consumption. Hence, findings on the rebound effect after deprivation are not consistent. Thus, the third aim of this study was to examine the rebound effect of rice deprivation on desire for and intake of rice among Japanese people.

2. Study 1

2.1. Methods

2.1.1. Participants

Sixty-two undergraduate students at Doshisha University were recruited for the study (M_{age} = 20.56 years, SD_{age} = 0.90 years; 11 males, 51 females). All of them were Japanese and their first language was Japanese. Participants were randomly assigned to three conditions: no deprivation (n = 15), one-day deprivation (n = 17), or three-day deprivation (n = 30). Of the participants, six who did not hand in a food diary, two who failed to record a food diary, and three who did not comply with instructions were excluded, leaving 51 participants (M_{age} = 20.61 years, SD_{age} = 0.96 years; 8 males, 43 females; n = 13 in no deprivation, n = 13 in one-day deprivation, and n = 25 in three-day deprivation conditions). There was no significant difference in age (F (2, 48) = 0.83, p = 0.44, η^2 = 0.03) or gender distribution ($\chi^2(2)$ = 2.19, p = 0.33, V = 0.21) across conditions. There was no confounding effect of deprivation condition on the self-reported relative frequency of rice cravings (H (2) = 0.81, p = 0.67) and rice eating (H (2) = 2.36, p = 0.31), indicating the absence of confounds due to subjects across conditions prior to the experiment. Approximately twice as many participants were assigned to the three-day deprivation condition as to other conditions because the dropout rate for the three-day deprivation condition was expected to be high due to difficulty in complying with the longer deprivation period. Participants who took part in a session received course credits. In addition, participants in the no-deprivation condition were compensated with 1000-yen bookstore gift cards,[1] those in the one-day deprivation condition with 1500-yen cards, and those in the three-day deprivation condition with 2500-yen cards after they submitted 7 days of completed food diaries. Participants were not informed of the differences in compensation prior to the experiment. The study was approved by the Institutional Review Board of Doshisha University.

2.1.2. Median relative frequency of cravings for a month prior to the experiment

A paper-and-pencil based Food Craving Inventory for Japanese (FCI-J; Komatsu, 2008) that assesses the relative frequency of cravings with a five-point Likert scale for 21 food items was used to examine participants' food cravings for the month prior to the first day of the experiment. In the first part of the questionnaire, the definition of craving was given (in Japanese): "A craving is defined as an intense desire to consume a particular type of food. And this desire is so strong that the person finds it difficult to resist." After

[1] The exchange rate of the US dollar against the Japanese yen on the day of the session (12 May 2009) was 97.50 yen to the dollar.