Food selection changes under stress

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Abstract

Two studies investigate the effect of stress on food choice. Experiment 1 demonstrates experimentally that stress causes changes in food choice away from healthy low fat foods (grapes) to less healthy high fat foods (M&Ms), confirming previous survey research. Experiment 2, a survey study, finds that more females than males report increasing food consumption when stressed. A much larger percentage of those who report increasing their food consumption when stressed (71%) are restrained eaters (i.e., dieters) than are people who undereat or who do not change the amount they eat when stressed (35%). The foods that they report overeating when stressed are foods they normally avoid for weight-loss or health reasons (i.e., highly caloric high fat snack foods). They report eating these foods to feel better. Both studies show that stress not only increases consumption in certain individuals but also shifts their food choice from lower fat to higher fat foods.

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1. Food selection changes under stress

Stress has both direct and indirect adverse affects on health. There is evidence that it directly affects processes that result in adverse cardiovascular functioning, suppressed immune response, and other physiological functions, some of which could contribute to cancer (see Refs. [1–3] for reviews). Indirectly it affects health by having effects on certain behaviors which influence health. One such behavior that is influenced by stress is eating behavior (see Refs. [1,4] for reviews). When stressed some individuals increase their food consumption, which can lead to obesity and all the health problems associated with it. Other individuals decrease their intake when stressed producing other adverse health effects [5–7]. Stress may also have an effect on health by affecting which foods people choose to eat.

Survey studies of what foods people choose to eat when stressed found that people choose more highly caloric sweet and fatty snack foods (foods eaten at times other than during a meal) when stressed [8–11]. For example, Oliver and Wardle [9] found that stressed subjects, particularly women, reported eating more snack foods such as sweets (often chocolate). They also found that these subjects reported a decrease in consumption of fruits and vegetables when stressed.

This choice of sweet high fat snack foods and a decrease in consumption of fruits and vegetables are the opposite of what women report selecting when they are not stressed. Wardle et al. [12] found that more women than men report avoiding high fat foods and striving to eat “enough” fruits and fiber out of health concerns. These women also report a higher rate of dieting than do men. The higher levels of weight and health concerns in women seem to cause them to control or limit their consumption of sweet high fat foods under normal circumstances. This control over what they eat appears be reduced under stress (disinhibition), permitting them to eat what they usually avoid.

While questionnaire studies asking people about their food choices when stressed clearly find people reporting an increase in consumption of sweet, highly caloric, high fat foods, the findings of the few laboratory studies [13–15] on this topic are less clear. None of these studies found significant changes in food choice with stress. The only change in food choice found in these studies was an increase in consumption of sweet fatty foods by female emotional eaters [15]. Epel et al. [13] also found that women who had high cortisol levels in response to stress ate...
more sweet high fat foods when stressed than did women who did not have a high cortisol response to stress.

Clearly more research is needed directly measuring shifts in food choice in response to stress. Experiment 1 investigates the effect of stress on food choice in a laboratory setting using only female subjects. We use only female subjects because not only do more women than men restrict their intake of certain foods for weight loss reasons [16] but also more women than men restrict their intake of certain foods for health reasons [12]. If loss of dietary control by stress is causing stress-induced changes in food choice to sweet high fat foods considered taboo by those concerned about body weight and health, we would expect to see the effect more strongly in females than males. The foods used here included some that are considered to be fattening, unhealthy foods and others that are not. Food choice should be different between the subjects who are stressed and those who are not stressed and should parallel the self-report studies. When stressed, subjects should eat more of the foods they normally avoid (when disinhibition of control is likely to occur) and when not stressed (when subjects can control their eating) they should choose more of the “good” snack foods if they eat anything at all.

2. Experiment 1

This study directly investigates the food choices of females under stress to determine if these females choose foods they would normally avoid when they are stressed and reduce consumption of foods they would normally eat. In this experiment two groups of female subjects, one stressed and one not stressed, are presented with snack foods. In pilot testing it was found that some of the foods were regarded as ones to avoid for both health reasons and if dieting (i.e., chocolate and potato chips) and others that are equally easy to eat were not regarded as bad for health or dieting (i.e., grapes and dry roasted peanuts). This study will attempt to demonstrate that unstressed female subjects will eat the healthier/dietetic choices and that stressed female subjects will eat more of the foods normally avoided, similar to the self-report data of Oliver and Wardle [9].

2.1. Method

2.1.1. Participants

Subjects were 34 undergraduate female student volunteers from Montclair State University randomly divided into two groups. Their mean age was 22 years. All subjects were tested individually. We did not ask students their ethnicity. They were randomly selected from students in the hallways of the largest classroom building on campus. Therefore, they are effectively a random selection from the Montclair State University student body. The ethnic composition of the student body is 60% White, 18% Hispanic, 11% African American, and 6% Asian.

2.1.2. Materials

Subjects were presented with four cardboard disposable bowls containing plain M&M chocolate candies (about 100 g), Lays potato chips (about 50 g), Planter’s dry roasted peanuts (about 100 g), and red seedless grapes (about 100 g). These foods were selected to provide subjects with a sweet and a salty food viewed as good to eat and a sweet and salty food viewed as bad to eat (based on results of pilot testing). While peanuts are viewed as healthy and fine to eat if dieting, they are high in fat (unlike the healthy sweet choice, grapes). All foods have a high caloric content. They are all popular snack foods suggesting that most people find them to be hedonically positive.

Subjects were given a list of either ten solvable or ten unsolvable five-letter anagrams. The sheet containing the solvable anagrams also contained a word-bank of the answers at the bottom of the page.

2.1.3. Procedure

Upon arrival, subjects were seated in a small room which contained a table on which were placed the four bowls containing the M&Ms, grapes, potato chips, and peanuts. These bowls were weighed prior to being placed in the room. Subjects were told that the snacks were a “thank you” for their participation and were left over from a Psychology Club meeting. They were told to feel free to help themselves to the food during the experiment.

Each subject then received one of the two lists of ten anagrams. Half of the subjects (n=17, no-stress group) were presented with the solvable anagrams and the other half (n=17, stress group) were given the unsolvable anagrams. Subjects were told that they had ten minutes to solve the anagrams and were left alone in the room. After 10 min the experimenter returned, took the anagrams from the subjects and asked the subjects to fill out a brief questionnaire containing five questions about their verbal ability and an 11-point rating scale of 0 (low stress) to 10 (high stress), with which they were to rate how much stress they felt from trying to solve the anagrams. The verbal ability questions were given to mask our interest in the stress question and were not analyzed. Subjects were given an additional 5 min to fill out this questionnaire.

Upon completion of the questionnaire subjects were debriefed and those who received the unsolvable anagrams were told that they were unsolvable. After the subjects left, the bowls of foods were again weighed.

2.2. Results

The stress group (who got the unsolvable anagrams) reported being significantly more stressed (M=5.8, SD=3.0) than the no-stress group getting the solvable anagrams (M=0.7, SD=1.1), t(32)=6.54, p<.001. The no-stress group ate more grapes (M=15.6 g, SD=22.3) than did the stress group (M=4.0 g, SD=7.2), t(32)=2.04, p<.05. On the other hand, the stress group ate more M&Ms (M=6.9 g, SD=10.4) than did the no-stress group (M=1.2 g, SD=2.4), t(32)=2.20, p<.04. See Fig. 1.
highly caloric, high fat foods). Experiment 2 uses self-report to choose to eat foods they might normally avoid (e.g., sweet, salty choices were high in fat content contributed to seeing no difference in the choice of these foods with stress level. This is supported by the fact that intake of both salty choices was lower than the intake of the sweet choices. However, it is also possible that the fact that both of the salty choices were high in fat content contributed to seeing no difference in the choice of these foods with stress level.

That all subjects in the study ate something is somewhat surprising. One might expect that people who eat under stress might eat if they were in that group, but that people who tend not to eat when stressed would not. In addition, subjects who don’t change their intake under stress might only consume food when hungry. We do not know how many of the subjects in this study eat when stressed and how many stop eating. Nor do we know how many were restrained eaters who restrict their intake to lose weight (i.e., dieters) and how many were unrestrained. We do know that restrained eaters tend to eat when stressed [4] and we would expect that many though not all of the subjects were restrained eaters (e.g., Ref. [16]).

3. Experiment 2

Experiment 1 found that when stressed, women tend to choose to eat foods they might normally avoid (e.g., sweet, highly caloric, high fat foods). Experiment 2 uses self-report to look at the rate of overeating and undereating in response to stress in the same population of subjects used in Experiment 1 (with the addition of Montclair State University undergraduate males). It also investigates the proportion of restrained eaters.

In addition Experiment 2 investigates, through self-report, what foods stress-overeaters eat when they are stressed, whether these foods are normally avoided, and the reason for the usual avoidance of these foods. If release of dietary control is causing both the change in food selection seen in Experiment 1 and the stress-induced overeating, subjects should report that the foods that they overeat when stressed are ones they normally avoid.

If the present study finds that when stressed, overeaters eat foods that they normally avoid, the question will still remain as to why they eat these normally avoided foods when stressed. A popular idea is that people eat when stressed because doing so reduces anxiety and/or makes them feel better in some way. This is the idea of “comfort foods”; overeaters eat foods that comfort them when stressed. There is at best limited support for this idea [17–19]. The following study asks subjects directly why they eat the foods they eat when stressed.

2.3. Discussion

Stressed subjects ate more of the unhealthy high-caloric sweet choice (M&Ms) and less of the healthy sweet choice (grapes) than did the unstressed subjects. This parallels the self-report data of Oliver and Wardle [9] whose subjects reported increasing their intake of sweet snack foods and decreasing their intake of fruit when stressed. This supports the idea that stress causes disinhibition of self-imposed food selection rules to avoid foods perceived as fattening and unhealthy, particularly sweet foods.

It should be noted that no difference in intake of the salty snacks was observed. That could be due to the fact that subjects had a limited amount of time to consume the foods and the sweet foods might have been more liked and therefore selected before the salty ones. This is supported by the fact that intake of both salty choices was lower than the intake of the sweet choices. However, it is also possible that the fact that both of the salty choices were high in fat content contributed to seeing no difference in the choice of these foods with stress level.

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3. Method

3.1. Participants

One hundred and sixty nine undergraduate student volunteers (128 females and 41 males) from Montclair State University served as subjects. Their mean age was 24 years. Subjects were tested in a small classroom. We did not ask students their ethnicity. They were randomly selected from subjects in the hallways of the largest classroom building on campus. Therefore, they are effectively a random selection from the Montclair State University student body. The ethnic composition of the student body is 60% White, 18% Hispanic, 11% African American, and 6% Asian.

3.1.2. Procedure

The Eating-When-Stressed Questionnaire was administered to subjects to find out about their eating behavior under stress. The questionnaire asked subjects if they a) overeat or b) undereat when stressed or if c) stress has no effect on their eating (they selected one of those three alternatives). Those who indicated that they overeat when stressed were asked to indicate which food they most frequently overeat when stressed (this was an open-ended question) and whether they normally avoid eating this food (they could respond either yes or no). In addition, they were asked why they eat the food they indicated they eat when stressed (this was also an open-ended question). Finally, subjects completed the Restraint Scale [20].

3.2. Results

3.2.1. Gender differences in eating patterns when stressed

Eating patterns differed significantly under stress for women and men ($\chi^2(2)=10.85, p < .01$). Forty-six percent of the women and only 17% of the men reported overeating when stressed. Thirty-seven percent of the women and 54% of the men reported undereating when stressed. Seventeen percent of the
women and 29% of the men reported no change in consumption when stressed.

3.2.2. Restraint

Nine female subjects failed to answer some of the questions on the Restraint Scale and were dropped from the following analysis. Stress over-eaters were significantly more likely to be restrained eaters than were those who reported not over-eating when stressed, $\chi^2(2)=20.41, p<.05$. Seventy-one percent of the stress-overeaters (75% of females and 43% of males) had restraint scores which would classify them as restrained but only 35% of the stress-undereaters and those indicating no change in amount eaten when stressed (41% of females and 24% of males) had restraint scores high enough to be classified as restrained.

3.2.3. Food selection when stressed

Seventy-three percent of those subjects indicating that they overeat when stressed (73% of the 59 women and 71% of the 7 men) indicated that when stressed they eat foods that they normally avoid.

Sixty-four percent of subjects indicated that when stressed they eat sweet foods (66% of the women and 43% of the men). Sixty-seven percent of those who reported eating a sweet food when stressed said that it was a food that they normally avoided (64% of 39 women and all of the three men). Chocolate was the most commonly reported sweet eaten when stressed; fifty-nine percent of women who reported eating sweets when stressed specified chocolate. Of those specifying chocolate, 70% said that it is a food they normally avoid, as did the one male.

Of those who indicated that they eat foods other than sweet ones when stressed, 83% (ninety percent of the 20 women and 50% of the four men) said that they eat foods that they normally avoid. These were predominately high fat snack “junk” foods. Junk foods are foods people perceive as being unhealthy, generally high fat, high caloric foods.

3.2.4. Reasons for food avoidance

Of the 48 people who indicated that when stressed they eat foods that they normally avoid, 52% (56% of 43 women and 20% of five men) said that they avoid the foods because of weight concerns. Another 44% (40% of 43 women and 80% of five men) said they avoid the foods due to other, often unspecified, health concerns.

3.2.5. Reasons for eating avoided foods when stressed

Fifty-three percent of the subjects (53% of 59 women and 57% of seven men) who eat when stressed said that they select foods that make them feel better (e.g., relaxed, comforted, etc). Another 22% of the 59 women said that they select foods because they taste good.

3.3. Discussion

More women than men overeat when stressed. Most people who report overeating when stressed (71%) were restrained. The percentage of restrained eaters among stress overeaters was higher for women than for men. This is consistent with previous research showing that more females than males are restrained eaters (i.e., dieters) and the conclusion by Greeno and Wing [4] that restraint is the best predictor of stress-induced eating (see also Ref. [21]). Restrained eaters have been found to exhibit disinhibition of their diet and in certain situations to eat foods they normally avoid [22].

The majority of people who eat when stressed in our study said they eat foods that they normally avoid, not just any food. These are usually high calorie foods, mostly sweets (e.g., chocolate) and snack and “junk food”. These results are similar to those found in previous self-report studies [8–11].

However, dieting was not the only reason why subjects normally avoided highly caloric foods. Some subjects reported that they avoided these foods for health reasons other than weight concerns. The foods these subjects eat when stressed are obviously foods that are perceived as being foods to avoid, yet they are desirable and good-tasting foods.

When asked why they eat the foods they eat when stressed, more than half of the subjects responded that the foods made them feel better or “comforted” them. The second most common response was that the foods tasted good. So the subjects are eating foods that will provide something positive in a situation that is aversive. Although previous investigations have failed to show a reduction in anxiety among subjects eating when stressed [17,18], that finding does not mean that eating provides no positive outcome for the subjects. In fact, Polivy et al. [17] did find that people who ate cookies when stressed reported feeling happier while eating them. Eating the cookies did not, however, decrease their anxiety. Being stressed, happy, and anxious might be better than just being stressed and anxious.

Our self-report data on the reasons for eating certain foods when stressed differ from that of Polivy and Herman [19]. In their study subjects reported that they ate when stressed to distract themselves from the task that was stressful and rather than because they felt the food would comfort them. The reason for the difference between the studies could be because our question was open-ended whereas the Polivy and Herman [19] study provided subjects with a list of possible answers. Distraction from the distressing, stressful task might provide some “comfort” and might well make subjects feel better. So the subjects in the two studies might be alluding to the same basic reason for eating. That is, eating the foods they eat does something that makes them feel, maybe only momentarily, better than they were feeling. Eating the food might cause them to feel better for any of a number of reasons. It might distract people from an aversive task or it might remind them of some better, less stressful time in their lives. It might be simply that eating something that tastes good is enjoyable and makes one feel better.

4. General discussion

The studies presented here demonstrate that stress not only increases consumption of food in stress-eaters but also moves consumption toward high calorie snack foods that are normally avoided (particularly sweet high fat foods like chocolate) and away from healthier foods such as fruits. The
shift in food choice under stress that people reported in Experiment 2 and other studies [8–11] was also exhibited by female subjects in a laboratory setting in Experiment 1. This is the first experimental demonstration of a shift in food choice with stress. The low consumption of grapes and high consumption of chocolate is exactly what has been reported in questionnaire studies (e.g., Ref. [8]) but the behavior has never been measured directly.

That all of the females in Experiment 1 ate when stressed does not seem to be because they were all stress-eaters. Not all women in Experiment 2 (drawn from the same population as Experiment 1) reported overeating when stressed. In fact, 37% of them reported undereating when stressed. So, although it is likely many of our subjects in Experiment 1 were people who normally reduce intake when stressed, they still ate something when stressed. Possibly our subjects felt under some obligation to eat something since they were told that the food was a reward. Possibly our subjects felt under some obligation to eat something since they were told that the food was a reward. Not all of the females in Experiment 1 ate when stressed, but the majority of these subjects (many of whom were unrestrained eaters) ate under stress might also be a result of the type of stress we used. In previous research [23] a decrease in food consumption with stress (in unrestrained eaters) was found only when the stress was a result of a threat of physical pain (i.e., electric shock) and not when it was caused by ego threat such as failure at a task (as in our Experiment 1). So maybe our stress did not cause people to inhibit their consumption even if they would have categorized themselves as stress-undereaters.

What both studies show is that the particular foods people choose to eat or overeat when stressed are often foods that they normally avoid for weight control or health reasons. Thus, stress appears to cause the loss of the control subjects usually exert to prevent themselves from eating what they perceive as fattening, unhealthy foods. These are often snack foods. Since eating a snack has no effect on how much is consumed in a subsequent meal [24] encountering stressors that increase snack intake will also increase overall caloric intake. Therefore people who encounter stress frequently, as many people do, wind up overeating highly caloric snack foods frequently in an attempt to make themselves feel better. This increases their daily caloric intake, resulting in weight gain. This weight gain often leads to dieting which appears to lead to a greater tendency to overeat fattening, unhealthy foods, producing a “vicious cycle.”

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