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# Hungry or Stressed? Relationship between Stress and Attention for Food-related Words

## Original Paper

Obesity is a major health problem in western society and caused by different factors. Stress-induced eating is widely thought to increase the risk for obesity. The purpose of this study was to investigate the influence of stress on attention for food. We hypothesized that stress creates an attentional bias for high-caloric food, which can be assessed by an adapted Stroop task. This is measured by comparing reaction times for food-related words and non-food related words before and after stress. Against our expectations, we found that stress had no significantly different effect on the food word list compared to the neutral word list. Stressed and non-stressed participants turned out to be significantly slower on the food-word list than on the neutral-word list and participants were generally faster on both lists after stress. Taken together, our results show that the attentional bias for high-caloric food is not influenced by stress.
**Keywords**: MAST, attentional bias, food, Stroop task, POMS.

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## INTRODUCTION

Obesity is a serious and growing health problem in today's Western society. In the last 30 years, the prevalence of obesity has increased considerably. In 2008, up to 50% of the European population was overweight and over 20% of the population was obese (WHO Regional Office for Europe). Obesity does not leave people without consequences. Besides the physical consequences, such as an increased chance of cardiovascular diseases (WHO Regional Office for Europe, 2008), obesity may also lead to psychological problems such as low self-esteem and exposure to stigmatization and prejudice (Myers & Rosen, 1999). Excessive weight gain occurs when a person's energy intake is greater than one's energy consumption. In this way, the excess calories will be converted and stored in our bodies, which will cause an increase in body weight (Torres & Nowson, 2007). Why do we tend to eat more than we need?

Different genetic and environmental factors have been found to contribute to the development of obesity. Among these factors, stress is found to correlate with an increased desire for high caloric food (Torres & Nowson, 2007). Stress can be defined as an aversive state, which requires resources from the individual to leave this unpleasant state. As described by Adam and Epel (2007), stress is linked to activity of the hypothalamic-pituitary-adrenal (HPA) axis, which in turn influences the endocrine regulation of appetite. Eating high-caloric food while being stressed may serve as a compensation leading to the release of substances related to reward. Consequently, this release of opioids decreases the activity of the HPA axis, which reduces the stressful experience. Eating while being stressed may turn into a habit and this can contribute to the development of obesity (Greeno & Wing, 1994).

Oliver, Wardle and Gibson (2000) investigated the influence of stress on food choice during a meal. Although stress had no influence on the total amount of food intake, it did increase the desire for high-fat foods among participants. First, participants had to prepare a presentation in order to induce stress. Afterwards, participants could choose between several types of food to eat. The results showed that the desire for high-caloric food was greater in the stressed group compared to a control group.

In the study of Wardle, Steptoe, Oliver & Lipsey (2000), the association between work stress and nutrition was measured in a cross-sectional and longitudinal study. The load of work stress was determined by the averaged hours of work per week. The highest work stress session was compared with the lowest work stress session. The results showed that the high-caloric food intake of restrained eaters increased after stress, however this effect was not visible in unrestrained eaters.

The relationship between psychological factors and changes in food intake were investigated by Weinstein, Shide and Rolls (1997). Participants were divided in two groups based on their changes in food intake (increased or decreased) during stress. No differences were found between men and women. However, females with a less inhibited personality style ate more while being stressed compared to more inhibited women. In contrast, for men no differences were found related to personality.

In the past, various studies were conducted to detect a relationship between attentional bias for food and overeating. Werthmann (2015) investigated an attentional bias for food as a possible cognitive factor in the development of obesity in healthy weight and obese children. They tested whether children with obesity had a higher attentional bias for food in comparison to healthy-weight children. Further, it was tested whether an attentional bias has a predictive value in weight-change after three and six months. In contrary to the expectations, no difference between obese children and the control group was found. However, directing attention towards food lead to a reduced weight loss, which was measured after six months.

Additionally, the study by Schmitz, Naumann, Trentowska and Svaldi (2014) studied attentional biases for food cues in binge eating disorder (BED) in contrast to a control group. Attentional bias was tested with a clarification task and a spatial cueing paradigm. The results showed that food stimuli were detected in both groups. However, this effect was more apparent in BED patients. Further, an initial orienting bias towards food (stimulus engagement effect) was found in BED patients. This effect can be explained by different stimulus processing in BED, which is manifested in slower disengagement of attention from food stimuli. Both effects were correlated with severity of BED symptoms.

A specific way to measure attentional biases is the Stroop task (Stroop, 1935). In the original Stroop task, interference between the content of a word and the colour of the ink in which that word has been printed can be measured. The stimulus is a colour word printed in a conflicting colour. Naming the colour of a colour word is supposed to take longer than reading the letters of a word, because this is a conflicting stimulus. Dealing with a non-conflicting stimulus (consistent word and colour) takes less time and effort. The colour-naming Stroop task has consistent validity and has been a reliable research method for measuring attentional biases. In the past, this paradigm was used in different domains in psychological research and can be adapted to different contexts (Penner et al., 2012). For instance, emotional Stroop tasks measure automatic attentional biases towards emotional word stimuli. A longer reaction time for negative emotional content in contrast to neutral content reflects emotional distraction (Wentura, Bermeitinger, Englert, & Frings, 2009). Further, the Stroop task can be used in various clinical conditions, for instance to assess attentional bias for addiction-related stimuli (drugs, alcohol, cigarettes) (Cox, Fadardi & Pothos, 2006).

Ben-Tovim, Kay Walker, Fok and Yap (1989) adapted the Stroop task to measure food and shape concerns in patients with eating disorders. They compared the reaction time on a neutral, non-food and non-shape related word list against a food and shape related word list. Persons with psychopathological eating disorders showed an increased attention to food- and shape-related words in comparison to the control group. This is manifested in a significant longer reaction time to food related words than to non-food related words. In a similar study conducted with people with obesity an enhanced attentional bias towards food related stimuli was found. This was manifested in longer reaction times on a food related Stroop task (Nijs, Franken & Muris, 2010).

While previous studies investigated attentional biases for food in patients with eating disorders, we want to investigate how stress can influence the attention for food in healthy people, measured by an adapted Stroop task. Consequently, the research question is: Does induced stress cause an attentional bias for food-related words on an adapted Stroop task? We hypothesize that there is a potential link between stress and attention for high caloric food. We expect to find a significant difference between the reaction times on our adapted Stroop task, in which people show how an increased reaction time for food related words after stress.

## METHODS

### Participants and Design

Forty-one sophomore psychology students of the Maastricht University participated in this study. They were recruited via e-mail, Facebook, flyers, and the university platform. At the beginning of the experiment, subjects signed a consent form for their participation in the study. Furthermore, they were informed about their privacy and the possible option to quit without consequences. A within-subjects design with a before and after stress condition was used in this study. Stress and word-category were considered as independent variables and reaction time on the Stroop task was the dependent variable. After completing participation in the research, subjects received one participation credit as compensation. Also, they were debriefed on paper immediately after participation in the research. One session took approximately 45 minutes. From the forty-two participants, one dropped out due to feeling uncomfortable.

The standing ethical committee of the faculty of Psychology and Neuroscience approved the experiment.

## Materials

### *The Stroop Task*

Beside the original Stroop test (Stroop, 1935), two versions of the Stroop test were created exclusively for this research. One of the lists contains control words that are not related to food (e.g. photo, card, boss); the other list contains words that are related to high caloric foods (e.g. chips, pizza, cake). Each Stroop task consists of 100 words. We used 25 unique words that are repeated four times. In the selection of the words for both lists frequency, length, and similarity of the words to each other has been taken into account. The neutral and food-related words were matched in terms of number of syllables, pronunciation, and the letters that comprise a word. Moreover, the Stroop task was developed in Dutch for the Dutch native speakers and in German for the German native speakers. This is done in order to create the most pronounced Stroop effect as previous studies have pointed out that people showed the greatest interference on a Stroop task in their native language (Magiste, 1984). All Stroop task performances were recorded with a voice recorder. The original Stroop task is used for practice in order to reduce the differences in skill between participants. It is possible that not all students are familiar with this test, but it is necessary that all the participants have the same level of knowledge of the Stroop task in order to create a homogeneous sample.

### *Mood*

The POMS questionnaire (Profile Of Mood States) is a standard validated psychological rating scale used to assess transient, fluctuating affective mood states (McNair et al., 1992). The original version contains 65 words or statements that describe feelings people have. Five affective states are identifiable: 1) Tension-Anxiety, 2) Vigour-Activity, 3) Depression-Dejection, 4) Fatigue-Inertia and 5) Anger-Hostility. In this study an adapted version of 30 words (e.g. panicky, energetic, sad, listless, angry) was used to measure five different moods concerning the five subscales cited above.

*Maastricht Acute Stress Test*

The MAST is an effective and well-validated laboratory stress test capable of inducing subjective, autonomic and glucocorticoid stress responses (Smeets et al., 2012). It consists of two minutes of preparation phase and ten minutes of acute stress phase that includes both physical, mental, and social stress. Physical stress is initiated by a cold pressure task (holding your hand in ice-cold water (4°C) for 45 seconds). Mental stress is triggered by the instruction to count backwards from 2043 in steps of 17. Moreover, subjects were visibly videotaped and able to see themselves on a screen to enhance the feelings of stress amongst participants. In total, the stress test lasted for 12 minutes. The preparation period served to seat participants in front of a computer screen and instruct them about the task using a PowerPoint presentation (Smeets et al., 2012). The researcher started reading the presentation. In this way, participants were informed about the hand immersion task; that they would be monitored by the experimenter as well as videotaped in order to later analyze their facial expressions; that they had to provide written consent to the videotaping; and that they had the right to withdraw at any time during the task. They were informed that there would be multiple trials in which they had to immerse their hand in ice-cold water and the computer would randomly choose the duration of these trials yet never would exceed 90 seconds. In between the hand immersion trials, they were immediately engaged in the mental arithmetic test, which consisted of counting backwards in steps of 17 starting at 2043 as fast and as accurate as possible. Each time participants made a mistake, they were given negative feedback and they had to start over at 2043. They were told to continue with the mental arithmetic until the computer would signal the start of the next hand immersion trial, which would take at least 45 seconds. According to Smeets' and colleagues protocol (2012), in reality, the duration of the various trials was set in a fixed order and duration for all participants.

## Procedure

Each participant performed the set of Stroop tasks and the POMS in a no stress condition and in a stress condition, in order to obtain a comparison between paired samples. Participants started with the POMS questionnaire (Profile Of Mood States) in order to determine their current mood state. Subsequently, the subjects performed three versions of the Stroop task. All participants started with the original Stroop task, as a means of practice. The neutral and food-related word lists were counterbalanced in order to counteract possible practice or fatigue effects. Afterwards, the recordings were analyzed regarding errors and reaction time.

Next, subjects were exposed to stress by undergoing the Maastricht Acute Stress Test. After participants finished the MAST, they filled out the POMS once more. The repetition of this questionnaire served as an indicator of mood change as a result of the stress test undergone. Participants were still in the illusion of being only in the intermission of the MAST while doing the second measurements. The Stroop tests were performed again in order to find a possible delay in reaction times because of being stressed. The research ended with informing the subjects that they did not have to perform the MAST another time and with the debriefing.

### Data analysis

A two-way repeated measures ANOVA is conducted in order to test our hypothesis. Our primary interest and expectation is an interaction between stress and word content on the reaction time of the adapted Stroop task. Differences in reaction time between the Stroop tasks before and after stress served as our dependent variable. Condition (no stress vs. stress) and word category (neutral vs. food-related) served as independent variables. There was an a priori prediction for the direction of the interaction effect, so a 0.05 level of significance has been used. We have used the POMS as a manipulation check. The POMS is divided in 5 different subscales each governing a different mood state. Total points on every subscale were compared before and after stress by a paired-sample t-test.

## RESULTS

### Main analysis reaction time

In this study, no gender or age distinction between participants was made. Reaction times on the food-related and neutral Stroop task are displayed in Table 1. A main effect of stress was found $F(1, 40) = 13.45$, $p = .000$, indicating that reaction times on colour naming after stress ($M = 65.33$, $SD = 8.73$) were generally lower than the reaction times on colour naming before stress ($M = 62.87$, $SD = 9.03$). In addition, there was a main effect of word category $F(1, 40) = 31.30$, $p = .001$, indicating that the reaction times for food related words are higher. No significant interaction between stress and word-category was found $F(1, 40) = 2.03$, $p = .655$, as can be seen in Figure 1. This suggests that the effect of stress and word content on the RTs of the adapted Stroop task are independent of each other.

Table 1
*Mean Reaction Times on Stroop Lists in Seconds*

| | M Food Words (SD) | M Neutral Words (SD) |
|---|---|---|
| Before Stress | 66.95 (9.34) | 63.71 (8.58) |
| After Stress | 64.25 (10.21) | 61.49 (8.64) |

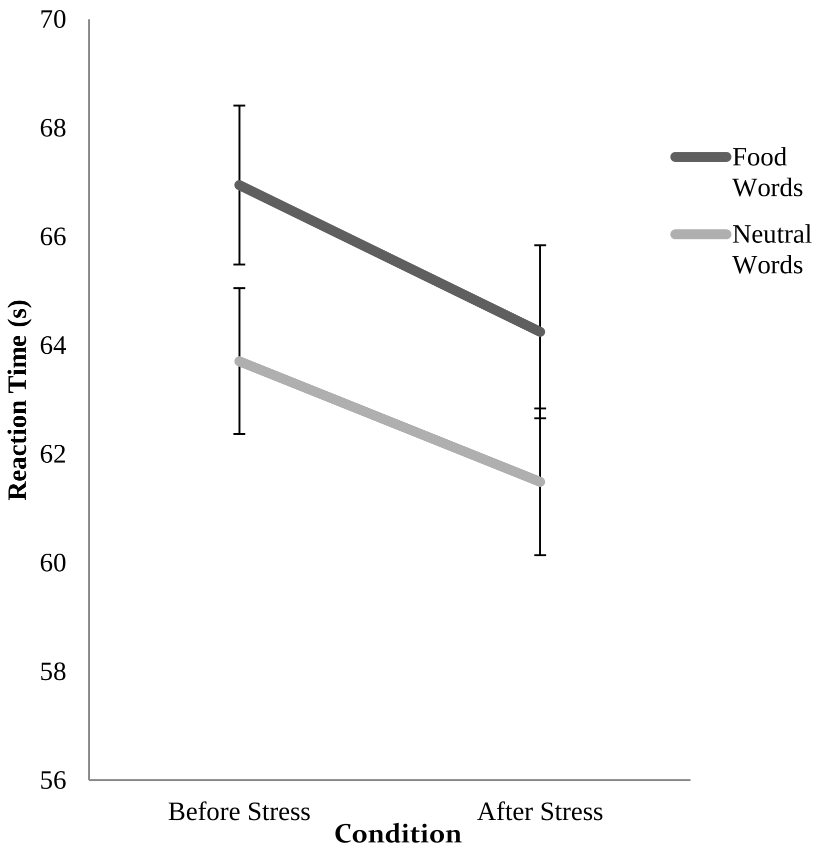


*Figure 1. Reaction Times on Stroop Lists in Seconds.*
Graphic shows mean reaction times on the two different Stroop tasks (neutral words and food-related words) before and after stress. The error bars represent the SD.

## Manipulation check on stress

A manipulation check on mood change after stress confirmed an increase in negative mood. There was an increase in all of the subscales (Table 2) except on the Vigor scale, which showed a decrease. This indicates an actual increase of stress among participants due to the MAST and it thereby served as an effective method to induce stress in subjects.

Table 2
*Negative Mood Reactivity*

| | Before Stress M | After Stress M | Paired ***t***-tests |
|---|---|---|---|
| **Anger** | 1.29 | 5.10 | $t(40)= -5.65$, $P= 0.000$ |
| **Anxiety** | 1.83 | 4.41 | $t(40)= -6.05$, $P= 0.000$ |
| **Depression** | 1.88 | 4.37 | $t(40)= -3.38$, $P= 0.002$ |
| **Vigor** | 11.20 | 8.17 | $t(40)= 4.59$, $P= 0.000$ |
| **Fatigue** | 4.44 | 6.05 | $t(40)= -2.93$, $P= 0.006$ |

Measured with POMS

## DISCUSSION

The purpose of this study was to find out what the influence of stress is on the attention for food words compared to neutral words in healthy people. Previous studies have demonstrated, by using an adapted Stroop task, that an attentional bias towards food words is present in patients with eating disorders (Ben- Tovim et al. 1988). In the current research, we intended to investigate if the same attentional bias for food-related words, in comparison to neutral words, in a Stroop task exists for healthy people after they have encountered/experienced stress. Participants performed an adapted version of the Stroop task containing food-related words and one Stroop task containing control words, before and after stress. It was hypothesized that people would show a greater attentional bias to food related cues when stressed and therefore require more time to complete the food-related Stroop list compared to the neutral word Stroop list.

In contrast to our expectations, the results showed that participants in general were faster at the Stroop task in both the food and neutral word lists after stress, in comparison to before stress. It is possible that this is effect is caused by a learning effect, by a higher level of adrenaline induced by the MAST or possibly also another unknown factor which could be very important for further investigations. Moreover, in both states, stressed and non-stressed participants turned out to be significantly slower on the food-word list in comparison to neutral-word list. One possible explanation for this effect could be that there is a general attentional bias for food-related cues. In our study, we did not find stress an influential factor in creating an attentional bias for food-related cues, perhaps because of our methodology. It could be possible that the Stroop test is not the appropriate tool to measure this attentional bias, or that the kind of stress induced by the MAST is different from daily real life stress (i.e. stress for an exam) and it only aroused the participants causing them to be faster in the Stroop Test.

We were the first to measure an attentional bias for food cues after stress in healthy people. Although we did not find the hypothesized effect, our results are relevant for the analysis of the relationship between attention and food cues.

### Further research

One shortcoming of our experiment is the sample population. All participants were selected from a similar group, i.e. healthy, second year, Western psychology students, meaning that there could be a smaller external validity to other groups of the society. Our findings suggested that stress makes people perform faster on the Stroop task, but it is not certain that stress is the factor that causes this quicker performance. It could be hypothesized that a learning effect played a role in the relation between reaction time and the Stroop task. Further research could look deeper into the relationship between stress and the attention towards food cues in order to investigate multiple influential factors.

## REFERENCES

Adam, T. C., & Epel, E. S. (2007). Stress, eating and the reward system. Physiology & Behavior, 91(4), 449-458. doi:10.1016/j.physbeh.2007.04.011.

Ben-Tovim, D.I., Kay Walker, M., Fok, D. & Yap, E. (1989). An adaptation of the Stroop test for measuring shape and food concerns in eating disorders: a quantitative measure of psychopathology? International Journal of Eating Disorders, 8 (6), 681-687.

Calabrese, P., Stöcklin, M., Penner, I., Opwis, K., Kobel, M., & Weber, P. (2012). The Stroop task: Comparison between the original paradigm and computerized versions in children and adults. The Clinical Neuropsychologist, 26(7), 1142. doi:10.1080/13854046.2012.713513.

Cox, W. M., Fadardi, J. S., & Pothos, E. M. (2006). The addiction-stroop test: Theoretical considerations and procedural recommendations. Psychological Bulletin, 132(3), 443-476. doi:10.1037/00332909.132.3.443.

Garner, D., Olmsted, M., Bohr, Y., Garfinkel, P. (1982). The eating attitudes test: Psychometric features and clinical correlates. Psychological Medicine 12, 871-878.

Greeno, C.G. & Wing, R.R. (1994). Stress-induced eating. Psychological Bulletin, 115(3), 444-464. doi:10.1037/0033-2909.115.3.444.

McNair, D.M., Lorr, M., Droppleman, L.P., (1992). EdITS Manual for the Profile of Mood States. Educational and Industrial Testing Service, San Diego, CA.

Myers, A. & Rosen, J.C. (1999). Obesity stigmatization and coping: Relation to Mental health symptoms, body image, and self-esteem. International Journal of Obesity, 23(3), 221-230. doi:10.1038/sj.ijo.080076.

Nijs, M.T.I., Franken, I.H.A. & Muris, P. (2010). Food-related stroop-interference in obese and normal-weight individuals: Behavioral and electrophysiological indices. Eating Behaviors, 11 (4), 258-265.

Oliver, G., Wardle, J. & Gibson, E.L. (2000). Stress and food choice: a laboratory study. Psychosomatic Medicine 82, 853-865.

Schmitz, F., Naumann, E., Trentowska, M., & Svaldi, J. (2014). Attentional bias for food cues in binge eating disorder. Appetite, 80, 70-80. doi:10.1016/j.appet.2014.04.023

Smeets, T., Cornelisse, S., Quaedflieg, C. W., Meyer, T., Jelicic, M., & Merckelbach, H. (2012). Introducing the Maastricht Acute Stress Test (MAST): A quick and non-invasive approach to elicit robust autonomic and glucocorticoid stress responses. Psychoneuroendocrinology, 37(12), 1998-2008.

Stroop, J. R. (1935). Studies of interference in serial verbal reactions. Journal of experimental psychology, 18(6), 643.

Torres, S. J., & Nowson, C. A. (2007). Relationship between stress, eating behavior, and obesity. Nutrition, 23(11), 887-894. doi:10.1016/j.nut.2007.08.008.

Wardle, J., Steptoe, A., Oliver, G., & Lipsey, Z. (2000). Stress, dietary restraint and food intake. Journal of Psychosomatic Research, 48(2), 195-202. doi:10.1016/S0022-3999(00)00076-3.

Weinstein, S. E., Shide, D. J., & Rolls, B. J. (1997). Changes in food intake in response to stress in men and women: Psychological factors. Appetite, 28(1), 7-18. doi:10.1006/appe.1996.0056.

Wentura, D., Bermeitinger, C., Englert, J., & Frings, C. (2009). Decomposing the emotional Stroop effect. The Quarterly Journal of Experimental Psychology, 63(1), 42-49. doi:10.1080/17470210903156594.

Werthmann, J. (2015). Food through the Child's eye: An eye-tracking study on attentional bias for food in healthy-weight children and children with obesity. Health Psychology, 1 (1), 1930-7810. doi:10.1037/hea0000225.

WHO Regional Office for Europe (2015). Obesity. Retrieved June 6, 2015 from: http://www.euro.who.int/en/health-topics/noncommunicable-diseases/obesity/obesity.

## ACKNOWLEDGEMENTS

We would like to thank the second year psychology students from the University of Maastricht for their participation in our study. Even if they had to endure some pain during the experiment, they did a great job and most of them continued with testing. Furthermore, we want to thank Jan Schepers for taking the time to explain us all the relevant topics of the statistics part. We appreciate the enthusiasm of Henry Otgaar during the course and we are grateful for making this chaotic course work. Last but not least, we would like to thank our tutor, who gave us good advice and the right directions, who did never let us down and who was as excited as we were about this research practical.