Does perceptive hunger influence food bias?

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Abstract

Food is essential for our survival, thus, to ensure our survival the body has developed a mechanism, hunger. Hunger is a sensation which induces an urge for food, by increasing attention towards food-related stimuli. Previous studies suggest that hunger affects our cognition by creating an attentional bias in memory toward food-related words and pictures. This study aimed to investigate the impact of one's perceived hunger levels on memory bias towards food-stimuli words. We hypothesized that participants with higher levels of perceived hunger would show a greater recall for food-stimuli words. Our findings showed there was no correlation between one's perceived levels of hunger and recall of for food-stimuli words. These results could be attributed to the different limitations we encountered in our study. However, it enables one to think of attentional bias to food related stimuli as a result of individual differences such as eating habits, motivational state etc. Thus, findings related to hunger effect on recall of food-stimuli words may exists, however, the effect may not be strong to generalize to all individuals.

Introduction

Living organisms require a source of energy in the form of nutrients to be able to survive and create offspring. As humans, this source of energy comes in the form of food; the body extracts these nutrients through the process of digestion which is used to carry out different functions necessary for our survival, well-being, and daily function.

To ensure our survival, the body developed a necessary sensation known as hunger. Primarily, hunger serves as a biologically induced urge for food vital for life (Beaulieu & Blundell, 2020). Therefore, hunger can be viewed as a biological trait of humans that is quantifiable, and used to predict the propensity to eat and the amount of food consumed (Stubbs et al., 2000). Rather than being a necessary condition for eating, hunger is a strong risk factor. In other words, in the state of hunger, people are more prone to eat (Beaulieu & Blundell, 2020).

Evolutionary, the innate mechanism, hunger, has developed to address the critical adaptive problem of food acquisition. To solve this problem, there is an increase in the likelihood of the reordering of a person's motivational priorities; the importance of acquiring food becomes more eminent and other concerns such as mating opportunities, pathogen avoidance, and status enhancement are momentarily reduced. This mechanism is dependent on the intensity of hunger the organism is facing in respect to other immediate and important adaptive problems (Al-Shawaf, 2016).

This food-based perspective shift influences cognitive processes such as, attention, problem-solving, categorization, memory etc., by making food-related stimuli more prevalent when the individual is in the state of hunger (Al-Shawaf, 2016). This may be caused by hunger-sates hormones, such as orexin, which may increase arousal to maintain a vigilant state towards food acquisition (Sakuria, 2014). Previous research shows in a fasted state, orexin released activates the locus coerulus – noradrenergic system which impacts arousal levels and modulates cognition (Soya et al., 2017). Likewise, in the amygdala and orbitofrontal cortex, food-related neural activity is influenced on one's state of hunger; responses towards food during fasting are reduced after satiation (Rolls et al., 1989). This finding demonstrate that amygdala and orbitofrontal responses reflect the biological or motivating importance of food stimuli rather than just the sensory characteristics of certain foods (Rolls, 2000). A study carried out by Morris & Dolan (2001), investigated regional cerebral blood flow (rCBF) in participants while completing a memory recognition task involving food and non-food items, using positron emission topography. Results showed a positive covariance with rCBF in the left amygdala and memory recognition for food items, and a positive covariance with rCBF in the right posterior orbitofrontal cortex and hunger ratings during presentation of food items. These findings suggest that the human brain's ability to integrate perceptual (food), motivational (hunger), and cognitive (memory) processes is mediated by the amygdala and specific regions of the orbitofrontal cortex (Morris & Dolan, 2001).

Aforementioned studies, show the impact of biological process on memory in the state of hunger. In the same vein, a study by Mogg et al. (1998) investigated the effect of hunger on selective attention to food stimuli through the use of a dot probe task. Hungrier participants displayed a greater attentional bias for food-related words that were shown for 500msec, compared to participants with lower levels of hunger. Evidence from this result suggests an association between hunger and selective attention towards stimuli pertinent to the motivational state of an individual. Similarly, other studies have shown that in the state of hunger, individual's perception to food cues were heightened; presence of food stimuli captured hungry participants' attention more and decreased their ability to detect the target.

Previous research shows that hunger or a fasted state, affects one's cognition process by making them biased to food-related stimuli. Thus, this study investigated the impact of people's subjective hunger on memory towards food-stimuli words. This led to our hypothesis: participants with higher perceived level of hunger would remember food-related words compared to non-related food words, thus show a greater degree of food-bias.

Method

Participants

The participants involved in this study (women= 81, men=19.4) were volunteers from Marist college and different social media platforms obtained by convenience sampling(n=). The age of participants ranged from 18-28 (*M*= 19.8, *SD*= 1.91), and consisted of 71.6% White (n=68), 17.9% African-American (n=17), 1.1% Asian (n=1), 5.3% other (n=5), 4.2% preferred not to say (n=4). Three participants picked multiple races. Participants had to be over the age of 18 and agree to the informed consent to partake in the study.

To reduce ceiling and floor effects, participants with one word recall (n=5) and participants with 19-word recall (n=1), were eliminated from the data sat.

Materials

Food-stimuli and non-food stimuli words

The words we used in this study were adopted from the appendix of a study by Tarrega et al. (2021). In the study, the words were controlled for various factors such as the influence of lexical/sublexical factors. For our study, we selected 12 positive valence, non-food related words and 8 positive, food-related words (refer to appendix). These original words were in Spanish, and were translated to English using Bing translate. Positive valence words were chosen to control for possible arousal effect of words.

Filler questions

A filler task was incorporated in the study to reduce contextual effects that may influence word recall such as primacy or recency effects. Participants were asked demographic questions pertaining to age, race, and gender. Participants who identified as college students were asked questions pertaining to their majors, credits, and hours spent studying, while participants who identified as non-college students were asked questions pertaining to their job and hours spent working. Perceived stress was also measured as part of the filler question using the 10-item perceived stress scale (Cohen & Williamson, 1998). Participants were asked 8 questions from the scale such as “in the last month, how often have you been upset because of something that happened unexpectedly?” and “in the last month, how often have you felt things were not going your way?”

Perceived hunger

Perceived hunger of participants was measured using a scale based off the Hunger Scale (Grand, 1968). Participants were asked to “report the number of hours since last full meal” and to rate their subjective on a 7-point scale ((1) not hungry and all to extremely hungry (7). Responses were used to assess and infer participants level of hunger. Other items included, “Report an estimate of the amount of YOUR favorite food that you would be able to eat in this moment from 1-6 (1- none at all, 6 - as much as I could get)” and “report the estimated amount of time until you expect your next meal.”

Procedure

An anonymous form on Qualtrics was sent out via email and posted on social media platforms (snapchat and Instagram), to reach potential participants. To partake in the study and use the data, participants had to be at least 18 years in age, and agree to the consent form which informed them of the right to withdraw at any time, the purpose of the study, and possible risks. In the survey, participants were shown the food stimuli and non-food stimuli words for a minute. After, they filled out filler task questions, type of the words they recalled, and answered the perceived hunger questions, as listed above.

A pilot study was run initially with participants who were students of the biopsychology class, to ensure the filler question was not too long/hard. The results showed no floor or ceiling effects, and a variance of food-recall words, thus no changes were made to the survey. The results obtained were included in the data set.

Results

Of the 98 participants involved, participants who did not report subjective feeling of hunger and hours before last meal, were not involved in the analysis carried out by Jamovi.

To run a correlation between food-bias words recall and perceived hunger, the food-bias ratio was calculated. The number of correct of food words were divided by the total number of food words, and the number of non-food words were divided by the total number of non-food words. The value obtained for the food words was divided by the value obtained for the non-food words to obtain the food-bias words ratio; the higher the ratio, the more food words recalled.

The results from the Pearson's correlation showed there was no significant relationship between subjective hunger (M=2.88, SD=1.46) and food-bias word ratio (M=0.390, SD=0.199), r=0.07, p=0.49, and subjective hunger and hours since last meal (M=5.93, SD=6.52), r=-0.16, *p*=0.13. Also, there was no significant relationship between subjective hunger and recall of correct words (*M*=7.56, *SD*=2.98), *r*=0.006, *p*=0.950.

Discussion

From our results, the results show there was no relationship between one's perceived level of hunger and food-biased word recall.

Our findings go against literature are in support of hunger making one attune to food-related stimuli (Al-Shawaf, 2016; Sakuria, 2014), which affects one cognition by increasing memory and response towards food-related stimuli (Al-Shawaf, 2016; Rolls et al., 1989). This disparity in results could be attributed to the choice of stimuli we used in our study.

To investigate the hunger mechanism on bias to food stimuli previous studies incorporated visual stimuli (Tapper et al., 2010), which could be because visual stimuli (images) are remembered and processed better than word stimuli (Grady et al., 1998). Evolutionary, remembering various features of one's visual environment was essential for survival which could possibly explain why memory for visual information is especially developed (Grady et al., 1998). Therefore, there is a plausibility that the hunger mechanism, which increases bias to food-stimuli might be activated faster in visual stimuli compared to food stimuli. Conversely, a study carried out Freijy et al (2014), showed that there was no significant difference in attentional bias between pictorial or word stimuli, however, there was attentional bias towards high calorie food pictures and low-calorie words. In our study, most of the food-stimuli words were high-calorie words and that could have influenced participants to recall a lower number of food-stimuli words due to lack of attentional bias towards high-calorie food-stimuli words.

More general motivational states such as one interests and hobbies (Mogg et al.,1997), overlearned and meaningful words (Mack & Rock, 1998), have been found to successful influence inattentional blindness. The non-food stimuli words used may have had a theme which were meaningful or overlearned to the participants, hence, acting as a motivator for participants to remember more non-food stimuli words.

Apart from hunger, individual differences towards food may also play a role in attentional bias towards food stimuli. The incentive-sensitization model (Robinson & Berridge, 1993), suggest that substance related stimuli become salient with repeated association with a reward; thus, overweight children process food-words faster than non-food words compared to non-overweight children. Similarly, research on individuals with eating disorders, anorexia and bulimia nervosa, show selective interference in color-naming food and eating related words (Channon et al., 1988, Cooper et al, 1992), which implies slower cognitive processing of food-related stimuli. It is possible to infer that one's eating habit influences their processing of food-related stimuli, however, since we did not ask participants about eating habits it is impossible to measure the effect this could have had on the result.

Different studies mentioned previously, have shown that hunger influences selective attention, and improves memory for food related stimuli, however our study and a study by Redlcih et al (2021) which focused on if hunger promotes the detection of food saw no hunger effect. This suggest that hunger may influence attentional selection towards food-stimuli, however this effect might not always be strong enough to be found in every paradigm.

Limitations and conclusion

Limitations of this study could have resulted due to individual differences, subjective nature of the task, and the ease of the study. Participants were not asked about their eating habits, which could have influenced their memory bias towards food-related words and normal words in general. Participants were asked to self-report levels of hunger; hence, hunger was not controlled. It is possible participants rated higher or lower levels of hunger than actual. An experimental method to control hunger would have reduced the possibility of the Hawthorne effect. The filler task was also quite short; thus, it is possible the time require for the degradation of memory words necessary to initiate food-bias memory was not long enough.

In this study, we found that there was no relationship between perceived hunger and memory bias to food words. This does not suggest that the hunger effect on attentional bias towards food-related stimuli does not exist, rather, it shows that it cannot be easily generalized to all individuals. Today, many factors such as one's culture, eating habits, motivations, etc., may influence one's cognitive processing of food. It is possible that with the advancement of food production and preservation, we are not as reliant on this hunger mechanism as our ancestors were to survive. Thus, it is easier for other non-biological factors to affect one's attention towards non-food stimuli even when one might be hungry. Future research should examine in-depth the influence of individual cognitive, emotional, and cultural factors, motivational states on attention bias to food-related stimuli. They should also take into account that one's eating habits (eating disorders) may influence their processing of food-related stimuli, which may affect bias towards these stimuli.

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