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Cognitive Distraction at Mealtime Decreases Amount Consumed in Healthy Young Adults: A Randomized Crossover Exploratory Study

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ABSTRACT

Background: Environmental distractions have been shown to affect eating patterns.

Objective: The purpose of this study was to determine the effects of a cognitive distraction on amount, preference, and memory of food consumed and perceptions of fullness, hunger, and enjoyment of food in a healthy young-adult population.

Methods: A randomized controlled crossover study of 119 healthy adults (20.2 ± 1.4 y; 57% women; 48% white) assigned participants to begin under either the distracted (DIS, $n = 55$) or control (CON, $n = 64$) conditions. DIS participants consumed a meal of quiche while completing a Rapid Visual Information Processing (RVIP) for 15 min. CON participants ate without any task assignment. After a 30-min rest period, participants were offered a snack and given 5 min to eat ad libitum. Participants completed a survey assessing fullness, hunger, and enjoyment of the meal using 100 mm visual analogue scales. One week later, participants completed the opposite condition. Data were analyzed using ANOVA.

Results: Those in DIS consumed 13 g less of the meal ($P < 0.001$), even when comparing by initial condition ($P < 0.001$) and adjusting for sex ($P < 0.001$). A carryover effect of initial condition was found ($P < 0.001$), such that participants first assigned to DIS condition consumed less (95.2 ± 61.7 g) when distracted compared to all other condition combinations (127–133 g). Those in DIS had decreased accuracy for both memory of quiche received (absolute difference, 1.1 ± 1.6 compared with 0.7 ± 1.2 for CON, $P < 0.001$) and memory of quiche consumed (0.8 ± 1.1 for DIS compared with 0.7 ± 1.2 for CON, $P = 0.007$).

Conclusions: When distracted, healthy young adults consumed significantly less food and their memory of the meal was dampened. These findings underscore the potential importance of cognitive distraction in affecting food intake. This trial was registered at clinicaltrials.gov as NCT04078607. *J Nutr* 2020;150:1324–1329.

Keywords: distraction, eating behavior, fullness, hunger, ingestive behavior, rapid visual information processing

Introduction

Influences of food environments on consumption patterns and not simply food choices are becoming increasingly clear for their contributions to energy intake. When, where, and with whom a meal is consumed has been shown to affect what an individual chooses to eat (1). Of particular interest is the presence of distraction. It has been postulated that when distracted, individuals are inclined to consume more than when not distracted (2, 3).

Memory of previous meals plays an important role in the regulation of food intake (4–7). The premise for this notion was established in work done with amnesic patients (8). It was discovered that patients with an inability to recall their previous meal were more likely to request or even consume a second meal. Similar patterns of behavior have been observed in individuals without amnesia, although to a lesser extent. Those who focus intently on their meal have better memory of it and consume less food at future eating occasions (6). What is less well known, however, is how distraction and memory impact subsequent food choice and preference. For example, it has not yet been determined what an individual who has previously consumed a meal while distracted will choose when presented

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Abbreviations used: CON, control group; DIS, distracted group; RVIP, Rapid Visual Information Processing.

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with snack foods that are perceived as either "healthy" or "unhealthy."

Hormonal regulation of food intake via ghrelin, glucagon-like-peptide 1, and peptide YY is well established (9–11). However, taste and enjoyment are repeatedly identified as primary mediators in determining food choices (12). These hedonic factors are important in understanding how and why individuals ignore hormonal regulation of satiety and hunger when making food intake decisions. It is commonly accepted that hormonal cues can be overridden by hedonic influences such as taste, smell, and sight (13). For this reason, perceptions of the feelings of hunger and fullness and how external factors, such as distraction, may affect an individual's food consumption are notable areas of interest for the present study.

A variety of methods have been employed to induce distraction during an eating episode, including watching television, social interactions, and audio clips (2, 14–16). Computer games have been commonly used (3, 11, 12). The challenge posed with use of a standard game is the inability to assess whether the individual was truly distracted. Mitchell and Brunstrom (3) used the Rapid Visual Information Processing (RVIP) task, a previously validated measure of sustained attention, during mealtimes (3, 17, 18).

The present study aimed to assess the effects of a cognitive distraction on the amount of food consumed, food preference, and perceptions of fullness, hunger, and enjoyment. It was hypothesized that when distracted an individual would consume more than when he or she was not distracted. Further, it was hypothesized that those who had been distracted would have poorer memory of the meal and greater consumption of an unhealthy snack option at a future eating occasion. It was expected that those who had been distracted would self-report greater feelings of hunger, lesser feelings of fullness, and lower ratings of meal enjoyment. This study implemented a randomized controlled crossover design to determine within-person effects of distraction on food consumption.

Methods

Participants

Individuals were recruited between the months of January and April 2017 from a large, Midwestern college community via campus listservs, flyers in campus buildings, social media, and word of mouth. Exclusion criteria included adhering to any dietary restrictions or diets (i.e., vegan, vegetarian, kosher, etc.), having any food allergies, and/or having any chronic or metabolic diseases (i.e., diabetes, polycystic ovary syndrome, irritable bowel syndrome, etc.). All participants were able to read and speak English and willing to consume foods provided during the study. Participants were not informed of the actual aim of the study to prevent behavior modification by participants, and instead, were told that the study was about the relation between breakfast consumption and appetite. Participants were compensated $45 for their time. The protocol was approved by the Institutional Review Board at the University of Illinois at Urbana-Champaign (IRB #17230) (clinicaltrials.gov identifier: NCT04078607).

Scheduling

Participants selected appointment times using an online scheduling system. All participants were scheduled for 2 testing sessions with a 1-wk washout period in between. Participants selected 1 of 2 time slots (08:00 or 09:30) for a session lasting 1.5 h. Sessions were at the same time and day of the week. Participants experienced the distracted condition at 1 session and the control condition at the other. Investigators used computer-generated random assignments to determine which condition was experienced first.

Procedures

All participants were tested between the hours of 08:00 and 11:00. Before arriving, participants were instructed to fast for 10 h before their appointment time, to get 8 h of sleep the night before, and to not engage in strenuous physical activity for 48 h before their scheduled session. Upon arrival at the food sensory laboratory, participants were required to store reading materials, homework, mobile phones, and any other technology devices or materials, such that these were not accessible for use during the entire testing session.

For the distracted (DIS) condition, each participant was taken to a private booth containing a computer equipped with the modified RVIP task and printed instructions. A plate of 10 miniature spinach and cheese quiche (AppetizersUSA) was brought to them. Participants were instructed to eat as much as they liked in both conditions. All quiche were counted and weighed before service. For the task, a series of numbers appeared on the computer screen at a rate of 1/s. The participant was required to identify any series of 3 consecutive odd or even numbers by hitting the space bar on the keyboard. The task lasted 15 min and included a 1-min practice session before the food being served. After completion of the RVIP task, the food plate was removed, and the remaining quiche were weighed and counted.

The control (CON) condition mimicked the DIS condition in every way except that the RVIP task was omitted. When a participant arrived, he or she was taken to a private booth and was served a plate of 10 spinach and cheese quiche and allowed to eat for 15 min. All quiche were counted and weighed before service. At the end of the 15-min period, the plate was removed, and the remaining quiche were counted and weighed.

After the 15-min DIS or CON condition, participants were escorted to a secondary location where they rested for 30 min. They were provided with water and a variety of number and word games. They were free to talk with other participants, stretch, and use the restroom. Personal items or materials (e.g., mobile phones, books, homework, etc.) not provided by the investigators were not allowed to be used during the resting period. Investigators remained in the room to monitor participants and redirect any conversation about the purpose of the study.

After the 30-min waiting time, participants were escorted back to a private booth where a snack had been laid out. The snack consisted of 30 g of miniature chocolate chip cookies (Famous Amos, Kellogg's Co.) and 50 g of green grapes (local grocery). Participants were instructed to help themselves to the food provided, if they wished, while they waited for an exit survey to be administered. Participants were given 5 min with the food before it was removed and the survey was given. All food items were weighed before and after service to quantify consumption.

Participants were given an investigator designed exit survey and asked to recall how many miniature quiche they had been given and how many they had consumed during the mealtime. Only numeric answers were accepted. The exit survey contained a series of 100 mm visual analogue scales that assessed feelings of fullness, hunger, and enjoyment. Questions included: "How full do you feel right now?" "How hungry do you feel right now?" and "How much did you enjoy the meal provided?" The scale ranged from "Not at all" at the minimum to "Very much" at the maximum. Participants were instructed to mark the line with a single dash to indicate their response. The survey included a question asking participants to confirm whether they complied with all pretest instructions. Any participant who indicated noncompliance was removed from analyses. The questionnaire also included items pertaining to beliefs about breakfast consumption for consistency with the pretext of the study.

After the second testing session, trained investigators measured blood pressure (mmHg) using a digital blood pressure monitor (seated systolic and diastolic, Baumanometer® Desk Model), height (cm) using a stadiometer (Seca 700), and body weight (kg) and body fat percentage (%) using a bioelectrical impedance scale (Tanita 410GS). An investigator calculated BMI (kg/m^2) for each participant using

TABLE 1 Characteristics of 119 healthy young adults (aged 18–25 y) at baseline, randomly assigned to initial condition of distracted eating or nondistracted (control) eating[1]

Characteristics	All participants ($n = 119$)	Initial DIS[2] ($n = 55$)	Initial CON[2] ($n = 64$)
Age, y	20.2 ± 1.4	20.2 ± 1.5	20.3 ± 1.3
Sex, women, %	57.5	58.0	57.0
Race, %			
White	47.5	47.3	47.7
Asian	45.0	49.1	41.5
Black	0.8	0.0	1.5
Other	6.7	3.6	9.3
Ethnicity, %			
Hispanic or Latino/a	5.0	3.6	6.2
Non-Hispanic	95.0	96.4	93.8
Regular physical activity, yes, %	74.0	71.0	77.0
Height, cm	169 ± 10	169 ± 9	169 ± 10
Weight, kg	66.4 ± 14.1	66.4 ± 13.7	66.9 ± 15.3
BMI, kg/m^2	23.0 ± 3.8	23.1 ± 4.2	23.3 ± 4.2
Body fat, %	21.6	22.0	21.2
Blood pressure, mmHg			
Systolic	120 ± 16	120 ± 15	120 ± 17
Diastolic	69 ± 10	69 ± 10	68 ± 10
RVIP accuracy, score[3]	81.3 ± 14.4	81.4 ± 13.5	81.1 ± 15.2
Regular breakfast eater, 4+ d/wk, %	50.4	47.4	53.1

[1] Includes participants randomly assigned first to DIS or CON condition and later crossed over to opposite condition. Values given in means ± SDs or %. CON, control condition; DIS, distracted condition; RVIP, Rapid Visual Information Processing.
[2] Comparisons between DIS and CON condition by *t* tests, chi-square, 1-factor ANOVA were all nonsignificant, $P > 0.05$.
[3] Highest possible score = 100.

measured body weight and height. At the conclusion of the study, all participants were contacted via electronic mail and informed of the true aim of the investigation.

Statistical analyses

A sample size of $n = 119$ with 55 in the DIS group and 64 in the CON group with a power of 80% and an α of 0.05 (2-sided) leads to the ability to detect a small difference in means of 0.23 SD units, which is conservative as it is based on period 1 of the crossover study. Data were analyzed using the Statistical Package for the Social Sciences (SPSS; version 23.0.0, 2015, IBM Corp.). Significance was set at $P < 0.05$. Descriptive statistics (means ± SDs) were calculated for all variables by condition. A series of *t* tests, chi-square, and a 1-factor ANOVA were conducted to determine differences in self-reported age (y), sex (men/women), race (white/Asian/black/other), ethnicity (Hispanic or Latino/a/non-Hispanic), and physical activity habits (yes/no), as well as measured height, weight, body fat percentage, and blood pressure and estimated BMI. A 2-group ANOVA was conducted to assess amount of quiche consumed between DIS and CON groups. A 4-group ANOVA, including initial condition groups, was used to assess amount of quiche consumed, snack intake and preference, memory, fullness, hunger, and enjoyment (19). Effect size (Cohen's *d*) was calculated, with small, moderate, and large effects represented as 0.20, 0.50, and 0.80, respectively (20).

Results

Participant characteristics

One-hundred and nineteen (50 men, 69 women) young-adult participants were included in data analyses (Table 1). There were no significant differences in characteristics between those who were randomly assigned first to DIS ($n = 55$) and those assigned first to the CON ($n = 64$) condition (all $P > 0.46$). A total of 196 individuals was initially enrolled in the study; 77 were lost to attrition ($n = 42$, nonresponse; $n = 24$, did not attend the first session; $n = 10$, did not return for the second session; 1 removed because of noncompliance with study protocol).

Intake

In the DIS condition, participants ($n = 119$) consumed an average of 115 ± 60 g of quiche (Table 2). Participants ($n = 119$) consumed more in the CON condition with an average intake of 128 ± 49 g of quiche. A 2-group ANOVA indicated that this was statistically significantly different, suggesting that individuals consumed less when distracted.

Intake including initial condition

To determine if effects observed in the 2-group ANOVA were a result of any factors other than the presence of distraction, a 4-group ANOVA was conducted that included initial condition, either DIS or CON. A carryover effect of initial condition was found ($P < 0.001$), such that participants whose initial condition was DIS consumed significantly less quiche in the DIS condition compared to all other condition combinations (Table 2).

Intake by sex

Differences in intake by sex were assessed in a similar manner. Using a 4-group ANOVA, adjusting for sex, difference in intake remained statistically significant ($P < 0.001$), with those in DIS consuming less quiche than those in CON, but there was no significant interaction of sex ($P = 0.181$). Both women and men who were first randomly assigned to DIS consumed less quiche during the DIS condition compared to all other condition combinations.

TABLE 2 Intake of food, memory of quiche, and satiety measurements by distracted eating condition compared to nondistracted (control) condition in healthy young adults (aged 18–25 y)[1]

Measures	DIS ($n = 119$)	CON ($n = 119$)	Observed ranges	P value[2]	Effect size[2]	DIS Initial DIS ($n = 55$)[3]	CON Initial CON ($n = 64$)	DIS Initial CON ($n = 64$)	CON Initial DIS ($n = 55$)
Quiche intake, g	115 ± 60	128 ± 49	0–223	<0.001	0.231	95.2 ± 61.7[a]	129 ± 51.3[b]	133 ± 53.0[b]	127 ± 45.4[b]
Grape intake, g	47.3 ± 9.2	43.8 ± 12.5	0.0–53.0	0.245	0.038	46.7 ± 9.98	44.0 ± 11.9	47.8 ± 8.51	43.5 ± 13.3
Cookie intake, g	19.7 ± 12.6	18.2 ± 12.1	0.0–33.0	0.156	0.121	21.0 ± 12.3	19.6 ± 12.2	19.0 ± 12.7	17.2 ± 11.9
Proportion of grape intake, %	94.0 ± 18.1	87.1 ± 25.0	0.0–100	0.204	0.279	93.2 ± 19.7	87.7 ± 23.8	94.8 ± 16.6	86.5 ± 26.4
Proportion of cookie intake, %	65.0 ± 41.6	60.7 ± 40.4	0.0–100	0.197	0.103	69.1 ± 40.4	64.0 ± 40.4	61.9 ± 42.1	57.4 ± 39.6
Quiche received memory, abs[4]	1.1 ± 1.6	0.7 ± 1.2	0.0–6.0	<0.001	0.286	1.7 ± 1.9[a]	0.8 ± 1.1[b]	0.5 ± 1.3[b]	0.5 ± 1.4[b]
Quiche consumed memory, abs[4]	0.8 ± 1.1	0.7 ± 1.2	0.0–8.0	0.007	0.045	1.0 ± 1.4[a]	0.6 ± 0.9[b]	0.6 ± 1.4[b]	0.6 ± 1.1[b]
Fullness, mm	59.7 ± 18.9	64.0 ± 17.6	9.0–100	0.440	0.235	55.0 ± 19.9	62.4 ± 15.0	63.7 ± 17.1	65.8 ± 19.9
Hunger, mm	28.5 ± 21.6	24.0 ± 14.9	0.0–91.0	0.273	0.242	27.9 ± 21.8	25.7 ± 15.9	29.6 ± 21.4	22.0 ± 13.4
Enjoyment, mm	63.8 ± 23.0	67.5 ± 20.7	0.0–100	0.103	0.169	58.0 ± 22.0	72.0 ± 19.7	68.2 ± 23.4	62.4 ± 20.7
Proportion consuming 100% of all food offered, %	20.2	14.3				16.4	16.4	23.4	12.5

[1] Values given in means ± SDs or %. abs, absolute difference; CON, control condition; DIS, distracted condition.

[2] P values for comparisons between DIS and CON groups by 2-group ANOVA. Effect size (Cohen's d) with 0.20 = small, 0.50 = moderate, 0.80 = large effects.

[3] P values for comparisons between DIS initially in DIS condition, CON initially in CON condition, DIS initially in CON condition, and CON initially in DIS condition by 4-group ANOVA. Labeled means without a common letter differ by $P < 0.001$; all other comparisons without letters are nonsignificant ($P > 0.05$).

[4] Results shown in absolute difference (quiche received = 10 minus number reported by participant; quiche consumed = 10 minus the number reported by participant) of units of quiche.

Snack intake

On average, participants ($n = 119$) consumed 45.5 ± 11.1 g of grapes and 18.9 ± 12.4 g of cookies. A series of 4-group ANOVAs were conducted, including initial testing condition and adjusting for intake at the earlier mealtime. No significant differences in grape or cookie consumption were observed among groups (Table 2).

Snack preference

To assess snack preference, a 4-group ANOVA, including initial condition and adjusting for intake at the earlier mealtime, was conducted to compare the proportion of each snack that was consumed relative to what was offered. No significant difference in the proportions of grapes or cookies consumed among groups were detected (Table 2).

Memory

To assess participant memory of the meal consumed, 2-group and 4-group ANOVAs were conducted using the absolute difference of the discrepancy between actual and reported for both the number of quiche received and the number of quiche consumed. These analyses revealed a significant difference between DIS and CON groups for memory of quiche received and memory of quiche consumed, with those in CON having more accurate recall for both quiche received and consumed (Table 2). A carryover effect of initial condition was found, such that participants whose initial condition was DIS had significantly less accurate recall for quiche received ($P < 0.001$) and quiche consumed ($P < 0.001$) in the DIS condition compared to all other condition combinations (Table 2).

Fullness, hunger, and enjoyment

Responses were analyzed using a 4-group ANOVA, including initial condition and the amount of quiche, cookies, and grapes consumed. No statistically significant differences were observed among groups for fullness, hunger, or enjoyment (Table 2).

Discussion

The present study aimed to examine the ways in which the presence of a cognitive distraction at mealtime affected selected components of an individual's eating behaviors. Of particular interest was its effect on the amount consumed during the distracted period. Additional analyses were conducted to examine what, if any, effect consuming a meal while distracted had on later consumption. In addition, the effect of distraction at mealtime on an individual's perceptions of fullness, hunger, and enjoyment of the meal consumed was measured to examine the cognitive impact of eating environment.

Results were surprising, and in some cases contrary to findings previously reported (2, 3). When distracted, individuals consumed significantly less than when they were not distracted. This effect was not mitigated by the participants' initial condition or sex; however, when stratified by initial condition an interesting pattern emerged. Those who experienced the DIS condition first ate significantly less than any other group when distracted. This result was not observed, however, in those who experienced the CON condition first. This suggests that there may be a potent carryover effect between the mechanism of distraction and the novelty of the food served.

It is possible that the presence of distraction during the first encounter with the quiche prevented participants from familiarizing themselves with the food. One strength of the

study is the high level of engagement with the distraction indicated by participant scores on the RVIP. The combination of a novel food item and an engaging, task-oriented method of distraction resulted in lesser consumption. When participants starting with DIS condition received the same food during the CON condition, they behaved as if they were encountering the food for the first time as evidenced by a rate of consumption similar to that of those who began in the CON condition. Conversely, those who began in the CON condition had the opportunity to familiarize themselves with the food during their initial session. When they were distracted during their second session, they ate more of the food provided, potentially because they had already developed some habituation with the quiche and did not perceive it as new.

The discrepancy between this observation and previous published reports also calls into question how "distracted eating" is measured and defined. It appears that the influence of distraction is different based on what type of distraction is used. The present study used the RVIP task, because it is a validated measure of sustained attention and therefore a dependable tool for ensuring a cognitive distraction was induced. Differences in methods of distraction across studies may produce a variety of responses within the brain. The purpose of this study was not to assess neurological impacts of distraction; however, it was possible that these methods resulted in different cognitive responses. Additional research is needed to determine whether the various methods of distraction used produce the same results.

Results from the current study suggest a difference between "distracted" and "mindless." The current literature often uses these terms interchangeably (2, 6, 11, 12). Regarding findings presented here, there is a case to be made for differentiation of these 2 terms. In both scenarios, an individual must be engaged in an activity to the extent that the meal they are consuming becomes secondary. To be considered a distracted eating episode, however, there must be a conscious decision to consume the meal, but when the actual consumption begins, the individual's attention is actively diverted. In a mindless eating episode, an individual does not make a deliberate choice to begin eating. One may consume food because it is presented to them or it is already available in the environment. Individuals eat without intending to do so. Future investigations should keep this distinction in mind when assessing these phenomena, as keeping these constructs separate will be necessary to determine the unique and specific impacts they have on consumption.

Similar to previous investigations, the present study found a decrease in meal memory after participants consumed a meal in the DIS condition (4–7). This decrease in memory did not, however, result in an increase in snack consumption as was previously hypothesized. This may be a product of how memory was measured in the study. The same questions regarding memory of the meal were asked at each testing session. This may have resulted in a carryover effect between the 2 sessions. In addition, a longer rest period may have resulted in greater variation in recall accuracy. Previous studies have examined the effect of memory loss on food intake [e.g., (8)]; however, it is likely that inaccuracy of recall in a young, healthy population may be a different phenomenon. In the present study, factors such as amount consumed at a previous meal may have had a much greater effect on how much an individual chose to consume at a future eating episode than memory.

The influence of distraction at mealtime on food preferences at a future eating episode was a novel assessment. The present study detected no difference in food preferences at a later eating occasion between the DIS and CON conditions. For the purposes of this study, food preference refers to food items that are generally perceived to be "healthy" or "unhealthy." In this instance, grapes and miniature chocolate chip cookies were used. Additional research is needed to confirm these findings as well as expand on this topic area. Future investigators may want to consider other variations in food preference, such as sweet and savory. This question could also be expanded to include food preferences during the distracted meal. The present study provided only 1 type of food during mealtime. Future studies should include a variety of foods and assess effects of distraction during mealtime.

Although the present study offers a novel insight, it is far from conclusive. The study design did not include a baseline measure of hunger before participants were offered the meal. Baseline hunger may have affected the amount of food consumed. However, participants were instructed to follow pretesting conditions related to fasting and activity in both conditions. In addition, testing sessions were held on the same day of the week and time of day in an effort to control for daily shifts in appetite.

This study was unique in that it included a larger proportion of men in the sample; however, the age group tested (18–25 y) was relatively narrow. Although it was not a requirement for participation, all participants were enrolled as either undergraduates or graduate students at a large Midwestern university. The majority of the sample was either white or Asian, reflecting demographics of the university at which the research was conducted. Further, the sample represented adults who were mostly physically active with a healthy BMI, suggesting they may have better self-regulation of food intake. Future studies should aim to diversify the sample population to include a wider variety of age groups, races/ethnicities, BMI, and lifestyles.

In addition, this study, as well as previous investigations, was conducted in a laboratory setting. Although this allows for tightly controlled experimental conditions, it may result in observations that are not truly reflective of how the population behaves in everyday life. It is also worth noting that enjoyment of the quiche was relatively low. Intake may have differed if a more conventional breakfast food were chosen. Future investigations may consider an observational study design to assess effects of distraction in a more naturalistic setting with more familiar food and over longer duration.

In conclusion, results from the present study indicate the need for a more detailed and nuanced investigation into the nature of distractions and effects on eating behavior. Distracted and mindless eating may be different constructs and need to be examined with that in mind. Although the exact effects of distraction may not be entirely clear, environment plays a role in food choice (1). How an individual experiences their meal has a measurable influence on what they choose to consume and may ultimately have a meaningful impact on their health.

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References

1. Caspi CE, Sorensen G, Subramanian SV, Kawachi I. The local food environment and diet: a systematic review. Health Place 2012;18(5):1172–87.
2. Ogden J, Coop N, Cousins C, Crump R, Field L, Hughes S, Woodger N. Distraction, the desire to eat and food intake. Towards an expanded model of mindless eating. Appetite 2013;62:119–26.
3. Mitchell GL, Brunstrom JM. Everyday dietary behaviour and the relationship between attention and meal size. Appetite 2005;45(3):344–55.
4. Higgs S. Memory for recent eating and its influence on subsequent food intake. Appetite 2002;39(2):159–66.
5. Higgs S. Cognitive influences on food intake: the effects of manipulating memory for recent eating. Physiol Behav 2008;94(5):734–9.
6. Higgs S, Donohoe JE. Focusing on food during lunch enhances lunch memory and decreases later snack intake. Appetite 2011;57(1):202–6.
7. Higgs S, Williamson AC, Attwood AS. Recall of recent lunch and its effect on subsequent snack intake. Physiol Behav 2008;94(3):454–62.
8. Rozin P, Dow S, Moscovitch M, Rajaram S. What causes humans to begin and end a meal? A role for memory for what has been eaten, as evidenced by a study of multiple meal eating in amnesic patients. Psychol Sci 1998;9(5):392–6.
9. Degen L, Oesch S, Casanova M, Graf S, Ketterer S, Drewe J, Beglinger C. Effect of peptide YY 3-36 on food intake in humans. Gastroenterology 2005;129(5):1430–6.
10. Woods SC, Gibbs J. The regulation of food intake by peptides. Ann NY Acad Sci 1989;575:236–43.
11. Wren AM, Seal LJ, Cohen MA, Brynes AE, Frost GS, Murphy KG, Dhillo WS, Ghatei MA, Bloom SR. Ghrelin enhances appetite and increases food intake in humans. J Clin Endocrinol Metab 2001;86(12):5992.
12. Spitzer L, Rodin J. Human eating behavior: a critical review of studies in normal weight and overweight individuals. Appetite 1981;2(4):293–329.
13. Rolls ET. Understanding the mechanisms of food intake and obesity. Obes Rev 2007;8(Suppl 1):67–72.
14. Higgs S. Manipulations of attention during eating and their effects on later snack intake. Appetite 2015;92:287–94.
15. Brunstrom JM, Mitchell GL. Effects of distraction on the development of satiety. Br J Nutr 2006;96(4):761–9.
16. Oldham-Cooper RE, Hardman CA, Nicoll CE, Rogers PJ, Brunstrom JM. Playing a computer game during lunch affects fullness, memory for lunch, and later snack intake. Am J Clin Nutr 2011;93(2):308–13.
17. Smit HJ, Rogers PJ. Effects of low doses of caffeine on cognitive performance, mood and thirst in low and higher caffeine consumers. Psychopharmacology (Berl) 2000;152(2):167–73.
18. Talland GA. Effects of alcohol on performance in continuous attention tasks. Psychosom Med 1966;28(II):596–604.
19. Chiva-Blanch G, Magraner E, Condines X, Valderas-Martinez P, Roth I, Arranz S, Casas R, Navarro M, Hervas A, Siso A, et al. Effects of alcohol and polyphenols from beer on atherosclerotic biomarkers in high cardiovascular risk men: a randomized feeding trial. Nutr Metab Cardiovasc Dis 2015;25(1):36–45.
20. Thomas JR, Salazar W, Landers DM. What is missing in $P < .05$? Effect size. Res Q Exerc Sport 1991;62(3):344–8.