

THE EFFECTS OF DISTRACTION ON AMOUNT OF FOOD CONSUMED, FOOD
PREFERENCE, AND SATIETY

BY

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THESIS

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ABSTRACT

Distracted eating is the intentional consumption of a meal while engaged in a secondary activity to the extent that the significance or memory of the meal is diminished. Limited published studies suggest distracted eating leads to increased intake; however, results of the present study do not support previous findings. The present study also aimed to assess the effects of distraction of food preference and perceptions of satiety.

A randomized controlled crossover study was conducted with 120 healthy adults (age: 20.2 ± 1.4 years; 57% female; 48% white). Participants were randomly assigned to begin in either the distracted (DIS, $n=55$) or non-distracted (NON, $n=65$) test condition. In both conditions, participants were provided with miniature quiche. In DIS, participants consumed quiche while playing a Rapid Visual Information Processing (RVIP) task. In NON, participants ate without any distraction. Plates were weighed before and after consumption. After a 30-minute rest period, participants were offered a snack of grapes and miniature cookies and given 5 minutes to eat as much as they liked. The food was removed, and participants completed an exit survey assessing satiety and enjoyment of the meal. After a 1-week washout period, participants completed the opposite condition.

A repeated measures analysis of variance was conducted (Statistical Package for the Social Sciences, version 23.0.0). Participants on average consumed 115.4 ± 5.5 g of quiche during DIS and 128.12 ± 4.4 g during NON. Those in DIS consumed significantly less ($F(1, 117) = 11.78, p=.001$). The relationship held when adjusting for initial condition ($F(1, 117) = 28.786, p=.000$) and gender ($F(1, 116) = 30.441, p=.000$). A significant interaction of initial condition was also detected ($F(1, 117) = 19.689, p=.000$).

A repeated measures analysis of covariance (ANCOVA), controlling for initial condition and previous intake, was conducted to assess snack intake. Participants consumed 45.5 ± 11.1 g of grapes and 18.9 ± 12.4 g of cookies, on average. No significant difference in grape consumption ($F(1, 113) = 1.366, p=.245$) nor cookie consumption ($F(1, 115) = 2.035, p=.156$) was observed between groups. No significant difference in the proportion of grapes consumed ($F(1, 113) = 1.632, p=.204$) or proportion of cookies consumed ($F(1, 115) = 1.682, p=.197$) between groups was detected. An ANCOVA controlling for initial condition revealed a significant difference between groups for memory of quiche received ($F(1, 116) = 30.737, p=.000$) and memory of quiche consumed ($F(1, 118) = 7.616, p=.007$).

Perceptions of satiety were measured using a 100mm Visual Analogue Scale (VAS). No statistically significant differences were observed between groups in perceptions of fullness ($F(1, 109) = .600, p=.440$), hunger ($F(1, 109) = 1.213, p=.273$), or enjoyment of the meal ($F(1, 108) = 2.710, p=.103$).

Participants consumed significantly less food when distracted, on average. Memory of the meal was decreased when distracted, but no differences were observed in amount consumed or food preference at a future eating occasion. No difference in perceptions of satiety or enjoyment of the meal were observed. Findings may be due to testing distracted eating during breakfast, the novelty of the RVIP to participants, or the inclusion of male participants. Future research should aim to determine more conclusive results.

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CHAPTER 1: INTRODUCTION

The factors that determine what an individual chooses to consume are as numerous and diverse as the individuals themselves. There are the obvious considerations of flavor preference and familiarity, the insidious influence of advertising and marketing schemes, and the increasingly important issues of affordability and accessibility. There are concerns of social desirability and influence, specific medical considerations, and environmental cues. Because of these competing dynamics, determining why people eat what they eat is difficult. It also indicates the need for an interdisciplinary approach to unraveling this ubiquitous question. With so many facets at play, it is unlikely that the answer will come from a singular science. The utilization of neighboring sciences, in conjunction with human nutrition, will be essential in providing a wider and more complete view. Specifically, identifying the behaviors that surround a given eating episode may help to illuminate the underlying motivation for the food that an individual chooses to consume.

The term “ingestive behavior” refers to the collective set of actions that surround the intake of food. It has previously been established that behavioral modifications have the most substantial impact on energy balance (Gittleman & Thompson, 1988). This implies the need to include the behavioral sciences when addressing the complexities of food intake motivation. It may be that the food environment or behavioral adaptations to that environment have some understated influence. Within this broad category of possibilities, the presence of distraction during meal time presents an interesting conundrum. The distracted state is a prime example of how factors outside of simply the food on the plate can play a role in determining food intake.

Having an understanding of how individuals in the general population are spending their time with food provides points of entry for scholarly discussion. Americans are spending less time eating as a primary activity today than they were in the past (Hamrick & McClelland, 2016). This does not come as a surprise when considering the increasingly busy and burdensome schedules Americans are adopting. When attempting to satisfy competing needs, the environment in which food is consumed may take a back seat. The time that may otherwise be allocated for a meal has been repurposed to support other tasks. This does not, however, mitigate the basic need to eat. Therefore, mealtime begins to overlap with morning commutes, office work, and personal recreation. There is a disconnect that occurs between the consumer and their food. Food choices are made with little to no recollection of their impact.

It has been previously suggested that when an individual is distracted, he or she will likely consume more food than required (Brunstorm & Mitchell, 2006; Mitchell & Brunstorm, 2005; Ogden et al., 2013; Wansink, 2010). There is little exploration, however, into what it truly means to be “distracted” while consuming a meal. There are numerous activities that may compete for an individual’s attention, but it is quite difficult to determine whether or not this competition actually results in a shift of the individual’s attention away from their food and onto another task. With this in mind, it becomes apparent that there is a need for the use of robust and validated methods of distraction when attempting to assess an individual’s eating behaviors under a variety of conditions. It will be important to be able to differentiate between what is truly distracting and what is simply serving as background noise in the individual’s environment.

The aim of the current study was to determine the effects of distraction on the amount of food consumed, food preference, and an individual's subsequent perceived satiety in a healthy, young adult population. To ensure the presence of distraction, previously validated, quantifiable methods were used. The study asked, "What effect does distraction have on the amount of food consumed in a given eating episode." While previous investigators have sought to answer this question, there still remains an opportunity to pursue a more in-depth study of this phenomenon. The inclusion of a more diverse population, novel study design, and advanced methods of analysis provides a more complete and accurate picture than has previously been drawn.

The secondary objective of this study was to assess potential "downstream" effects of consuming a meal while distracted. Being a relatively narrow area of research, the current literature addressing distraction at mealtime provides little insight into how an individual who has consumed a "distracted meal" will behave during a future eating occasion. The current study asked, "What effect does consuming a distracted meal have on subsequent food intake?" Within that prompt, two metrics were assessed. First, the effect of distraction on the total amount of food consumed was examined. In addition, an individual's preference for foods that are traditionally considered to be "healthy" or "unhealthy" options were considered in both the distracted and non-distracted conditions.

Finally, the study asked, "What effect does consuming a distracted meal have on perceived satiety, memory, and enjoyment of the meal?" This question complemented findings from previous inquiries and allowed for a more detailed discussion of how distraction at mealtime affected individuals in aspects beyond the initial eating episode. The increased detachment from the food being consumed during a meal caused by the

presence of distraction may cause a blunting of an individual's feelings of fullness and hunger. In addition, if the distraction is substantial, it is possible that the individual will have a more difficult time recalling the details of the meal consumed further supporting the notion of increased detachment. The question of enjoyment of the meal is perhaps the most tepid of the ones presented; however, enjoyment continues to be a primary motivator of food intake. Knowing what impact, if any, distraction has on even the most basic of human impulses will be essential to untangling the web of its multifaceted influences.

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CHAPTER 2: LITERATURE REVIEW

Diet and Health

Creating a succinct dietary recommendation that can be widely applied is not a simple task, but it is an exceptionally important one. Six of the top ten leading causes of death in the United States can be directly linked to diet quality (Centers for Disease Control and Prevention, 2016). The definition of optimal dietary intake is constantly in flux and will differ from person to person. With such variability across prescriptions, it would seem that a shift in focus is necessary. It is time to look for determinants of disease beyond an individual's dietary pattern.

The food environment is often overlooked when considering determinants of food intake. There is mounting evidence to suggest that when and where an individual chooses to eat a meal will have an impact on food choice and how much they will consume (Caspi, Sorensen, Subramanian, & Kawachi, 2012). Everything from background noise to plate shape has been implicated (Fiese, Jones, & Jarick, 2015; Jarick, Jones, & Fiese, 2015; Wansink, 2010). A recent household survey indicated that television watching during family meals has been associated with higher rates of obesity (Tumin & Anderson, 2017). Although not as well examined, the presence of distraction can drastically alter an individual's experience with their food and should be considered when making dietary recommendations.

Distracted Eating

In order to properly assess the effects of distracted eating, it must first be clearly defined. The current literature makes little to no distinction between distracted eating and

“mindless eating.” Mindless eating is a term coined by Dr. Brian Wansink (Wansink, 2010). He defines it as an unintentional over-consumption of calories that can occur in a variety of settings. Perhaps the most common example is that of the office candy bowl. In this example, an individual takes candy from the dish and consumes it while walking by without consciously making the decision beforehand to eat (Painter, Wansink, & Hieggelke, 2002).

This nomenclature, however, does not account for differences in intention. Not all instances of mindless eating happen unintentionally (Wansink, 2010). When making the case for behavior change, understanding the motivations and context behind an individual’s food choice is imperative. There is an inherent difference between someone eating without intending to do so and someone eating intentionally without being wholly present for the meal.

For example, a man is at a party with friends. He sits down on the couch to talk with someone and begins eating from the bowl of chips that happens to be on the end table. The man had no prior intention to consume the chips, but ate them anyway. This would be an example of mindless eating. In contrast, a man in the same situation carefully prepares a plate of food before going to sit on the couch to talk with someone. Once he engages in conversation, however, he no longer pays attention to the food he is eating. This would be an example of distracted eating. There is a clear intention to eat prior to the distracted episode. In both situations, the man is actively engaged in a secondary activity for the duration of the eating episode.

This introduces the question, “How is distraction measured?” A variety of methods have been employed to assess distraction. Ogden et al. (2013) took a multipronged

approach to assess the association between various distractions and eating habits among female adults (ages 18-40 years). Participants were randomly assigned to one of the following conditions: a simulated driving task; watching television; a social situation; and a control in which no distraction was provided. "Hula Hoops," a European fried potato snack, was the food of choice and given to participants in each condition. Findings indicated that participants in the television condition had significantly higher desires to eat compared to the driving and social interaction conditions. Feelings of fullness were increased during the control condition.

Computer games are commonly used as distractors (Brunstrom & Mitchell, 2006; Mitchell & Brunstrom, 2005; Oldham-Cooper, Hardman, Nicoll, Rogers, & Brunstrom, 2011). Brunstrom and Mitchell (2006) used a sample of only female participants. All were undergraduate students with a mean age of 19.5 years. They used the video game "Pong" as their distraction and, similarly to Ogden et al. (2013), fed the participants a snack food ("Jaffa Cakes," a common type of European sponge cake).

Likewise, Oldham-Cooper et al. (2011) used a computerized game of solitaire as their method of distraction. In their study, a sample of men and women (n=44) were randomly assigned either the distracted or control condition. All were served a series of lunch foods including sandwiches and potato chips. Participants in the distracted condition were encouraged to focus on winning the maximum number of games. The control group did not have a game to play and was told to focus on the physical properties of their food.

It may be erroneous to assume that if someone is playing a game, she is giving it her full attention. It is quite plausible that a participant may not engage with the game to the extent that it becomes distracting, and instead focuses more fully on the food being served.

One study in particular by Mitchell and Brunstrom (2005) attempted to ensure true distraction using the Rapid Visual Information Processing (RVIP) task. The RVIP has been used previously as a validated measure of sustained attention (Smit & Rogers, 2000; Talland, 1966; Wesnes & Warburton, 1983). In this task, a series of numbers continually flash on a computer screen. When a series of consecutive odd or a series of consecutive even numbers is identified, the participant presses the space bar on the computer keyboard.

The aim of Mitchell and Brunstrom's (2005) two-part study was to establish differences in how those who were classified as highly restrained and/or highly disinhibited eaters behaved when consuming a meal while distracted. These classifications were determined using the Dutch Eating Behavior Questionnaire (DEBQ) and the Three Factor Eating Questionnaire (TFEQ). In Experiment 1 of the study, investigators began with a sample of 100 female college students. Over the lunch hour, participants were presented with a small plate of food including cheese sandwiches, scotch eggs, and sausage rolls. They were instructed to consume one food item for each 60-second block of the RVIP task. At the end of each block, participants were asked if they would like to continue with another session. This continued until the participant no longer wanted to continue. Those who were identified as highly restrained and highly disinhibited consumed more than their counterparts in the distracted condition (Mitchell & Brunstrom, 2005).

In Experiment 2, 87 college-aged females were recruited. For this study, a variety of snack foods, including Jaffa Cakes, potato chips, and chocolate bars were used instead of the traditional lunchtime foods. It was noted that these foods were considered "highly forbidden" by the study participants. Similar to Experiment 1, the RVIP task was used as

the method of distraction. In this iteration, the time blocks were increased to 120 seconds, and participants were instructed to eat three food items per testing block. The investigators found that participants classified as low restraint and highly disinhibited consumed significantly more than those classified as highly restrained and highly disinhibited (Mitchell & Brunstrom, 2005).

In addition to a validated measure, level of distraction has been manipulated in intensity through the use of incentives. In a sample of 39 college women, Higgs (2015) utilized a computer video game to distract participants, but modified the intensity by telling the “high intensity” group that those receiving the highest score would be eligible to receive a cash prize. The “low intensity” group was simply told to play the game while they ate their lunch. In this particular study, participants were instructed to eat all of the food presented to them, and therefore, amount consumed while distracted was not measured.

In Part 2 of the above study, distraction was introduced in the form of television. Sixty-three female college students were assigned to one of three conditions: watching a cooking show; watching a home improvement show; or no distraction. Again, participants were instructed to consume all of the food they were given. Thus, a conclusion cannot be drawn on the effects of the distraction on intake (Higgs, 2015).

Part 3 of the study utilized audio clips as a method of distraction. In this session, 45 female college students were assigned to one of three conditions: listening to an audio clip that encouraged them to visualize themselves eating; listening to an audio clip that encouraged them to visualize a celebrity (David Beckham) eating; or no distraction. Participants were again instructed to eat all of the food provided, as the aim of this study was to assess future food intake (Higgs, 2015).

Memory and Future Food Intake

Distraction results in decreased meal memory (Oldham-Cooper et al., 2011; Higgs & Donohoe, 2011), and the ability to recall previous meals impacts intake at later eating occasions (Higgs, Williamson, & Attwood, 2008). This indicates that distraction during mealtime may have further-reaching effects. Not only are individuals likely to consume more when distracted, but the distraction may result in a diminished memory of the meal consumed. There is evidence to indicate that how well an individual remembers the previous meal may play a role in how much they choose to eat later on in the day.

Indications that memory plays an important role in food choice can be found in observational studies of amnesic patients (Rozin, Dow, Moscovitch, & Rajaram, 1998). Patients would routinely accept and, on occasion, request second or third meals within 20 minutes of completing a meal. These findings suggest that initiation and cessation of a meal are likely dependent on factors beyond feelings of satiety.

Evidence that a similar behavioral pattern exists in non-amnesic individuals has been established through related work (Higgs, 2002; Higgs, 2008; Higgs & Donohoe, 2011; Higgs, Williamson, & Attwood, 2008). A sample of 20 female participants were provided with a lunch of cheese pizza in a laboratory setting (Higgs, 2002). All participants were instructed to return to the lab later in the day to participate in a cookie taste-testing panel. Prior to the taste test, half the participants were instructed to think about pizza and the other half were instructed to think freely. Those that focused specifically on the food they consumed for lunch, ate significantly less than those who thought freely (Higgs, 2002).

Higgs, Williamson, and Attwood (2008) conducted a multifaceted experiment to further explore the relationship between memory of a meal and amount consumed.

Although they did not implement a method of distraction, their findings help to shed some light on this relationship. Part 1, including 14 male college students, aimed to investigate the effects of recalling a previous eating episode on snack consumption. It was determined that by actively recalling what they had for lunch earlier that day, the participants could significantly decrease their consumption of a popcorn snack offered to them in the laboratory setting. This result was not observed when the participants were asked to recall lunch from the previous day before being offered the snack.

Part 2 examined 73 college-aged women and stratified participants based on their eating behaviors. Again the DEBQ and TFEQ were utilized to determine if participants were highly restrictive and/or highly disinhibited eaters. The procedure mimicked that of Experiment 1. For this sample, there was no statistical difference in amount of popcorn consumed between those that recalled their lunch from that day and those that recalled their lunch from the previous day. This indicates that memory of a meal may have different effects depending on the population, in this case, men and women (Higgs, Williamson, & Attwood, 2008).

Part 3 of the study aimed to determine if previously observed effects were truly due to the memory of the meal or if it could be attributed to some outside factor. Here, 47 college-aged females were recruited. Participants attended two days of testing. On both days, participants were fed lunch in the laboratory. One day they were asked to come back after one hour and the second day they were asked to come back after three hours. When participants returned, they were asked to either recall the lunch they had been served earlier or recall their travel to campus that day before receiving the snack. A variety of cookies were supplied instead of the popcorn snack that was previously used. There was

no difference in the amount of cookies eaten between the group that recalled lunch and the group that recalled travel. The investigators determined that those who were asked to return after three hours consumed more cookies than those who returned after one hour. The groups showed no differences in self-rated feelings of hunger indicating that the difference in intake was due to the memory of the meal (Higgs, Williamson, & Attwood, 2008).

Higgs and Donohoe (2011) explored whether degree of mealtime attention was associated with future snack intake. In a sample of 29 female college students they introduced lunchtime activities including listening to an audio clip that encouraged participants to focus on the sensory properties of the food they were consuming or reading a newspaper article about chocolate and soda production. Participants were randomly assigned to one of three groups: audio recording; newspaper reading; or a control group that had no interference. At least two hours after the lunchtime intervention, participants returned to the lab for a cookie taste test. Those who had previously listened to the audio recording ate significantly less than the other two groups at a later snack time. This suggests that paying close attention and being present during meal time may affect how much an individual chooses to consume at a future eating episode.

In a study by Oldham-Cooper et al. (2011), previously described, a series of food items were presented to participants in either the distracted or control condition. Those who were distracted during mealtime were significantly less accurate than those in the control group when asked to recall the foods in the correct order they were presented. There were no significant differences between the groups when the participants were asked to recall the foods presented independent of order. In both conditions, female

participants were significantly more accurate than their male counterparts. The researchers did not test for memory or cognitive impairment prior to the testing sessions. Furthermore, participants in the distracted condition consumed significantly more of the cookies offered 30 minutes after lunch. There were no gender differences observed.

Higgs (2015), previously described, provided several levels and intensities of distraction during lunch to a sample of female college students with the aim of assessing their intake at a future eating occasion. Part 1 of the study modulated intensity of the distraction by offering an incentive to the “high distraction” group for doing well in the computer game. Those in the high distraction group ate more of the cookies offered than those in the “low intensity” and control groups. Those in the control condition had the best memory of the meal they consumed, while those in the “high distraction” group had the worst memory. Only descriptive analyses were reported; therefore, it was impossible to say if these results were significant.

Part 2 of the above study utilized television shows (a cooking show and a home improvement show) to moderate the effects of distraction on future food intake. Those who watched the home improvement show ate relatively more cookies than those in the other two groups. Ratings of memory were highest in the control group and lowest in the group that watched the home improvement show. Similarly to Part 1, only descriptive analyses were reported making it impossible to say if these results were significant (Higgs, 2015).

In Part 3, a pair of audio clips were employed as methods of distraction. One group listened to a clip encouraging them to visualize themselves eating, the second group listened to a clip encouraging them to visualize a celebrity (David Beckham) eating, and the third group received no distraction. Snack intake was highest in the control group and

lowest in the self-visualizing group. Recall for the foods consumed was similar across all groups. Again, only descriptive analyses were reported (Higgs, 2015).

Present Study

The current literature has made modest strides into understanding the mechanisms behind how distraction affects ingestive behavior. It is by no means, however, conclusive. Most of the research presented here was conducted in female only populations. Few studies have included men in the sample, leaving large gaps concerning what the effects of distracted eating may be on men. Small samples with limited generalizability indicate the need for more research in this area to confirm or refute the previous findings.

Although there has been growing interest in the role memory of a meal plays in the amount of food an individual chooses to consume at a later eating episode, there has been little done in the way of food preference. Most studies only provided participants with one food type (i.e., cookies) for their snack option. This does not give any indication as to what types of foods people may choose to eat after a distracted eating episode, if given an option.

Furthermore, there has been little focus on ensuring that an individual is truly distracted during mealtime. Many of the methods outlined above make the presumption that because someone is presented with another activity while eating, they are automatically distracted. This further muddies the line between “distracted” and “mindless” eating. A distinction needs to be made between the two. The only way of assuring that only “distracted eating” is being assessed is by using validated measures of distraction, such as the RVIP (Mitchell & Brunstrom, 2005; Smit & Rogers, 2000; Wesnes & Warburton, 1983).

In addition, all studies presented here have utilized a cross-sectional design. While this is useful technique for getting a snapshot of human behavior, it may not tell the whole story. The research has not allowed for any crossover of the study arms making it impossible to determine within person differences. In addition, there is a need for a more robust statistical analysis of findings.

The current study partially filled some of the gaps in knowledge by answering the questions surrounding the immediate and downstream effects of distracted eating in a more diverse population. This research may be influential in contributing to the knowledge of what food choices are made post-distraction, as it investigated alterations in satiety recognition, meal memory, and enjoyment. A randomized, controlled crossover design was used in order to expand the current understanding of how distraction impacts eating behavior.

This study aimed to assess the effect of distraction on the amount of food consumed, food preference, and satiety. Based on previously published studies, it was hypothesized that food intake would increase during the distracted condition when compared to control condition. Given the information available on intake post-distraction, albeit limited, it was predicted that participants would choose to eat more, in both volume and calories, when previously distracted compared to non-distracted.

This design was unique in that it included a validated method of distraction, the RVIP, included male participants, and applied a crossover design. This information will be useful in clarifying one piece of the ingestive behavior puzzle and may be beneficial in creating future dietary recommendations for optimal health.

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CHAPTER 3: METHODOLOGY

Introduction

Although trends in obesity appear to be stabilizing, it is still a salient health concern affecting 36% of all Americans over 20 years of age (Ogden, Carroll, Fryar, & Flegal, 2015). The need for dietary intervention is apparent. While what an individual chooses to consume undoubtedly has an impact on their health, focusing on the food itself may not be the only solution. There is growing evidence that suggests where, when, and with whom an individual eats can have a substantial impact on what they eat (Caspi, Sorensen, Subramanian, & Kawachi 2012). The impact of distraction and the importance of memory have recently become the focus of intervention (Brunstrom & Mitchell, 2006; Mitchell & Brunstrom, 2005; Oldham-Cooper, Hardman, Nicoll, Rogers, & Brunstrom, 2011; Higgs & Donohoe, 2011; Higgs, Williamson, & Attwood, 2008).

A variety of methodologies have been applied in order to induce distraction during an eating episode (Brunstrom & Mitchell, 2006; Mitchell & Brunstrom, 2005; Oldham-Cooper et al., 2011). Tactics span from television watching to computerized card games (Ogden et al., 2013; Oldham-Cooper et al., 2011). When assessing the impact of distraction on food intake, it is necessary to ensure that participants are truly distracted throughout the eating episode. While watching television or playing computer games may be considered potentially distracting, there is no way of ensuring that an individual is truly distracted without using a validated measure. The Rapid Visual Information Processing (RVIP) task is a validated measure of sustained attention (Talland, 1966). It has previously been used by Mitchell and Brunstrom (2005) to distract participants during mealtime. By

using a previously validated measure, the impact of the distraction can be reasonably assured.

When an individual consumes a meal while distracted, they will likely have a diminished memory of the meal (Higgs & Donohoe, 2011; Oldham-Cooper, et al., 2011). Research conducted in patients with amnesia suggests that an individual's ability to recall previous meals will have a significant impact on how much they choose to consume at a future eating occasion (Rozin, Dow, Moscovitch, & Rajaram, 1998). There is ample evidence to indicate that this holds true in individuals without amnesia as well (Higgs, 2002, 2015; Higgs & Donohoe, 2011; Higgs, Williamson, & Attwood, 2008; Robinson et al., 2013). Those who have poor recollection of their previous intake are more likely to consume more at a later eating episode. Understanding the relationship between distraction during mealtime and subsequent memory of the meal is an essential step toward establishing positive food environments.

The current literature has begun to shed light on this relationship; however, it is by no means conclusive. Small sample sizes and predominantly female participants limit the generalizability of the findings. In addition, all designs have been cross-sectional and do not allow for assessment past one time point. The proposed study aimed to determine the effects of distraction on the amount of food consumed, food preference, and perceived satiety. It attempted to address the gaps in current research by including a larger, more diverse sample of participants. The proposed study utilized a randomized control cross-over design in an effort to determine within person effects of distraction. It was hypothesized that when in the distracted condition, participants would consume more at

mealtime and at a future eating occasion. It was also posited that after consuming a meal while distracted, the individual would be more likely to choose a less healthy snack option. In addition, it was hypothesized that participants who had consumed a meal while distracted would have decreased perceptions of satiety, enjoyment, and memory of the meal compared to when they were not distracted.

Participants

Participants included 121 healthy young adults aged 18-25 years of age. Exclusion criteria included individuals with food allergies and those following any specific dietary restrictions (e.g., vegetarian, vegan, kosher, etc.) or diagnosed with metabolic disorders or gastrointestinal diseases (e.g., diabetes, heart disease, Crohn's disease, etc.) as these conditions can be aggravated by dietary intake. Any participants exhibiting cognitive impairment were also excluded to ensure that the integrity of the distraction mechanism was maintained. All participants had to be able to read and speak English. An equitable selection of adults, aged 18 to 25 years was assured, as anyone meeting the inclusion and exclusion criteria was included. Race, ethnicity, and socioeconomic status were not considered when screening participants.

Procedures

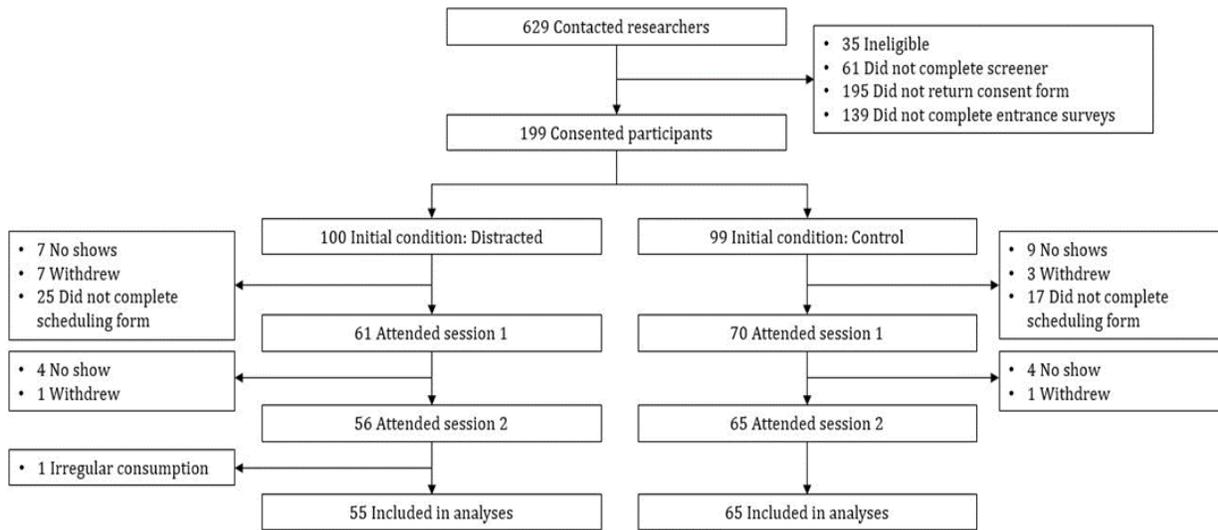
Convenience sampling techniques were used to identify, contact, and recruit prospective participants. Word-of-mouth was used to recruit participants from a Midwestern college town. Online recruiting was done through e-mail listservs and postings to social media sites including Reddit and Facebook. Flyers were posted in local

restaurants, residence halls, and campus bulletin boards to be seen by potential participants.

Individuals who expressed interest in participating in the study contacted the study investigators via electronic mail. Participants were not informed of the actual aim of the study at time of interest, and instead, were told that the study was to assess the relationship between breakfast consumption and appetite. They were then sent one pre-screening questionnaire that was completed at their convenience. The questionnaire lasted no more than 30 minutes. Eligibility for study participation was assessed at this time. If individuals meet pre-screening criteria, they were sent an electronic consent form, general demographic questionnaire, Dutch Eating Behavior Questionnaire (DEBQ), Eating Inventory (EI), and Zung scale. This information was used to stratify participants into specific groups during data analysis. Completing these questionnaires lasted no more than one hour.

Following receipt of the Informed Consent Forms and after completing all entrance questionnaires, participants were then randomly assigned to begin with either the controlled condition or the distracted condition for the first visit (Figure 3.1).

Figure 3.1 Consort Flow Diagram



Each participant was assigned a three-digit ID code number to maintain confidentiality for the duration of the study. Following randomization to intervention groups, participants were contacted and instructed to select a pair of testing sessions that fit into their schedules via an online scheduling system. One session was under the controlled condition and the other under the distracted condition; however, they were not informed of conditions at this time. Participants were scheduled at the same time and day of the week with a one-week separation between sessions. All sessions were scheduled between the hours of 8am and 11am. Participants had the option of attending either an 8am or 9:30am session.

Before each testing session, participants were provided with specific instructions for eating and sleeping. Each participant, regardless of condition, was instructed to sleep for eight hours the night before the session and fast for 10 hours prior to his or her scheduled testing time. Participants were instructed not to exercise 48 hours before their

testing session. At each testing session, participants were asked to confirm that they followed all pre-testing instructions.

In the distracted condition, participants entered a private booth that contained a computer equipped with the Rapid Visual Information Processing (RVIP) task and a printed instruction sheet (Talland, 1966). They were instructed by a researcher to sit and read the instructions carefully. The researcher remained present for the duration of instructions to answer any questions and address any concerns that may have arisen. Participants were given the opportunity to practice the task for one minute before beginning the trial. Investigators then provided the participant with a meal consisting of 10 Swiss cheese and spinach miniature quiche (AppetizersUSA, Scottsdale, AZ). Participants were instructed to consume the meal while executing the RVIP task. After 15 minutes, the RVIP task ended, and an investigator removed the plate of food. The control condition was identical to the distracted condition in every way with exception of the RVIP task activity. When in the control condition, participants consumed the initial meal in a private booth without any distraction. All following activities were the same.

Meal plates were weighed before and after the trial to quantify consumption of food. The participant was asked to wait for 30 minutes and was provided with a variety of word and number puzzles to occupy the time. Participants were provided with water and were free to use the restroom at this time. No outside materials (i.e. cellular phones, books, homework, etc.) were permitted for the duration of the testing session in order to assure a controlled environment.

After the 30-minute rest period, participants were escorted to a second private booth where two snack food options, grapes and miniature chocolate chip cookies, were made available. The snack plates, containing approximately 50 g of grapes and 30 g of cookies, were weighed prior to presentation to the participants. Participants were instructed to sit and help themselves to the snack provided if they so desired. They were given five minutes to make a food choice and consume the food if they wished. After five minutes, an investigator returned to provide the participant with the Exit Survey. Investigators removed the snack foods at this time, and the plates were weighed to quantify consumption. After the completion of the second testing session only, anthropometric data were obtained. Standing height (cm), body weight (kg), body fat percentage (%), and blood pressure (mmHg) were measured by standard protocols. Each session lasted no more than 1.5 hours. After all data were collected, participants were informed via electronic mail about the true purpose of the research. 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).

Measures

Screening assessment. An investigator-designed screener was administered to participants via electronic mail. It requested information about current metabolic diseases, such as diabetes or hypertension, or gastrointestinal disorders, such as Irritable Bowel Syndrome or Crohn's Disease, which may be exacerbated through dietary means. It also asked about any dietary restrictions or allergies that would exclude participation. Additional self-reported information about height, weight, and age was also requested.

Cognitive impairment. The Trail Making Test (TMT) was used as an initial screener for the study. This measure was used to assess cognitive impairment. If an individual had preexisting cognitive difficulties, it had the potential to create an exaggerated effect in the distracted condition. Participants complete the two parts of the TMT. In Part A, circles were numbered 1 – 25, and the individual drew lines to connect the numbers in ascending order. In Part B, circles included both numbers (1 – 13) and letters (A – L). As in Part A, the individual drew lines to connect the circles in an ascending pattern, and with the added task of alternating between the numbers and letters (i.e., 1-A-2-B-3-C, etc.). The individual was instructed to connect the circles as quickly as possible, without lifting the pen or pencil from the paper.

Participants were timed as they connected the "trail." If an individual made a mistake, it was pointed out immediately, and he or she was allowed to correct it. Errors affected the individual's score only in that the correction of errors was included in the completion time for the task. It was unnecessary to continue the test if the individual did not complete both parts after five minutes had elapsed. If it took an individual longer than 78 seconds to complete Part A or longer than 273 seconds to complete Part B, he or she was considered deficient and was excluded from the study (Reitan, 1955). The interrater reliability of Part A and Part B are 0.94 and 0.90, respectively (Fals-Stewart, 1992). The criterion validity is 0.68 for Parts A and B combined (Stanczak, Lynch, McNeil, & Brown, 1998).

Restrained eating. The Dutch Eating Behavior Questionnaire (DEBQ) was administered to identify participants that exhibited restrained eating patterns (Van Strien, Frijters, Bergers, & Defares, 1986). Sample questions on the DEBQ include:

“When you have put on weight, do you eat less than you usually do?”

“Do you have a desire to eat when you are emotionally upset?” and

“If you see others eating, do you also have the desire to eat?” (Van Strien, et al., 1986). Responses were recorded per standard scoring protocol on a 5-point scale with 1 being “Never” and 5 being “Always.” Internal reliability is 0.95 across all body mass indexes and genders. Internal validity is 0.97 (Van Strien, et al., 1986).

Anxiety. Participants completed the Zung Scale, which assessed anxiety and depression (Zung, 1971). Participants indicated to what degree they believed a given statement applied to them, with “None or little of the time” being the least and “Most of the time” being the greatest. Sample statements include:

“I feel downhearted, blue, and sad.”

“I get tired for no reason.” and

“I feel that others would be better off if I were dead” (Zung, 1971). Internal reliability is 0.81 (Olatunji, Deacon, Abramowitz, & Tolin, 2006). Any participants classified as moderately or severely depressed were excluded from analyses; however, no participants responded in a fashion that indicated exclusion for anxiety-related reasons.

Eating behaviors. The Eating Inventory is a three-factor questionnaire that measures restraint, disinhibition, and hunger. Restraint refers to a person’s desire and ability to limit their calorie intake. Disinhibition refers to the extent to which an individual will “let loose” and disregard their dietary norms. Hunger refers to the physiological feeling that comes from a desire to eat (Stunkard & Messick, 1985). Participants responded to

statements as either “True” or “False” or to questions on a 4-point Likert scale. Sample statements and questions include:

“When I feel lonely, I console myself by eating.”

“Sometimes when I start eating, I just can't seem to stop.” and

“How likely are you to consciously eat slowly in order to cut down on how much you eat?” (Stunkard & Messick, 1985). The Eating Inventory has an internal reliability of 0.78-0.94 (Capellari, et al. 2009).

Distraction. The RVIP task was utilized as the method of distraction during the experimental condition. The RVIP task is a validated measure of sustained attention that has previously been used to assess the role of distraction on food consumption (Smit & Rogers, 2000; Talland, 1966; Wesnes & Warburton, 1983; Mitchell & Brunstrom, 2005). During the activity, a series of numbers flashed on the computer screen at a rate of one per second. When a series of three consecutive even or three consecutive odd numbers was identified, the participant pressed the space bar on the keyboard. The task lasted 15 minutes and had a 1-minute practice session.

Food consumption. Food plates were weighed before and after participant consumption. This provided a means of quantifying consumption without disrupting the participants while they ate. Calorie per g of food was determined from the nutrition facts panel. This information was used to calculate how many calories were consumed by the participant at each session.

Exit Survey. An investigator-designed exit survey was administered to participants after the snack option. The survey included a series of 100mm Visual Analogue Scales to assess satiety and enjoyment of the meal. 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?” In order to assess the participant’s memory of the meal, the survey included the question, “How many mini quiches did you receive” and “How many mini quiches did you consume?” These responses were later compared to actual consumption data in data analyses. The survey also included questions about perceived benefits and barriers to breakfast consumption for consistency with the advertised purpose of the study. Participants were also asked to confirm that they complied with all pre-testing instructions regarding sleep, fasting, and physical activity.

Data Analyses

The focus of this study was to illuminate the effects of distracted eating on consumption, food preference, and satiety within persons. The independent variable was the presence of distraction during meal time. The primary dependent variable was the amount of food (g) consumed during a distracted eating episode. In addition, the amount of food (g) consumed at the later snack option was assessed as well as what type of food (health vs. unhealthy) an individual was more likely to choose. The tertiary outcomes of this work were an assessment of an individual’s perception of satiety, enjoyment, and memory of the meal in both the distracted and control conditions. Data were analyzed

using the Statistical Package for the Social Sciences (version 23.0.0, 2015, IBM Corp., Armonk, NY, U.S.). Significance was set at $p < .05$.

Preliminary analysis of variance (ANOVA) tests were conducted to determine if any differences existed between the distracted and control groups. Because this was a within-person design, a repeated measures ANCOVA, controlling for initial condition as the covariate (C), was conducted to compare the amount consumed at the initial eating episode in both the distracted and control condition for each individual. Differences between subgroups, such as gender, were also examined. Similarly, data from the snack intake period were assessed using a repeated measures ANCOVA, controlling for initial condition and amount consumed during the initial eating episode.

Data collected regarding perceptions of satiety, enjoyment, and memory of the meal were assessed in a similar manner. Perceptions of satiety and enjoyment of the meal were evaluated using a repeated measures ANCOVA, controlling for initial condition and amount consumed at the initial eating episode and snack option. Memory of the meal was also analyzed using a repeated measures ANCOVA, controlling for initial condition.

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CHAPTER 4: RESULTS

Effects of Distraction on Consumption at Mealtime

Participant characteristics. A total of 119¹ participants were included in data analyses (Table 4.1). The sample was fairly evenly split between genders (57.5% female) with a mean (\pm SD) age of 20.2 ± 1.4 years. Participants were predominately White (47.5%) or Asian (45.0%). Seventy-four percent engaged in regular physical activity. On average, they routinely obtained 7.1 ± 0.9 hours of sleep at night. They had a mean body mass index (BMI; kg/m^2) of 23.0 ± 3.8 . There were no significant differences between those who were assigned to begin with the distracted condition ($n=55$) and those who began with the control condition ($n=64$). A one-way ANOVA revealed that the two groups did not differ in gender ($p=0.89$), age ($p=0.70$), race ($p=0.96$), sleep behavior ($p=.55$), exercise habits ($p=0.46$), or BMI ($p=0.88$).

Table 4.1 Participant characteristics of individuals participating in a study on distracted eating

Characteristics	All participants ($n = 119$) Mean \pm SD	Distracted condition first ¹ ($n = 55$) Mean \pm SD	Control condition first ¹ ($n = 64$) Mean \pm SD
Age (years)	20.2 ± 1.4	20.2 ± 1.5	20.3 ± 1.3
Gender, female (%)	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%

¹ Number differs from total sample ($n=120$), due to one individual not having data for the initial weight of quiche served.

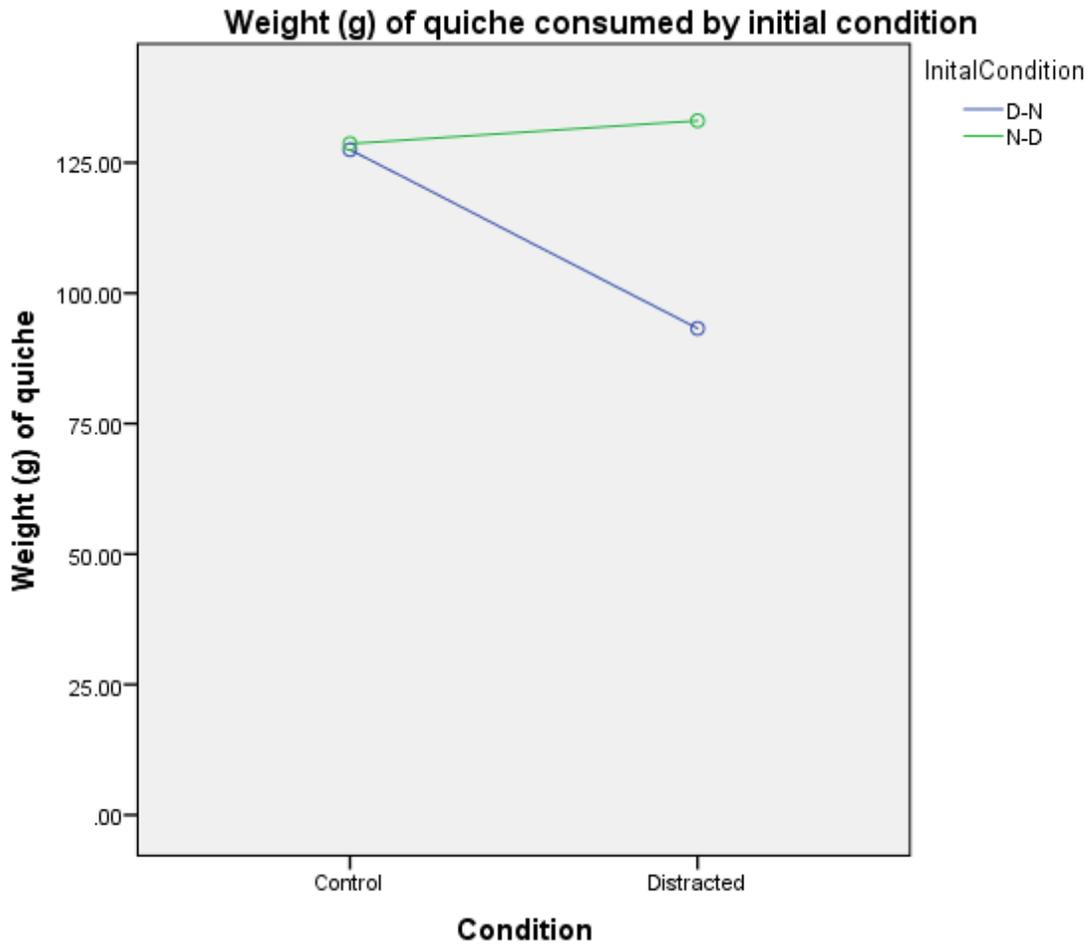
Table 4.1 (cont.) Participant characteristics of individuals participating in a study on distracted eating

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)	169.2 ± 10.1	169.1 ± 9.2	169.0 ± 10.0
Weight (kg)	66.4 ± 14.1	66.4 ± 13.7	66.9 ± 15.3
Body mass index (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	120.1 ± 15.9	119.8 ± 15.3	120.4 ± 16.5
Diastolic	68.5 ± 9.6	68.7 ± 9.7	68.3 ± 9.6
RVIP accuracy (score)	81.3 ± 14.4	81.4 ± 13.5	81.1 ± 15.2

¹Participants randomly assigned to begin with distracted or control condition.

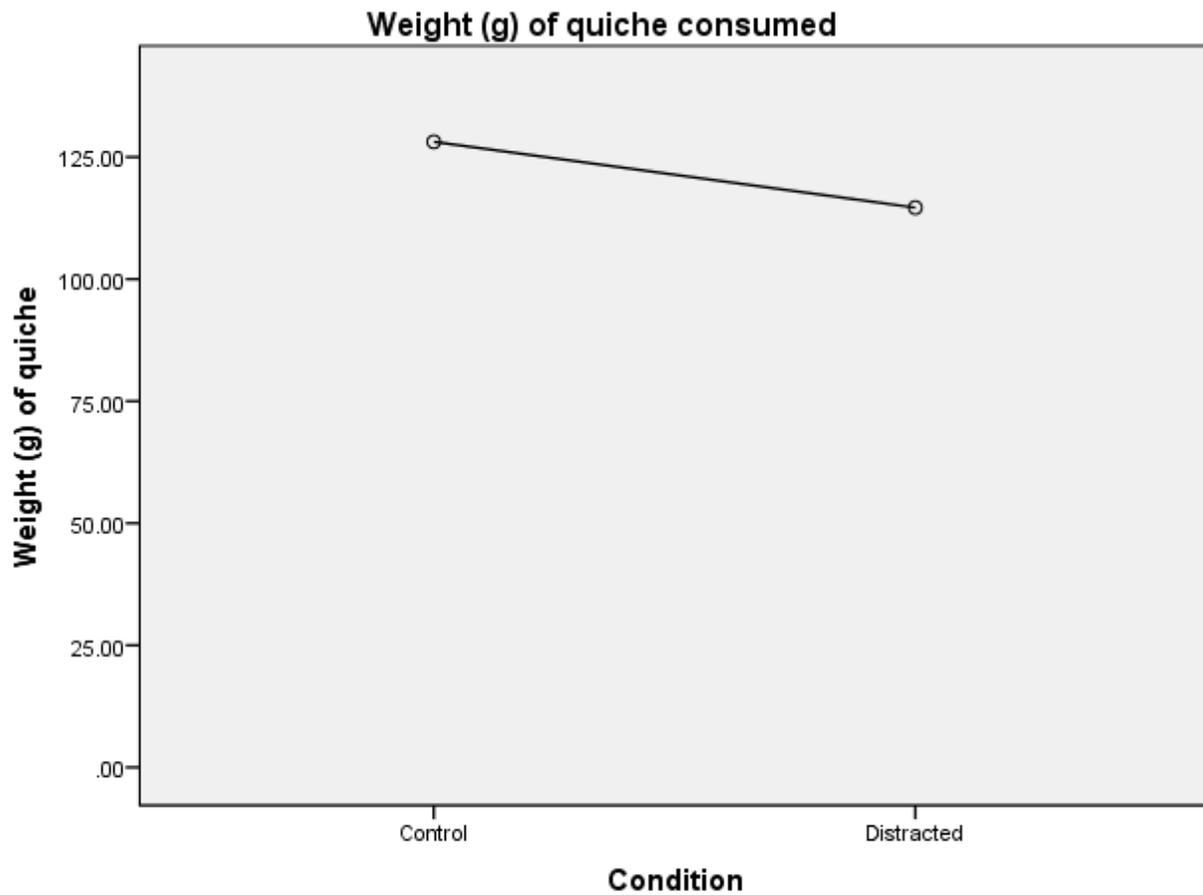
Intake. In the distracted condition, participants (n=119) consumed an average of 115 ± 60 g of quiche. Participants (n=119) consumed more in the control condition with an average intake of 128 ± 48 g of quiche (Figure 4.1). A repeated measures ANOVA was conducted to determine if any statistical difference in food intake existed between the distracted and control conditions. A statistically significant difference was found ($F(1, 117) = 11.78, p=.001$) indicating that individuals consumed less when they were distracted.

Figure 4.1 Weight of quiche consumed by condition



Intake controlling for initial condition. In order to determine if the effects observed in the repeated measures ANOVA were caused by any factors other than the presence of distraction, a repeated measures ANCOVA was conducted. In these analyses, the initial condition, either distracted or control, was treated as a covariate. A statistically significant difference was detected in food intake between the distracted and control groups ($F(1, 117) = 28.786, p=.000$). A significant interaction of initial condition was also determined ($F(1, 117) = 19.689, p=.000$) (Figure 4.2).

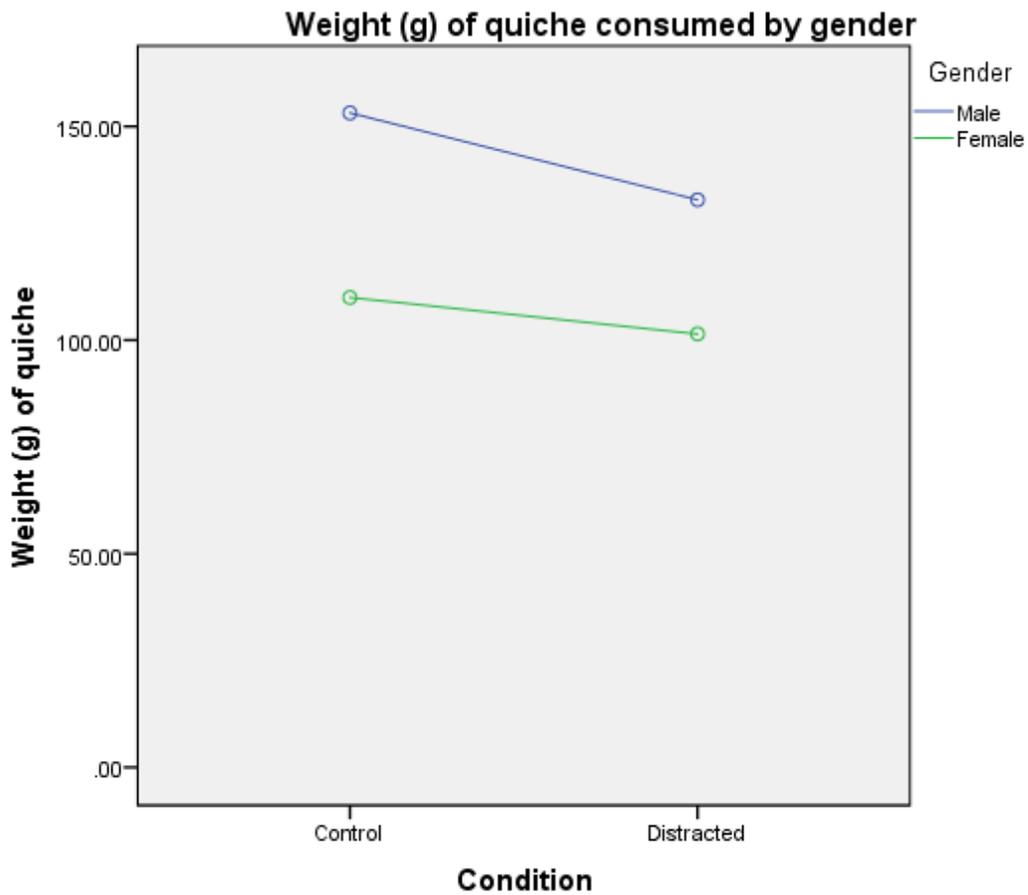
Figure 4.2 Weight of quiche consumed by condition controlling for initial condition



Covariates appearing in the model are evaluated at the following values: InitalCondition = .54

Intake by gender. Differences in intake by gender were assessed in a similar manner. Using a repeated measures ANCOVA, controlling for initial condition, difference in intake remained statistically significant ($F(1, 116) = 30.441, p=.000$), but there was no significant interaction of gender ($F(1, 116) = 1.814, p=.181$) (Figure 4.3).

Figure 4.3 Weight of quiche consumed by gender



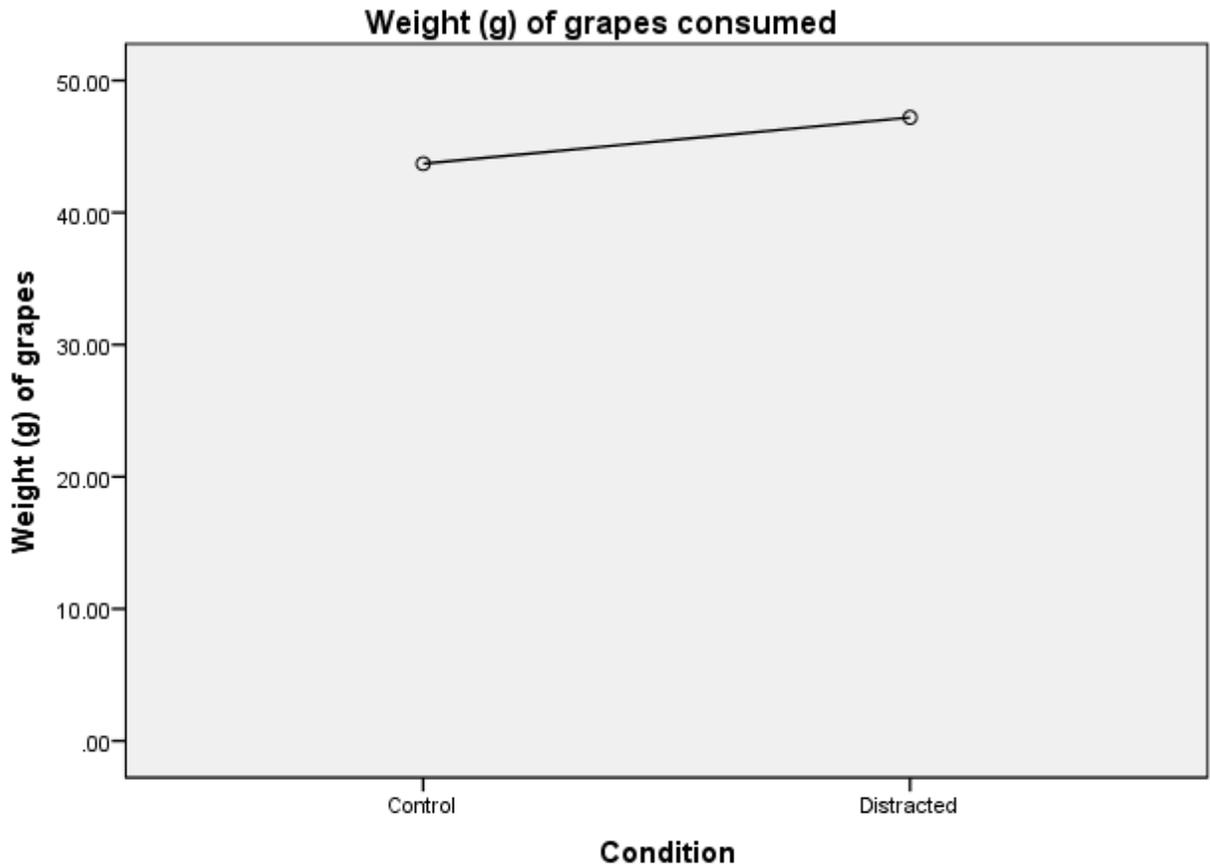
Covariates appearing in the model are evaluated at the following values: InitialCondition = .54

The Effects of Distraction on Amount Consumed and Food Preference at a Future Eating Occasion

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 repeated measures ANCOVA were conducted, controlling for initial testing condition (distracted or control) and intake at the earlier mealtime. No significant difference in grape consumption was observed between groups

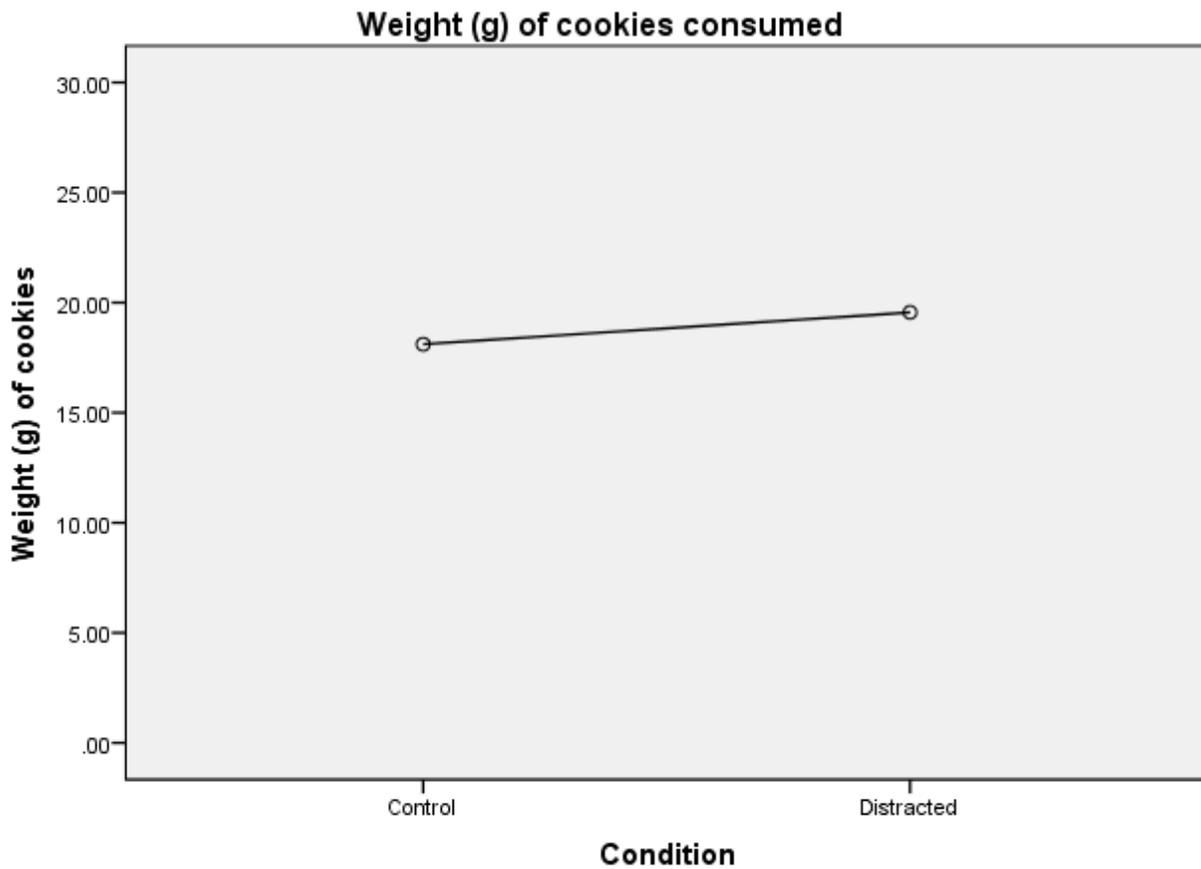
($F(1, 113) = 1.366, p=.245$) (Figure 4.4). No significant difference in cookie consumption was observed between groups ($F(1, 115) = 2.035, p=.156$) (Figure 4.5).

Figure 4.4 Weight (g) of grapes consumed at snack time



Covariates appearing in the model are evaluated at the following values: InitialCon = .53, D_Quiche = 113.5556, N_Quiche = 127.2393

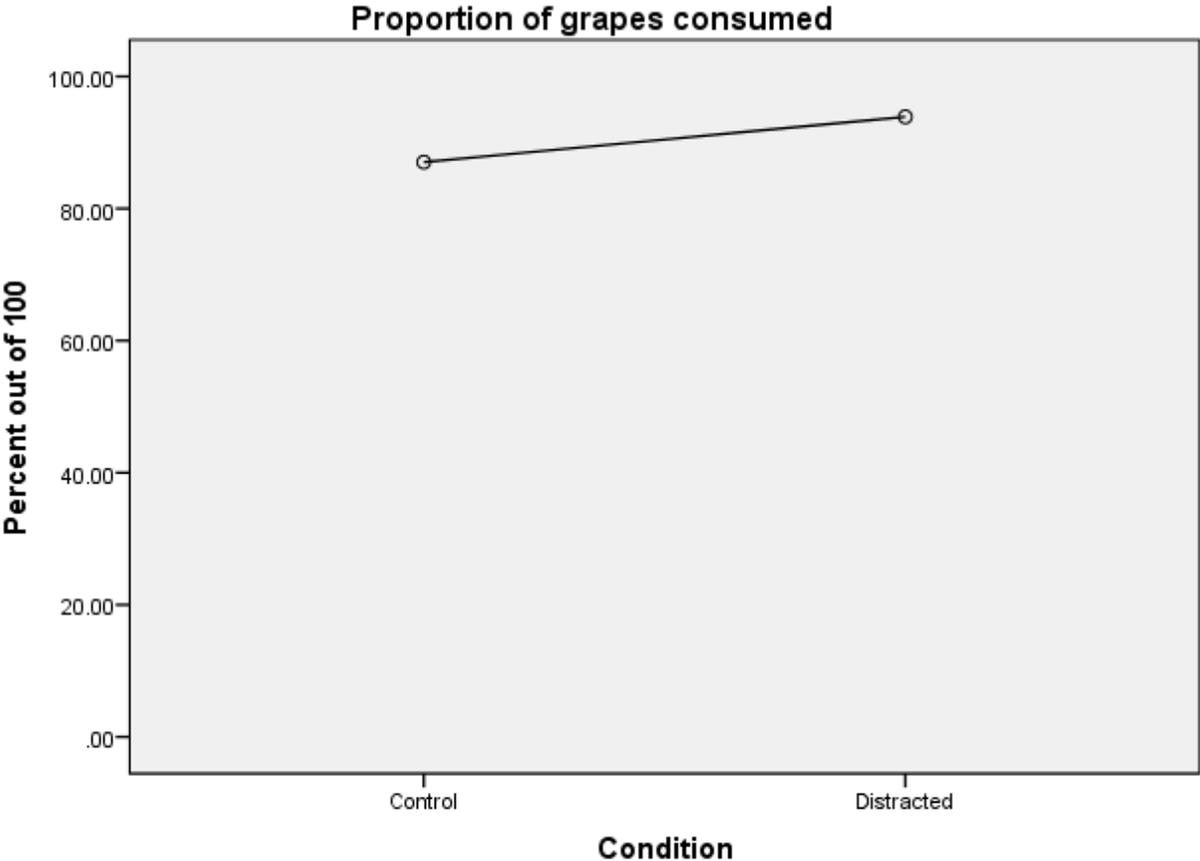
Figure 4.5 Weight (g) of cookies consumed at snack time



Covariates appearing in the model are evaluated at the following values: InitialCon = .54, D_Quiche = 114.6387, N_Quiche = 128.1176

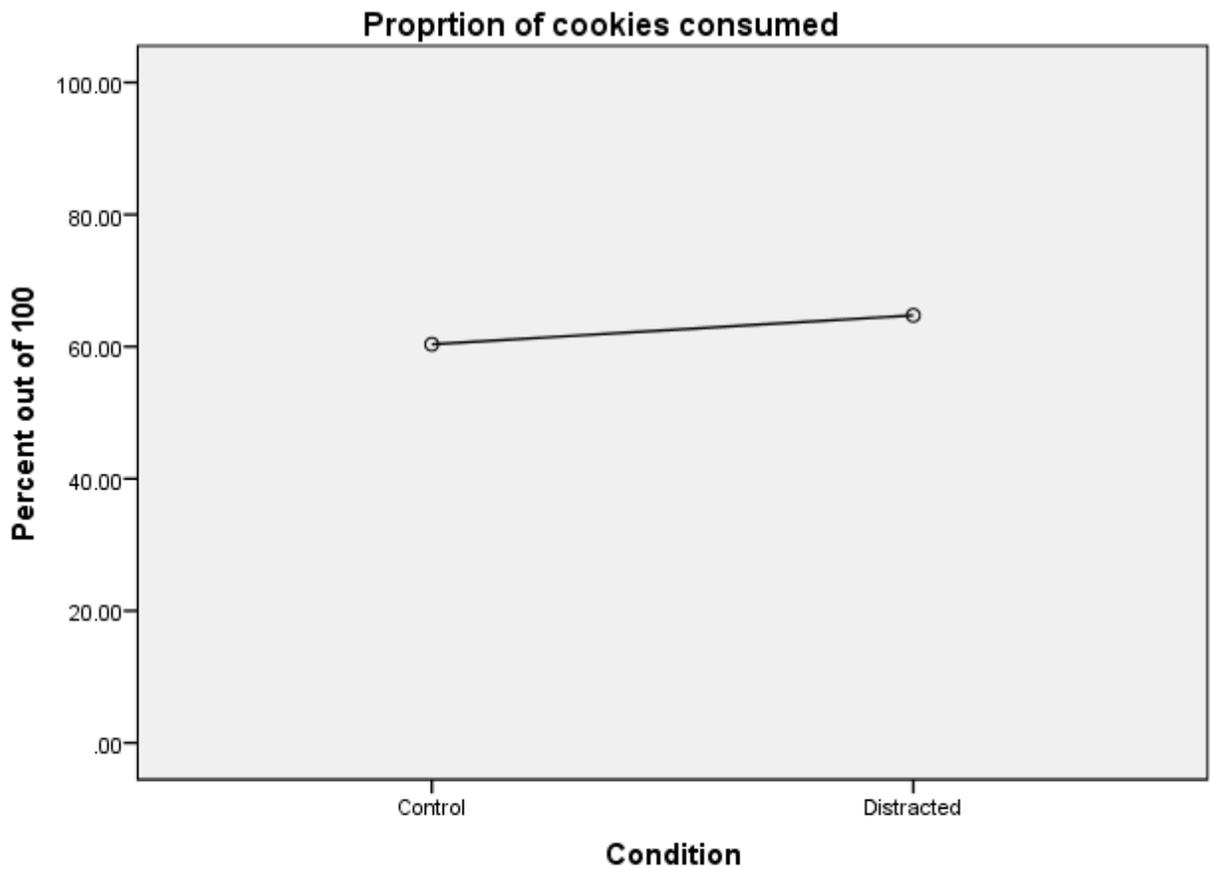
Snack preference. In order to assess snack preference, a repeated measures ANCOVA, controlling for initial condition and intake at the earlier mealtime, was conducted to compare the proportion of each snack that was consumed relative to what was offered. No significant difference in the proportion of grapes consumed between groups was detected ($F(1, 113) = 1.632, p=.204$) (Figure 4.6). Similarly, no significant differences in the proportion of cookies consumed was observed between groups ($F(1, 115) = 1.682, p=.197$) (Figure 4.7).

Figure 4.6 Proportion of grapes consumed relative to the amount provided



Covariates appearing in the model are evaluated at the following values: InitialCon = .53, D_Quiche = 113.5556, N_Quiche = 127.2393

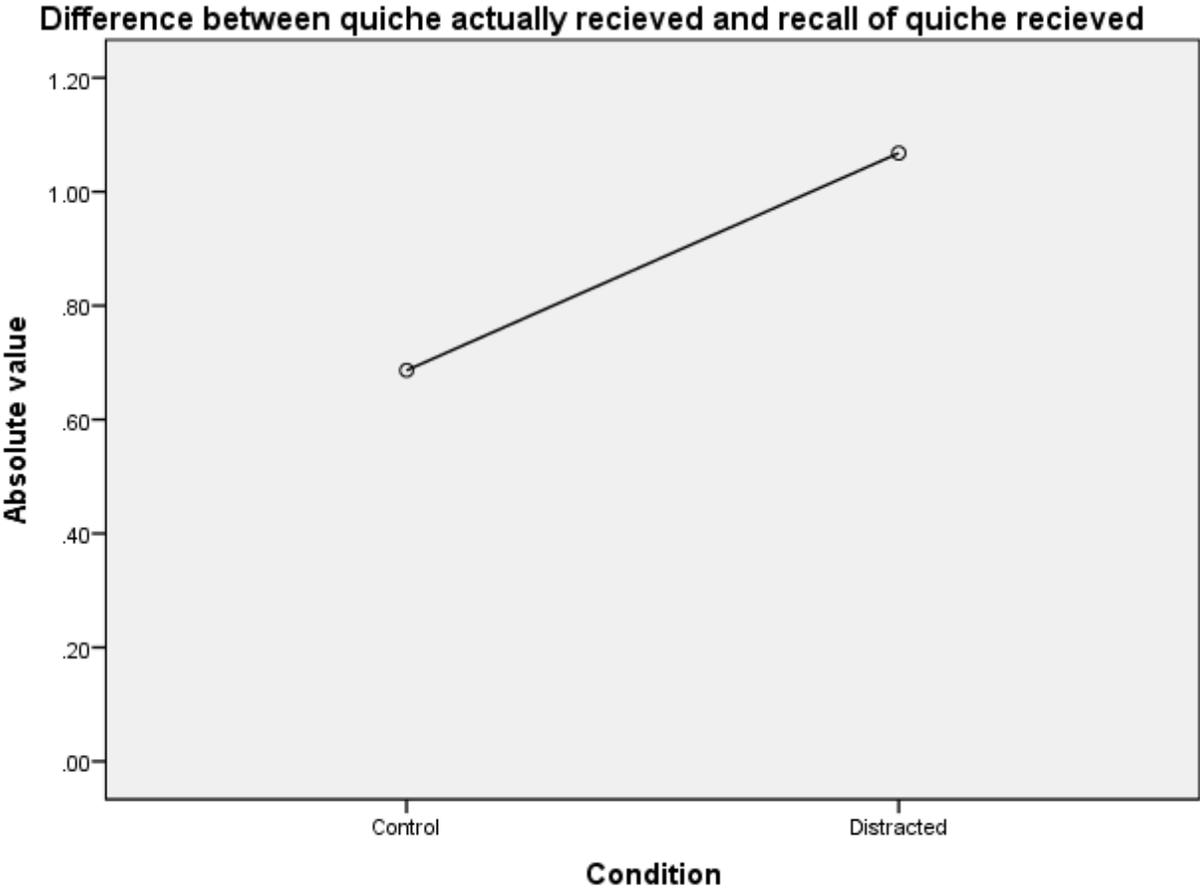
Figure 4.7 Proportion of cookies consumed relative to the amount provided



Covariates appearing in the model are evaluated at the following values: InitialCon = .54, D_Quiche = 114.6387, N_Quiche = 128.1176

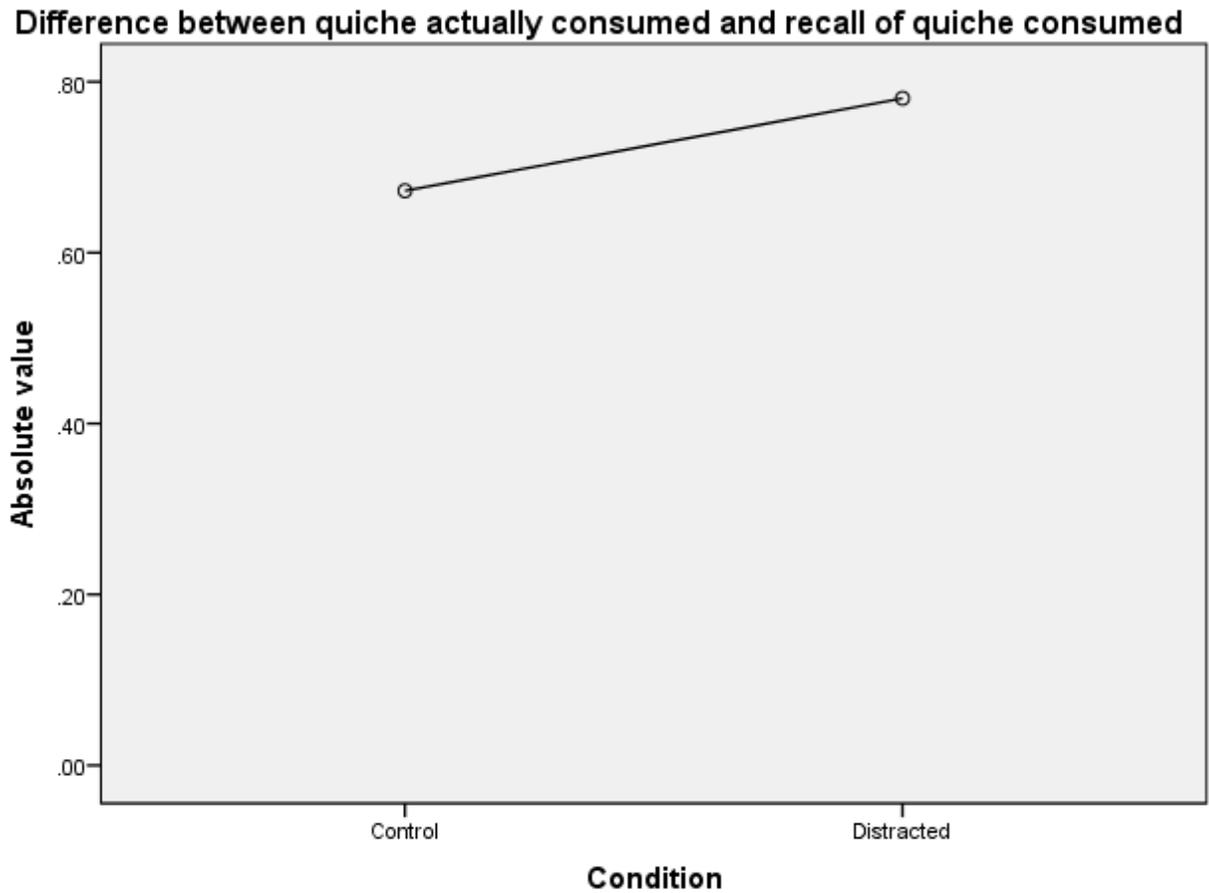
Memory. To assess the participants' memory of the meal they consumed, a repeated measures ANCOVA, controlling for initial condition, was conducted using the absolute values of the differences between actual and reported for both the number of quiche received and the number of quiche consumed. These analyses revealed a significant difference between groups for memory of quiche received ($F(1, 116) = 30.737, p=.000$) (Figure 4.8) and memory of quiche consumed ($F(1, 118) = 7.616, p=.007$) (Figure 4.9).

Figure 4.8 Comparison of absolute values of differences between number of quiche actually received and number of quiche received recalled by participant



Covariates appearing in the model are evaluated at the following values: InitialCon = .53

Figure 4.9 Comparison of absolute values of differences between number of quiche actually consumed and number of quiche consumed recalled by participant

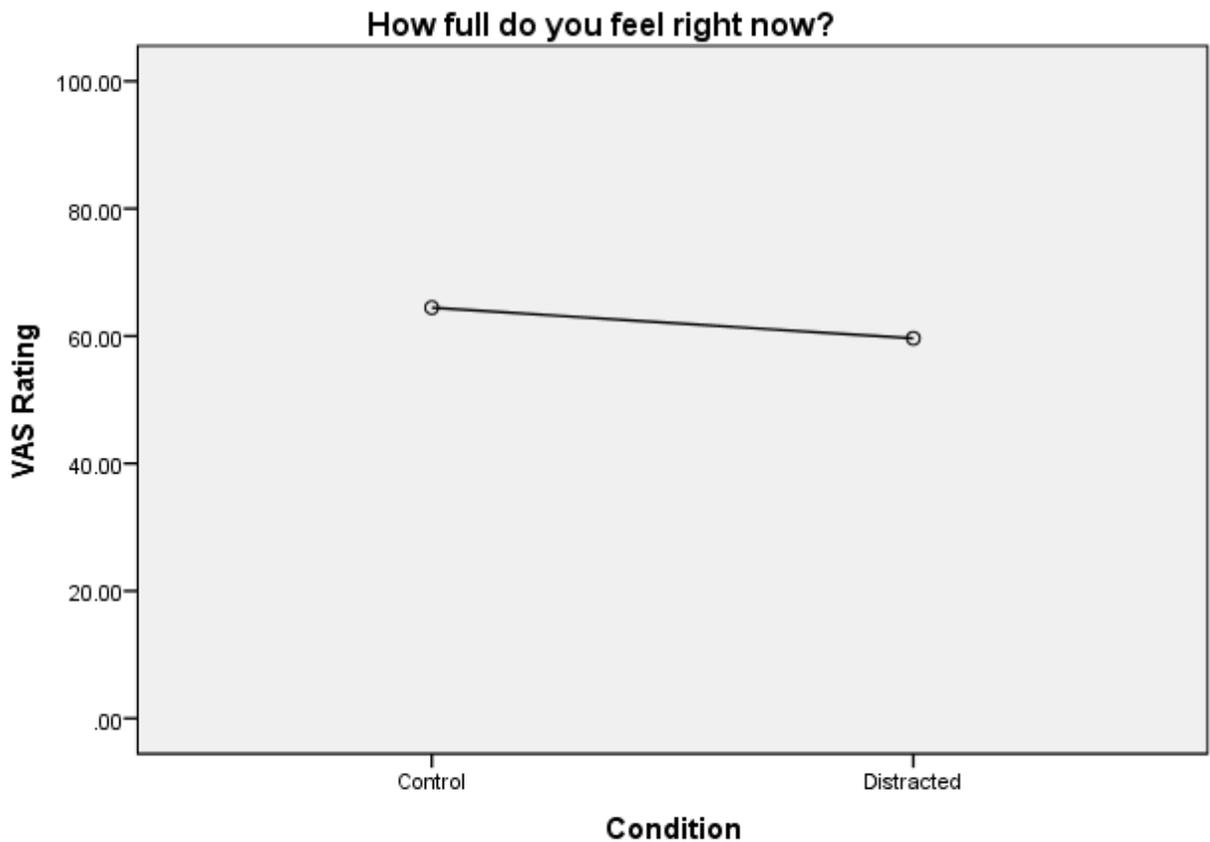


Covariates appearing in the model are evaluated at the following values: InitialCon = .53

The Effect of Distraction at Mealtime on Perceptions of Satiety and Enjoyment

Fullness. To assess feelings of fullness, the question “How full do you feel right now?” was asked, and participants responded using a 100mm VAS. Responses were analyzed using a repeated measures ANCOVA controlling for initial condition and the amount of quiche, cookies, and grapes consumed. No statistically significant differences were observed between groups ($F(1, 109) = .600, p=.440$) (Figure 4.10).

Figure 4.10 Responses to “How full do you feel right now?” on a VAS



Covariates appearing in the model are evaluated at the following values: InitialCon = .53, D_Cookies = 19.6325, N_Cookies = 18.1709, D_Grapes = 47.2051, N_Grapes = 43.7009, D_Quiche = 113.5556, N_Quiche = 127.2393

Hunger. Feelings of hunger were assessed using a 100mm VAS accompanying the question, “How hungry do you feel right now?” A repeated measured ANCOVA, controlling for initial condition and the amount of quiche, cookies, and grapes consumed, was used to analyze responses. No significant difference was observed between groups ($F(1, 109) = 1.213, p=.273$) (Figure 4.11).

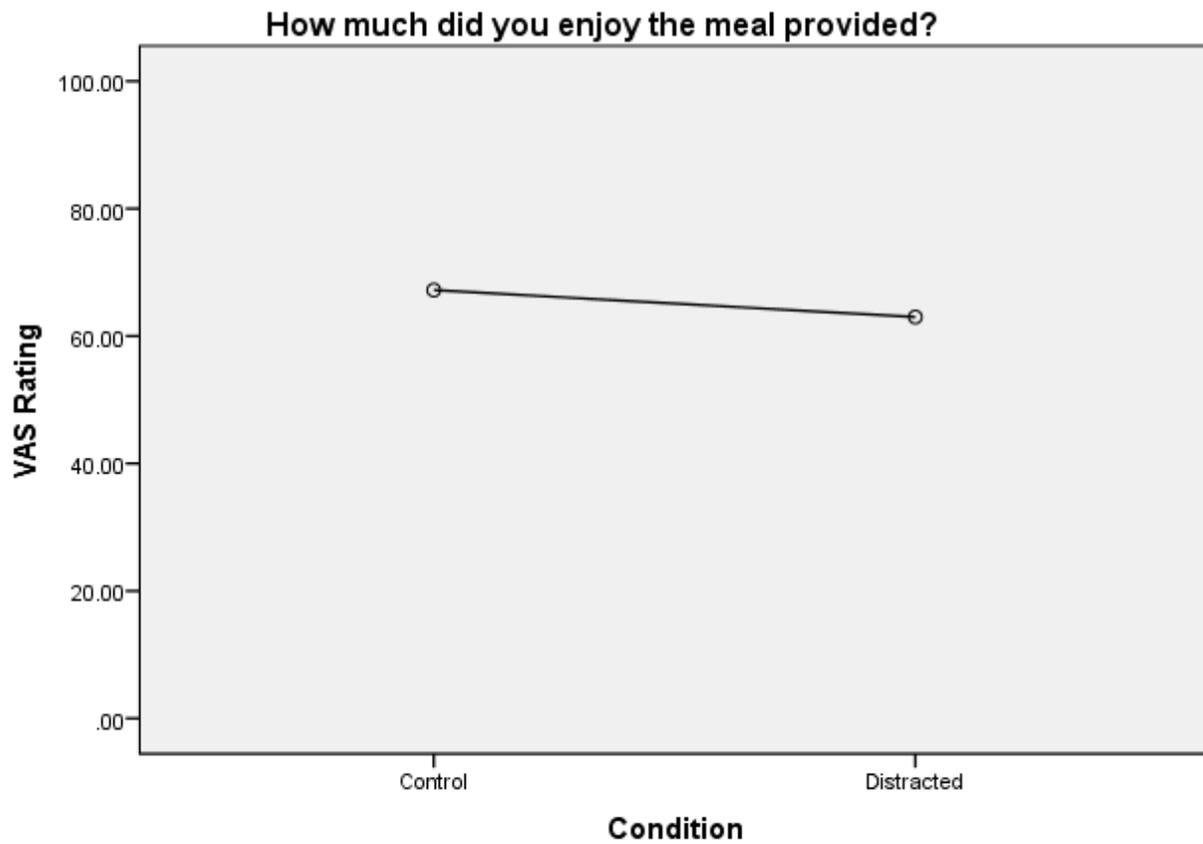
Figure 4.11 Responses to “How hungry do you feel right now?” on a VAS



Covariates appearing in the model are evaluated at the following values: InitialCon = .53, D_Cookies = 19.6325, N_Cookies = 18.1709, D_Grapes = 47.2051, N_Grapes = 43.7009, D_Quiche = 113.5556, N_Quiche = 127.2393

Enjoyment. Enjoyment of the meal was determined by asking the question, “How much did you enjoy the meal provided?” Participants responded using a 100mm VAS. Responses were analyzed using a repeated measures ANCOVA controlling for initial intake and amount of quiche, cookies, and grapes consumed. Analysis revealed no significant differences in enjoyment between the two groups ($F(1, 108) = 2.710, p=.103$) (Figure 4.12).

Figure 4.12 Responses to “How much did you enjoy the meal provided?” on a VAS



Covariates appearing in the model are evaluated at the following values: InitialCon = .53, D_Cookies = 19.5259, N_Cookies = 18.0603, D_Grapes = 47.1724, N_Grapes = 43.6552, D_Quiche = 113.1724, N_Quiche = 127.4138

CHAPTER 5: DISCUSSION

Consumption of a Meal Decreases When Distracted

Previous studies have concluded that those who were distracted during mealtime consumed more food than those who were not distracted (Ogden et al., 2013; Mitchell & Brunstrom, 2005; Wansink, 2010). Results of the current study, however, do not concur with previous findings and do not support the hypothesis. When distracted, participants ate less, on average, than when not distracted. This contrasting result may be due to a number of reasons. Previous studies used cross-sectional designs and were, therefore, unable to identify any within person effects. It appears that the presence of distraction has a lesser within person effect than between person effect. Another novel aspect of the current study is the inclusion of male participants. Although not statistically significant, men had a stronger response to the presence of distraction at mealtime. This may also have contributed to the difference in directionality that has not been previously observed. It may also be that the type of distraction matters more than has been previously asserted.

Currently there is little distinction in the literature between “distracted” and “mindless” eating. This distinction, however, may play an important role in the differences observed here. The RVIP task was used because of its past validation as a measure of sustained attention. It requires the player to be focused on the activity with little ability to multitask. This would be considered a distracted eating condition. This is a very different condition than watching television or listening to an audio clip during which it would be possible for the mind to wander or to be engaged in other activities. These would constitute examples of mindless eating conditions. While these may be salient experiences for the

population and worthy of exploration, they may not have the same effect on food consumption as distracted eating.

It was observed that initial condition played an important role in how much participants consumed during the distracted condition. The largest difference was observed in the group of participants who were randomly assigned to the distracted condition first, when they were in the distracted condition. The effect of the distraction on food intake was only significant at the individual's first testing session. This may be attributed to a number of reasons, namely the novelty of the RVIP task. It may have been that the participants perceived doing well on the computer game to be more rewarding than the food provided. It is possible that the population, being college students from an academically competitive institution, placed a higher value on excelling in the task assigned than on consuming the plate of food. This may be reinforced by the difficulty of the task. If they found it to be more challenging, it may have demanded more of their attention.

In addition, it is possible that the miniature quiche provided were a less familiar food than was initially realized. If participants were encountering the quiche for the first time as a new food, those in the distracted condition may not have had the opportunity to familiarize themselves with the food. Those who began in the control condition had the opportunity to focus on the food provided. Even if it was a new food for them, they were able to familiarize themselves with the quiche in a way that those who began in the distracted condition were not. This would explain why both groups behaved similarly in the control condition, regardless of their initial condition. The group that began distracted

interacted with the quiche like they were encountering it for the first time, even though it was their second testing session and they had eaten the quiche before.

While the present study has provided new insight into nature of distracted eating, it is not without limitations. The sample used in the study was fairly homogenous, and may be limited in generalizability. Because the interaction of initial condition was significant, it would have been useful to have two additional groups included: one group that was distracted at both time points; and one that was not distracted at both time points. Without this information, it is difficult to say to what degree the initial condition played a role in influencing intake. In addition, the use of quiche as the primary food component may have introduced some additional, unintended variability. Using a food that is more familiar to college students may help to avoid that pitfall.

Future Intake Is Not Altered After a Distracted Meal

The importance of where and when a meal is consumed has been well established (Caspi, Sorensen, Subramanian, & Kawachi, 2012). Factors beyond simply what is on the plate can and will play a role in what an individual chooses to consume. Previous studies have investigated the role that memory plays in food intake (Higgs, 2002; Higgs, 2008; Higgs & Donohoe, 2011; Higgs, Williamson, & Attwood, 2008). Higgs and Donohoe (2011) observed that those who had poorer memory of their meal consumed more at a future eating occasion. The results of the present study do not match those findings, where the hypothesis was supported. Here, it was determined that when controlling for amount consumed at mealtime, the amount of food consumed at a later snack did not differ between the distracted and control condition. These distinctions may have been observed

because of the difference in design of the two studies. The present study utilized a cross-over design to assess within person variability, whereas earlier findings related to between subject variability. Previous studies confirmed that intake at mealtime was not significantly different between all groups but did not control for that previous intake in the statistical model. The present study was also conducted in a larger, more diverse sample with the inclusion of male participants.

Little is known about the influence of distraction on food preference. With exploratory intent, the present study aimed to provide some preliminary insight into the effect of distraction at mealtime on food preference at a future eating occasion. Here preference between food perceived to be either healthy or unhealthy was assessed; however, no differences were observed between the two groups. This may be due to the timing of the meal. All testing sessions took place in the morning during breakfast time. The snack choices offered were either chocolate chip cookies or grapes. A higher proportion of grapes was consumed on average, regardless of condition. It may have been that participants perceived grapes to be a more appropriate choice for the morning eating time. Future research should examine these effects at different times of day or use food items that are more suitable for breakfast, such as pastries or muffins.

The reduction in memory of the meal for those in the distracted condition was not surprising. Previous work has found similar results (Oldham-Cooper, Hardman, Nicoll, Rogers, & Brunstrom, 2011; Higgs & Donohoe, 2011). The question of importance of meal memory, however, is still unresolved. Even though distraction resulted in poorer recall of the amount of food received and consumed at mealtime, there was no difference in the

amount of food consumed or food preference at the future eating occasion. This suggests that the ability of an individual to recall what he/she has previously consumed may neither play a role in what nor how much he/she consumes in the future.

By controlling for amount consumed at mealtime in the statistical model, the present study was able to isolate and assess the amount of food consumed at a future eating occasion without variation from additional factors. Future investigators, however, should consider controlling for mealtime intake in the study design. Giving participants a set amount of food during mealtime that they are required to consume in its entirety under both the distracted and control conditions may help to isolate the impact of distraction on future eating behaviors and eliminate the need to control for extraneous factors.

Perceptions of Satiety and Enjoyment Are Not Altered After a Distracted Meal

Results of the present study indicated that the presence of distraction at mealtime had no effect on perceptions of fullness, hunger, or enjoyment of the meal. When controlling for initial condition and previous food intake, there was no statistically significant within person differences in the distracted or control conditions. While it has been suggested that memory of the meal may be diminished when an individual consumes the meal while distracted (Higgs & Donohoe, 2011), distraction does not appear to influence the individual's perception of his or her own satiety. Contrary to expected, findings from the current study do not support the hypothesis.

An individual's perception of their own satiety may be important for several reasons. Perceived hunger and fullness may affect food preferences, serving sizes, and ultimately how much an individual chooses to consume at a given eating episode. If

perceived satiety does not correlate with actual energy intake, this can lead to overeating and weight gain. Based on the findings presented here, distraction does not appear to play a role in perceived satiety. While mindfulness during mealtime may be important for meal memory and monitoring (Painter, Wansink, & Hieggelke, 2002), subsequent feelings of satiety are not affected. This may blunt the impact of distraction on future eating episodes.

The enjoyment of food is a primary motivator in food choice (Spitzer & Rodin, 1981). The miniature quiche used in the present study were generally well received by the participants. Future research should investigate whether this relationship holds when the food being consumed is less desirable. For example, do enjoyment ratings still hold constant across conditions when participants are asked to eat cruciferous vegetables or whole wheat versions of their favorite pasta? This may be a potential avenue of intervention for promoting intake of healthful foods among those that find them unpalatable.

While an individual's motivation to eat can be contributed to numerous external factors, this does not negate the influence of hormonal regulation. The absence of an objective measure of satiety in the present study, however, leaves the relationship between distraction and biological methods of intake regulation unexplored. This may be a potentially useful piece of information needed to further expand on the role distraction plays in postprandial perceptions. Measuring blood concentrations of satiety hormones, such as PYY, GLP-1, and ghrelin, before and after a distracted eating period would help to determine if biological measures and perceptions of satiety are congruent.

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CHAPTER 6: CONCLUSIONS AND FUTURE DIRECTIONS

The present study aimed to examine the ways in which the presence of 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. The amount of food consumed by individuals and their food preferences when a snack was offered were measured to evaluate this outcome. In addition, the effect of distraction at mealtime on an individual's perceptions of satiety and enjoyment of the meal consumed was measured in an attempt to examine the cognitive impact of eating environments.

The resulting observations were surprising and in some cases contrary to what has previously been reported. When distracted, individuals consumed significantly less than when they were not distracted. This effect was not mitigated by the participants' initial condition or gender, however, when stratified by initial condition an interesting pattern emerged. Those who experienced the distracted condition first ate significantly less than any other group when distracted. This result was not observed, however, in those who experienced the control condition first. This suggests that there may be a potent interaction 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 the participants from familiarizing themselves with the food. The combination of a novel food item and an engaging, task oriented method of distraction resulted in decreased consumption. When participants received the same food during the control condition, they behaved as if they were encountering the food for the first time as

evidence by a rate of consumption similar to that of those who began in the control condition. Conversely, those who began in the control 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 utilized the RVIP task because it is a validated measure of sustained attention and therefore a dependable tool for ensuring distraction is 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 will need to be conducted to determine if the various methods of distraction utilized produce the same results.

This calls into question the difference between “distracted” and “mindless.” The current literature often uses these terms interchangeably. In light of the findings presented here, there is a case to be made for the differentiation of the two 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. They 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. It will be essential to keep these constructs separate in order 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 distracted condition. This decrease in memory did not, however, result in an increase in snack consumption as was previously hypothesized. This suggests that memory of food previously consumed may not play as large a role in intake regulation as previously believed. It may be that additional, outside factors contribute more substantially. In the present study factors such as amount consumed at a previous meal had a much greater effect on how much an individual chose to consume at a future eating episode.

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 distracted and control 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 upon 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 one type of food during mealtime. Future studies should include a variety of foods and assess the effects of distraction during mealtime.

While the present study has offered novel insight, it is far from conclusive. In addition to what has been previously mentioned, future studies should aim to increase the generalizability of this field of research. This study was unique in that it included a larger proportion of men in the sample; however, the age group tested (18-25 years of age) 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 where the research was conducted. Future studies should aim to diversify the sample population to include a wider variety of age groups, races/ethnicities, and lifestyles.

In addition, this study, as well as previous investigations, was conducted in the laboratory setting. While this allows for tightly controlled experimental conditions, it may result in observations that are not truly reflective of how the population behaves in their everyday lives. Future investigation may consider an observational study design in order to assess the effects of distraction in a more naturalistic setting.

In conclusion, results from the present study indicate the need for a more detailed and nuanced investigation into the nature of distraction and effects on eating behavior. Distracted and mindless eating may be different constructs and need to be examined with that in mind. While the exact effects of distraction may not be entirely clear, what is certain is the impact of the environment on food choice. 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.

APPENDIX A: IRB LETTER

UNIVERSITY OF ILLINOIS
AT URBANA-CHAMPAIGN

Office of the Vice Chancellor for Research

Office for the Protection of Research Subjects
528 East Green Street
Suite 203
Champaign, IL 61820



October 13, 2016

Sharon Nickols-Richardson
Food Science & Human Nutrition
University of Illinois at Urbana-Champaign
260A Bevier Hall
905 South Goodwin Avenue
Urbana, IL 61801

RE: *The Effects of Distracted Eating on Consumption Food Preference and Satiety*
IRB Protocol Number: 17230

Dear Dr. Nickols-Richardson:

Your response to stipulations for the project entitled *The Effects of Distracted Eating on Consumption Food Preference and Satiety* has satisfactorily addressed the concerns of the University of Illinois at Urbana-Champaign Institutional Review Board (IRB) and you are now free to proceed with the human subjects protocol. The IRB approved, by expedited review, the protocol as described in your IRB application with stipulated changes. The expiration date for this protocol, IRB number 17230, is 10/11/2017. The risk designation applied to your project is *no more than minimal risk*.

Copies of the attached date-stamped consent form(s) must be used in obtaining informed consent. If there is a need to revise or alter the consent form(s), please submit the revised form(s) for IRB review, approval, and date-stamping prior to use.

Under applicable regulations, no changes to procedures involving human subjects may be made without prior IRB review and approval. The regulations also require that you promptly notify the IRB of any problems involving human subjects, including unanticipated side effects, adverse reactions, and any injuries or complications that arise during the project.

If you have any questions about the IRB process, or if you need assistance at any time, please feel free to contact me at the OPRS office, or visit our website at <https://www.oprs.research.illinois.edu>.

Sincerely,

A handwritten signature in cursive script that reads "Dustin Yocum".

Dustin Yocum, MA, CIP
Human Subjects Research Specialist, Office for the Protection of Research Subjects

Attachment(s): Informed consent form; and Alteration of Informed Consent Form

c: Carli Liguori
Qianwen Liu