An Evaluation of Bite Counting as a Form of Visible Feedback

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AN EVALUATION OF BITE COUNTING AS A FORM OF VISIBLE FEEDBACK

A Thesis
Presented to
the Graduate School of
Clemson University

In Partial Fulfillment
of the Requirements for the Degree
Master of Science
Applied Psychology

by
Jacqueline Elizabeth McSorley
August 2018

Accepted by:
Dr. Eric Muth, Committee Chair
Dr. Elliot Jesch, Committee Member
Dr. Benjamin Stephens, Committee Member
ABSTRACT

This study aimed to determine if viewing bite count in real time had the same effect as viewing visible food records to decrease intake during a meal. Behavioral intervention is the most common treatment used to lower food consumption. This includes the idea of self-monitoring food intake through a variety of methods like bite counting. Another factor that leads to the reduction of food consumption is the presence of feedback. This feedback can take the form of visible food records such as chicken bones, candy wrappers, or bottle caps. In this study, chicken wings were used as the visible food record and compared to a bite counting display. A 2x2 between-subjects study was conducted with the following conditions: bones/bite group, bones/no bite group, no bones/bite group, no bones/no bite group. An effect of food waste was hypothesized such that individuals would consume fewer grams when the chicken bones were present. The main effect of bone presence was found to be significant \((F(1,88)=3.314, p<0.05, \eta^2=0.036)\). Additionally, an effect of bite count was hypothesized such that individuals would consume fewer grams when bite count was present. The main effect of bite presence was not significant \((F(1,88)=0.014, p=0.45, \eta^2=0.00)\). Finally, no interaction between food waste and bite count was hypothesized such that individuals would consume the fewest grams when both were present and the most grams when neither were present. A significant interaction was observed for bite count presence and bone presence \((F(1,88)=3.187, p<0.05, \eta^2=0.035)\).
ACKNOWLEDGEMENTS

I would like to acknowledge Dr. Eric Muth for his assistance through my thesis and the past four years of my time in his lab. I would also like to thank my committee members, Dr. Elliot Jesch and Dr. Benjamin Stephens, for helping me become a better scientist. Next, I would like to acknowledge my lab mates Sarah Beadle and Amelia Kinsella, as well as my Creative Inquiry research assistants, for all their help with data collection. Finally, I would like to thank Joe’s New York Pizza in Clemson, SC, for the excellent wings and their cooperation with the study.
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CHAPTER ONE
INTRODUCTION

Purpose

The purpose of this study was to determine if viewing bite count in real time acted as a visible food record during a meal. Additionally, it aimed to see if bite count feedback could reduce food consumption as effectively as visible food records.

It is important to establish techniques to aid weight loss due to the growing number of overweight individuals, both in the United States and worldwide. According to the Center for Disease Control (2016), 37.9% of adults in the United States are obese and another 32.8% are considered overweight. While there are many diets and methods for losing weight, one prominent method is daily self-monitoring.

Self-Monitoring

Self-monitoring is one of the most reliable ways to promote weight loss (Burke, Wang, & Sevick, 2011). Consistent exercise monitoring can lead to significantly greater weight loss and fewer difficulties with exercise than those who do not monitor (Carels et al., 2005). Exercise monitoring with smart devices has become a popular trend that gives users a sense of accomplishment. Fitbits allow for goal-setting, provide immediate feedback, and display performance review on the device screen or smartphone application (fitbit.com). Goal setting is most effective when individuals set their own attainable goal (Locke, 2002). Fitbit users receive feedback within the application through alerts and “badges” for taking certain amounts of steps or completing milestones. Performance data are delivered through instantaneous device alerts, visualizations within
the phone application, and compiled weekly data delivered via email. These aspects of fitness monitoring aid users in staying consistently self-aware of their actions and goals.

*Self-Monitoring for Eating*

Self-monitoring food intake can also be beneficial for losing weight or maintaining a healthy lifestyle. One common self-monitoring technique is the practice of daily weighing. Daily weighing gives individuals a greater sense of self-awareness for their situation, and increases the likelihood of maintaining a normal weight over time (Wing, Tate, Gorin, Raybor, & Fava 2006). Diet diaries are another means of self-monitoring by tracking daily food intake. There are smartphone applications where users can digitally record daily food intake by scanning barcodes to easily input prepackaged foods. This method works well when used properly; however, users must be willing to consistently input their daily intake (Laing et al., 2014). Self-monitoring can also bring unwanted attention to the user, which makes them reluctant to consistently record their data. One of the biggest problems with self-monitoring is that people struggle with estimating proper portion sizes, typically underestimating their intake (Ovaskainen et al., 2008). Fortunately, there are other ways to increase awareness while eating.

Self-monitoring is simplified through new technological advancements that encourage a reduction of food intake during the meal rather than pre- or post-meal recordings. These new tools can help users monitor their eating rate in order to increase awareness during an eating activity. Martin and colleagues (2007) explored this idea by measuring eating rate and satiety levels. After measuring each individual’s baseline eating rate during an acclimation meal, the participants ate at their baseline rate, reduced-
rate (50% slower), and a combined rate (baseline rate at the beginning of the meal with a transition to reduced rate). Food intake decreased significantly for male subjects in the latter two conditions, a result of the reduced eating rate.

After conducting this study, Martin and his colleagues posed the question of whether a reduced eating rate could really be trained. This idea was examined by Zandian and colleagues, who found that eating rate training can now be used as an interventional method to treat eating disorders (Zandian et al., 2007). A device named the Mandometer (AB Mando, Sweden) aids users in retraining their eating rate, which has shown to be positively correlated with weight change (Ford et al., 2010). The Mandometer is a scale-integrated eating station that monitors real-time changes in food weight. It displays the current plate weight as well as calculated eating rate on a small screen in front of the user. The goal of this system is to increase mindfulness in order to eat at a slower rate or reduce average bite size. It can also be used for people with eating disorders that restrict consumption of food. One study used the Mandometer to help patients with Anorexia Nervosa by encouraging participants to monitor their eating rate and satiety levels (Zandian et al., 2007). They were able to train participants to increase consumption and eating rates, and continue to maintain normal eating habits after a later follow-up. While this method is valuable for clinical or home use, it can be burdensome to transport or use discreetly when dining out.

Another device is the 10S Fork (Slowcontrol, France), which silently alerts the user to slow down eating rate if more than one bite is taken during a ten second period. One problem with this device is that the user must carry it wherever they go, so it is not
effective if a meal is consumed without it. Also, the 10S Fork only works for food items that can be consumed with a fork, which limits the items that can be monitored to solid foods. Furthermore, the design of this mechanical fork could attract unwanted attention to the user. Unwanted attention can lead to weight gain if eaters are uncomfortable performing self-monitoring behaviors in front of others. Due to problems with mobility and discretion, these two devices have limited practical application in social settings.

**The Bite Counter**

Unlike the Mandometer and the 10S Fork, The Bite Counter (Bite Technologies, Clemson, SC) is both a mobile and discrete way to track food intake. The Bite Counter is a wrist-worn device that detects the specific wrist roll motion of taking a bite of food. It displays a real-time count of total bites for an eating activity and works as a watch when not counting bites (Dong, Hoover, Scisco, & Muth, 2011). The Bite Counter also has a built-in alarm that can be set to sound after the consumption of a specific, predetermined number of bites per meal. In order for it to count bites, it must be set to bite count mode by pressing a button before each meal. Further, bite count mode must be turned off at the end of each meal by pressing the same button. This results in a relatively burden-free protocol, with no calculations required by the user. The device also counts steps taken throughout the day to provide additional information regarding the user’s health-related habits. Due to its watch-like design, it can be worn throughout the day and used unobtrusively when eating with others.

Scisco and colleagues (2012) used Bite Counters to assess the relationship between the energy density of food and bite size. They tested participants for two weeks
using Bite Counters and the Automated Self-Administered 24-Hour Recall (ASA24), an online food diary that records calorie count per meal. The relationship between kilocalories and bites showed natural variability based on differences in food and bite size, but became more stable at the meal level. In other words, bite count is intrinsically scaled: it varies from person-to-person but averages out for each individual. This demonstrates long-term consistency in calories consumed per bite and how this tool can be used to monitor eating behavior.

Wilson and colleagues (2013) examined the use of bite count as a way to reduce intake and lose weight. Participants were assigned to one of two groups: one group was instructed to wear Bite Counters in order to record their data, and one group wore Bite Counters and did not record anything. This study found a significant difference between the two groups such that the group that used the Bite Counters lost more weight. This outcome illuminates the potential effectiveness of Bite Counter feedback as a self-monitoring tool.

Monitoring bite count works regardless of food type because it promotes self-awareness, focusing on reducing portion size while not asking for major alternations in food selection. The Bite Counter works to encourage self-monitoring by providing direct feedback of how much an individual has consumed during a particular meal. This is important because feedback allows individuals to stay aware of the amount they are consuming, while they are eating, and adjust their behavior to stay within a certain portion size. It was hypothesized that bite count could provide an environmental cue regarding the portion consumed, much like a visible food record.
Environmental Cues

Environmental cues influence the amount of food an individual consumes rather than what types of food they consume (Wansink, 2004). It is imperative that eaters are aware of these cues because their behavior is often unknowingly changed due to environmental influences. Wansink (2004) discusses two main categories of environmental cues that impact total consumption: the eating environment and the food environment (Figure 1).

![Diagram showing antecedents and mediators of food consumption volume](image)

**Figure 1.1: Antecedents and mediators of food consumption volume (Wansink, 2004).**

**Eating Environment**

The cues from the eating environment, e.g., the sensory stimuli surrounding the eater, can have just as big an impact as the presence of food itself. The overall atmosphere of the environment can increase or decrease consumption based on a number
of characteristics (Wansink, 2004). Temperature is a significant factor. When the room is cold, more energy is used by the body to warm up, and accommodates greater food consumption (Westerterp-Platenga, 1999). Also, dim lighting in an eating area can lengthen eating activity duration and increase comfort (Lyman, 1989). People will feel less inhibited by social factors when consuming food in a darker space (Lavin & Lawless, 1998). Another factor is the amount of effort needed to access the food supply. When food is already opened, people will be more likely to consume the food than if they have to put forth effort to access the food. This was exemplified by a study where people ate more ice cream when the lid was already off (Meyers, Stunkard, & Coll; 1980), and another where people ate more almonds when they were already shelled (Schachter & Friedman, 1974).

Another notable environmental cue is the presence of other eaters. Eating with friends or family increases duration of the meal and comfort in consuming greater amounts of food (Bell & Pliner, 2003). Also, the number of people eating in a group is positively correlated with food volume consumption (de Castro & Brewer, 1992). On the other hand, food consumption decreases in certain situations such as during job interviews or on a date where individuals are trying to manage the impression that they make (Chaiken & Pliner, 1990). Environmental distractions such as reading, watching television, or viewing a sporting event can also have an effect on food consumption. One survey found that the cessation of a particular eating activity for some individuals often occurred at the end of their television program (Tuomisto et al., 1998). This
demonstrates how eating can be used as a secondary task when taking part in a distracting activity and can lead to consumption beyond necessary levels.

*Food Environment*

Much like the eating environment, the food environment plays an important role for influencing eating behavior. Food saliency, or the prominence of the food to the eater, is a significant contributing factor to how much food an individual consumes (Wansink, 2004). When food is sensed by the visual and olfactory systems, individuals are more likely to eat—even if not previously anticipating engagement in an eating activity (Cornell, Rodin, & Weingarten, 1989). Another aspect of saliency is the amount of food displayed, particularly when food is purchased in bulk. Food purchased at wholesale stores can take up large amounts of storage space, so individuals are more likely to see the item and consume (or over-consume) that food item (Chandon & Wansink, 2002). In another study, Wansink (2004) assessed total consumption with yogurt flavors, M&M® colors, and jelly bean varieties. He found that when multiple food options are available, people will consume significantly greater quantities than when a smaller assortment is present.

Another food environmental factor is the size of the container in which the food is served. According to Wansink (2004), this may be due to the fact that larger packages give an altered view of an appropriate amount to consume. Completion compulsion, or the “clean your plate” phenomenon, is instilled in many children at an early age (Siegel, 1957). Siegel found that when meal completion is the overarching goal of the meal, total consumption increases when larger portions of food are served. Similarly, using larger
bowls, plates, and drinking glasses lead to larger portions served and consumed (Wansink & Van Ittersum, 2003). People use these containers to estimate appropriate amounts to consume, which can be very misleading. For example, patients at a health care facility took liquid medicine with either a regular spoon or larger spoon; those that used the larger spoon overestimated the dosage size by 22% (Wansink & Van Ittersum, 2004).

Another article by Scisco and colleagues (2012) examined portion estimation when a fixed amount of JELL-O® was divided into different sized pieces. Participants reported that the plate of JELL-O® that was divided into more pieces was a greater portion than that divided into fewer pieces. This demonstrates the importance of awareness for portion size when not using specific measurement tools. As mentioned before, people are generally bad at estimating portion sizes. According to Wansink (2004) “determining how much to eat or drink is a relatively low-involvement behavior that is a nuisance to monitor continually and accurately, so they instead rely on consumption norms to help them determine how much they should consume.” This is why using a specific measurement tool or object guide can help people make better estimations. For example, a deck of cards is approximately the 3 ounces of meat, a computer mouse is one serving of baked potato, and a woman’s thumb is about a teaspoon of butter (Patritto, 2013). Increasing awareness of an activity, such as an overestimation of portion sizes, can promote weight loss (Burke, Wang, & Sevick, 2011).
Visible Food Record

Another environmental cue later discussed by Wansink and Payne (2007) is the presence of a visible food record. A visible food record is any uniform waste that accumulates as a food item is consumed. These help counter other factors that can lead to an increase in consumption such as socializing, food salience, and general distractions. Visible food records have been assessed with foods such as candy wrappers, cherry stems, bottle caps, and chicken bones. Wansink and Payne (2007) conducted a study at a wing buffet where participants were randomly assigned to have their wing bones cleaned from the table or left to accumulate in front of them. They found that men who had the bones pile up ate fewer wings compared to those whose food waste was constantly bussed from the table. This effect was not significant for women, but the trend followed the same pattern. When food waste piles up in front of them, they are more conscious of how much they have eaten and are able to self-monitor, despite negative environmental factors, due to this feedback. Visible food records are not necessarily limited to waste from food sources. Wansink made the following assertion:

In situations where “counting bones” is not possible, other proxy environmental cues may be used to keep track of what has been consumed. For example, a written tally of bites of food could be made to suggest how much has been consumed. Such effort to provide an environmental cue will help one better keep track of how much they have consumed compared to if people simply allowed the natural environment
of distraction and no evidence of how much was consumed to influence them to eat mindlessly. (Wansink and Payne, 2007)

It is theorized that any consistent form of feedback (such as a visible marker, like a poker chip, next to the plate after every serving) could yield the same effect since they still represent a standardized reminder of each serving or portion. The Bite Counter provides a form of feedback (bite count tally) that increases with average consumption. The steady increase in bite count could mimic the increase in bone count as consumption increases. Total consumption still depends on bite size, but this device provides an intrinsically-scaled way to self-monitor in real-time. Perhaps bite count acts as a proxy for portion size. A person may reason that “one meal is about 20 bites” or “one chicken wing is approximately 4 bites.” It is also possible that the unappetizing nature of food waste deters people from eating, which would not translate to bite count or other visual cues. This concept was assessed in the current study.

**Current Study**

The purpose of this study was to determine if viewing bite count in real time had the same effects as viewing visible food records during a meal. This was performed in order to move closer to determining the value that bite count represents to users. Participants were divided into four conditions (Table 2.1) in order in order to directly compare the effects of visible food records and bite count: bones present or absent; bite count present or absent. Chicken wings were chosen as the food item in order to replicate the effects of Wansink’s study. Furthermore, bite count is easiest to tally with foods that do not require “utensiling” (cutting with knife, stirring, etc.). Chicken bones were
employed as a form of visible feedback. Participants were instructed to eat a meal of barbecue chicken wings until they were full. Half were instructed to dispose of the bones in their trashcan as they ate. This was to eliminate the presence of the food waste feedback. The other half kept the bones on their plate as a form of feedback.

All four conditions had viewing access of the large monitor displaying bite count (Appendix B). This is consistent with how participants can all view each other’s eating progress during the meal. For the conditions with bite count feedback, the bite tally count increased with each bite and displayed their total bite count in real time. The conditions without the bite count feedback saw their bite count increase until they finished a chicken wing. At this time, their count was reset to zero to mimic the disposal of the visible food record. The independent variables were the presence or absence of the chicken bones and the presence or absence of bite count. The main dependent variable was the number of grams consumed. Secondary dependent variables include wings consumed, bites taken, food palatability and post-meal satiety.

Hypotheses

First, it was hypothesized that there would be an effect of chicken bone presence such that individuals would consume fewer grams when the bones were present. This is based on Wansink’s previous work using chicken bones as a visible food record. Next, it was hypothesized that there would be an effect of bite count such that individuals would consume fewer grams when total bite count was present on the display. Finally, it was hypothesized that there would be no interaction between food waste and bite count. It was hypothesized that the presence of both bite count and chicken bones would further
reduce grams consumed due to the additive effect of multiple feedback methods.

Without either form of feedback present, eaters would be less conscious of their eating and would consume the most grams of food.
CHAPTER TWO

METHODS

Participants

A power analysis was conducted based on Wansink’s “Counting bones: environmental cues that decrease food intake” study. An effect size of 0.62 (found in the Counting Bones study) was used along with an alpha value of 0.05 and beta of 0.8. A sample size of 33 per condition was determined as the number needed to detect an effect. Based on this, a sample of 36 subjects per condition, 144 subjects total, was used for the study to account for potential missing data. Participants were recruited using the SONA system (the Clemson Psychology department’s online subject pool management tool), email, and flyers. Participants were graduate or undergraduate students, 18 years or older, at Clemson University. Participants were not eligible to take part in the study if they had a history of an eating disorder or could not eat chicken wings.

Design

A 2x2 (Table 2.1) between-subjects design was used. For bite count feedback, participants experienced either the presence or absence of bite count display during their meal. For food waste feedback, participants experienced either the presence or absence of chicken bones.

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<td>Bones/No Bite Group</td>
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<tr>
<td><strong>Bones Absent</strong></td>
<td>No Bones/Bite Group</td>
<td>No Bones/No Bite Group</td>
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Table 2.1: Diagram of all four conditions: 1) Bones/Bite Group, 2) Bones/No Bite Group, 3) No Bones/Bite Group, 4) No Bones/No Bite Group.

Materials

Chicken Wings. Wings were purchased pre-cooked (baked) locally from Joe’s New York Pizza restaurant in Clemson, SC. The wings were re-heated and then coated with Sweet Baby Ray’s® barbecue sauce. To prepare the wings, they were stored in the freezer until the day before the session. One day prior, they were transferred to the refrigerator and re-heated in a roaster oven for 60 minutes prior to the session at 450 degrees. Thirty-six chicken wings were served in a 9x13 roaster pan for each experimental session. The servings included a mix of flats and drummettes. Average wing weight and bone weight are available in Appendix A.

Plates. Chinet Classic White Dinner Plates with a diameter of 26.4 cm were used.

HBF-306C Fat Loss Monitor. This device requires manual input of age, weight, height, activity level, and gender in order to calculate body fat percentage and body mass index. Participants hold the device two-handed with their arms outstretched while it calculates the rate of an electric signal through the body. The signal is slower based on the amount of fat in the individual’s body. This device is used to record BMI and body fat percentage prior to the start of the eating activity.

Tape Measure. A tape measure is used to record hip and waist circumference for each participant prior to the start of the eating activity.
Bite Count Display. A large monitor was placed next to the eating station and displayed all four participants’ bite count in real time. Appendix B illustrates the screen presented to the participants. An excel sheet was used by the researcher to manually update or reset each individual’s count using off-screen controls.

Manual Tally Sheet. A piece of paper that mimicked the tally display was given to two research assistants (Appendix C). They were instructed to watch the live stream of the participants eating and mark each time they took a bite in the respective block.

Instrumented Eating Station. This structure consists of a table with four scales that measure food weight in grams throughout the meal (Appendix D). Plates are placed on top of these scales when participants consume the meal. Two Dell Latitude E6520 laptops near the eating station are used to store raw sensor data from each scale.

Cameras. Four Cisco PVC300 cameras are fixed on the laboratory ceiling and are used to record participants from different angles. This is used to record the exact bite count taken for each participant during the meal.

Food Waste Baskets. Four lined, opaque, waste baskets with a 1.9 qt capacity were used to collect the bones during conditions without the presence of visible food waste. Participants were not able to view the remains after they dispose of the bones. The remains were weighed after the completion of the study.

Demographic Questionnaire. A short questionnaire was distributed to gain secondary knowledge of general demographic information including age, sex, education, and household income.
Satiety Labeled Intensity Magnitude (SLIM) Scale. This 11-point scale, designed by Cardello, Schutz, Lesher, and Merrill (2005), quantifies participants’ levels of hunger in order to measure satiety. The scale ranges from “Greatest Imaginable Fullness” to “Greatest Imaginable Hunger.” A copy of this scale is included in Appendix E.

Labeled Affective Magnitude (LAM) Scale. This 11-point scale, designed by Schutz and Cardello (2000), measures how pleasant a food is according to the participants. The LAM scale is proven to be a reliable measurement of hedonics in regards to food consumption. Peryam (1989) found that an 11-point scale is better at discriminating between levels of like or dislike than the previously used 9-point scale. The scale ranges from “Greatest Imaginable Like” to “Greatest Imaginable Dislike.” A copy of this scale is included in Appendix F.

Procedure

Participants were randomly assigned to one of the four conditions. Four participants took part in each session, all in the same condition. They were instructed to not consume any food for one hour prior to the start of the session. When participants entered the laboratory, they each filled out an informed consent form and a demographic questionnaire. Body measurements - including height, weight, hip/waist ratio, body mass index, and body fat percentage - were recorded by the researcher or a research assistant. Next, the first SLIM scale was administered to the participants. After all initial materials were completed, participants moved to the instrumented eating station. The chicken wings were removed from the cooker and placed in front of the participants. Participants were instructed to serve themselves as many wings as they wanted. After consuming
their initial serving, participants were allowed to serve themselves as many additional times as they desired.

Individual plates were automatically weighed using the eating station scales. All participants were told that they would be eating a meal of chicken wings until they were full and viewing their bite count on a monitor in front of the eating station. They were also informed that their bite count would increase each time they took a bite of food. After, instructions were given based on their condition (Table 2.1). Bones/Bite group was told to monitor their bite count on the bite count display and place the bones on their plate as they finish them. Bones/No Bite group was told to monitor their bite count on the bite count display and place the bones on their plate as they finish them. They were also informed that their bite count would reset to zero each time they finished a wing. No Bones/Bite group was told to monitor their bite count using the bite count display and place bones in the trashcan next to their plate after each wing. No Bones/ No Bite was told to monitor their bite count on the bite count display and place bones in the trashcan next to their plate after each wing. They were also informed that their bite count would reset to zero each time they finish a wing. All groups were instructed to eat until full and that they were allowed to serve more wings if requested.

After the completion of the meal, the second SLIM scale was administered along with the LAM scale. After the participants left, their individual food waste was weighed and the change in grams was recorded. For the Bones/Bite and Bones/No Bite groups, the food waste remaining on their plate was weighed. For conditions No Bones/Bite and No Bones/No Bite groups, the food waste remaining on their plate and in the separate
trashcans were weighed. Bite counts on the screen were collected along with bite counts recorded by the laboratory cameras.

**Analysis**

Wing weights were obtained before and after each serving. For the conditions where bones were thrown away, the final weight of the bones were separately obtained since the waste weights would just be the plate weight. Total grams consumed were calculated with the following equation for the “bones present” conditions, where

\[ s_1-w_1+(s_2-w_2)+(s_3-w_3)+(s_4-w_4) \]

For this equation, \( s_2 = w_1 + \) new serving of food, \( w_2 = w_1 + \) waste of serving 2, and so on. Total grams consumed were calculated with the following equation for the “bones absent” conditions, where \( s = \) serving and \( w = \) waste after serving:

\[ (s_1-w_1)+(s_2-w_2)+(s_3-w_3)+(s_4-w_4)-(\text{total bone waste-plate weight}) \]

For this equation, each waste is mainly just the plate weight, and each serving is its own individual weight.

Hypotheses were tested after statistical assumptions for normality and homogeneity of variance were met. The data were examined using a two-way analysis of variance (ANOVA) with pre-meal satiety as a covariate in order to assess group mean differences for grams consumed, wings consumed, bites taken, food palatability and post-meal satiety. Significant outliers were identified using grams consumed, pre-meal satiety, satisfaction with the food, and change in satiety. If a value was considered an extreme outlier (more than 3 times greater than the interquartile range of the data) the subject was removed.
CHAPTER THREE

RESULTS

Participants

Initially, both men and women were being examined in this study. The change from both genders to just females will be discussed later. Prior to any data reduction, a total of 140 female participants were tested. The mean age was 19.48±1.64 and average BMI was 23.91±4.80 for the sample. Of these participants, 118 of the participants were Caucasian, 12 were African-American, 3 were Hispanic, and 4 were Asian. All participants were students at Clemson University.

Average pre-meal satiety score (SLIM 1) was 4.04±1.45, average post-meal satiety score (SLIM 2) was 7.5±1.07, and average change in satiety was 3.46±1.56. Average satisfaction of the wings (LAM) was 7.37±0.99.

Outlier Analysis

A total of 140 participants took part in the study. Outliers were identified based on grams consumed, pre-meal satiety, satisfaction with the food, and change in satiety.
Figure 3.1: Box plots for grams consumed with the following parameters: line in the middle of each box represents the median, bottom of the box represents the 25th percentile, and the top of the box represents the 75th percentile. The whiskers represent the highest and lowest values not considered outliers. Potential outliers, represented by circles, are between 1.5 and 3 times greater than the interquartile range.
Figure 3.2: Box plots for pre-meal satiety and change in satiety as defined by the Satiety Labeled Intensity Magnitude Scale with 1 as “Greatest Imaginable Hunger” and 10 as “Greatest Imaginable Fullness.” The satisfaction with the food is defined by the LAM scale with 1 as “Greatest Imaginable Dislike” and 10 as “Greatest Imaginable Like.” Potential outliers, represented by circles, are between 1.5 and 3 times greater than the interquartile range. Extreme outliers, represented by asterisks, are more than 3 times greater than the interquartile range.

No extreme outliers were identified for grams consumed (Figure 3.1), pre-meal satiety, or change in satiety (Figure 3.2). One extreme outlier was found for satisfaction (case 20) measured with the LAM scale, and was eliminated due to its potential impact on her consumption. Even though the participant’s consumption was not an outlier, she likely ate less than she normally would, given her LAM score. This participant was also visibly disgusted by the wings during the session.

**Effect of Meal Time**

An independent samples t-test was conducted to determine if meal time (lunch or
dinner) had a significant effect on grams consumed. The results showed that participants ate more at dinner ($M = 165.94g$) than lunch ($M = 127.34g$) and found a significant difference $t(136) = -0.361, p<0.01$. In order to mitigate the effect of time of day, just the lunch data were used to analyze the rest of the results.

**Effect of Pre-Meal Satiety**

A Pearson product-moment correlation coefficient was computed to assess the relationship between the pre-meal satiety and grams consumed. There was a negative correlation between the two variables, $r = -0.398, n = 93, p< 0.01$. The scatterplot in Figure 3.3 summarizes the results. Increases in pre-meal satiety were correlated with decreases in grams consumed. Due to the significance of this factor, pre-meal satiety was used as a covariate in hypothesis testing.
Figure 3.3: Scatterplot of the relationship between pre-meal satiety (defined by SLIM scale 1) and grams consumed.

Hypothesis Testing

Grams Consumed.

<table>
<thead>
<tr>
<th></th>
<th>Bite Count Present</th>
<th>Bite Count Absent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bones Present</td>
<td>M=116.6±41.34</td>
<td>M=127.30±52.98</td>
</tr>
<tr>
<td></td>
<td>n=23</td>
<td>n=30</td>
</tr>
<tr>
<td>Bones Absent</td>
<td>M=163.61±67.45</td>
<td>M=122.65±48.14</td>
</tr>
<tr>
<td></td>
<td>n=22</td>
<td>n=53</td>
</tr>
<tr>
<td></td>
<td>M=139.58±59.92</td>
<td>M=151.49±74.18</td>
</tr>
<tr>
<td></td>
<td>n=45</td>
<td>n=40</td>
</tr>
<tr>
<td></td>
<td>M=130.81±62.29</td>
<td></td>
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<tr>
<td></td>
<td>n=48</td>
<td></td>
</tr>
</tbody>
</table>

Table 3.1: Chart of means, standard deviations, and sample size for each condition and main effect for grams consumed.

A 2-way ANCOVA was conducted to test for main effects of bone and bite presence on grams consumed (Table 3.1), using pre-meal satiety as a covariate. Participants in the bone present condition (M=122.65g) consumed less than those in the bone absent condition (M=151.49g). This supports the predicted hypothesis. The main effect of bone presence was found to be significant (F(1,88)=3.314, p=0.036, \( \eta^2_p=0.036 \)). Participants in the bite count present condition (M=139.58g) consumed more than those in the bite count absent condition (M=130.81g). This was the opposite of the predicted trend. However, this main effect of bite presence was not statistically significant (F(1,88)=0.014, p=0.45, \( \eta^2_p=0.00 \)). The result of the analysis does not support the hypothesis. A significant interaction was observed for bite count presence and bone presence (F(1,88)=3.187, p=0.039, \( \eta^2_p=0.035 \)). Since there was no predicted interaction, this does not support the stated hypothesis.
Wings Consumed.

<table>
<thead>
<tr>
<th></th>
<th>Bite Count Present</th>
<th>Bite Count Absent</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Bones Present</strong></td>
<td>M=4.48±1.20</td>
<td>M=4.42±1.31</td>
</tr>
<tr>
<td></td>
<td>n=23</td>
<td>n=53</td>
</tr>
<tr>
<td><strong>Bones Absent</strong></td>
<td>M=5.59±1.40</td>
<td>M=5.35±1.78</td>
</tr>
<tr>
<td></td>
<td>n=22</td>
<td>n=40</td>
</tr>
<tr>
<td></td>
<td>M=5.02±1.41</td>
<td>M=4.63±1.73</td>
</tr>
<tr>
<td></td>
<td>n=45</td>
<td>n=48</td>
</tr>
</tbody>
</table>

Table 3.2: Chart of means, standard deviations, and sample size for each condition and main effect for average number of wings consumed.

A 2-way ANCOVA was also conducted to test for main effects of bone and bite presence on total wings consumed (Table 3.2), using pre-meal satiety as a covariate. Participants in the bone present condition (M=4.42 wings) consumed less than those in the bone absent condition (M=5.35 wings). This supports the predicted hypothesis. The main effect of bone presence was significant (F(1,88)=5.933, p<0.01, ηp²=0.06). The result of the analysis supports the hypothesis. Participants in the bite count present condition (M=5.02 wings) consumed more wings than those in the bite count absent condition (M=4.62 wings). This was the opposite of the predicted trend. However, the main effect of bite presence was found not to be significant for number of wings consumed (F(1,88)=0.238, p=0.31, ηp²=0.003). The results of the analysis do not support the prediction. The interaction between bone presence and bite count presence was not significant (F(1,88)=0.849, p=0.18, ηp²=.01). No significant interaction was predicted, so the results supported the stated hypothesis.
Bites Taken.

<table>
<thead>
<tr>
<th>Bones Present</th>
<th>Bite Count Present</th>
<th>Bite Count Absent</th>
</tr>
</thead>
<tbody>
<tr>
<td>M=29.39±9.54</td>
<td>M=33.52±11.18</td>
<td>M=31.69±10.59</td>
</tr>
<tr>
<td>n=23</td>
<td>n=30</td>
<td>n=53</td>
</tr>
<tr>
<td>M=39.18±14.65</td>
<td>M=41.28±27.83</td>
<td>M=40.13±21.31</td>
</tr>
<tr>
<td>n=22</td>
<td>n=18</td>
<td>n=40</td>
</tr>
<tr>
<td>M=34.18±13.13</td>
<td>M=36.49±19.41</td>
<td></td>
</tr>
<tr>
<td>n=45</td>
<td>n=48</td>
<td></td>
</tr>
</tbody>
</table>

Table 3.3: Chart of means, standard deviations, and sample size for each condition and main effect for number of bites taken.

A 2-way ANCOVA was conducted to test for main effects of bone and bite presence on bites taken (Table 3.3), using pre-meal satiety as a covariate. Participants in the bone present condition (M=31.69) took fewer bites than those in the bone absent condition (M=40.13). This supports the predicted hypothesis. The main effect of bone presence was found to be significant (F(1,88)=4.833, p=0.016, η_p^2=0.053). Participants in the bite count present condition (M=34.18) took fewer bites than those in the bite count absent condition (M=36.49). This supports the predicted hypothesis. The main effect of bite presence was not significant (F(1,88)=2.244, p=0.069, η_p^2=.025). The result of the analysis does not support the hypothesis. No significant interaction was observed for bite count presence and bone presence (F(1,88)=.259, p=0.31, η_p^2=0.003). Since there was no predicted interaction, this supports the stated hypothesis.
CHAPTER FOUR
DISCUSSION

Bone Presence

The first hypothesis of this study predicted that participants would eat fewer grams of chicken wings when they leave their bones on their plate than those participants who disposed of their bones after each wing. The results of the study support this hypothesis. Participants in the bone present condition consumed significantly less than those in the bone absent condition, which supported the predicted trend. This suggests that using bone presence as a visible food record could assist females in consuming less food. This hypothesis was based on Wansink’s “Counting Bones” study, which found that the presence of food waste significantly impacted the number of chicken wings and total grams consumed by the participants. Interestingly, Wansink and colleagues did not find a significant effect for females in that study. This could be due to the presence of males, either friends or strangers, eating at the same table as the females. Anecdotally, several female participants reported they were glad there were no male participants in the room to see them eating such a messy food item. Females feel more comfortable eating with friends or other females, so the presence of a male stranger or acquaintance could unknowingly cause them to eat less (Salvy et al., 2007). This phenomenon was also mentioned earlier in regards to eating behavior on a date or job interview (Chaiken & Pliner, 1990).

While Wansink and Payne did not find an effect for women, they reported greater levels of food consumption for females (Table 4.1) than the current study. A noted
difference in these studies was the environment-the previous study was conducted during
a Super Bowl party in a sports bar. Loud, distracting environments promote greater food
consumption (Wansink, 2004). Further, there was no time limit given to participants in
the previous study, meaning they were free to eat over the course of several hours and
allowed to leave whenever they wanted. In the current study, data from lunchtime were
used due to the significant difference between lunch and dinner consumption. Lunch
consumption in a laboratory setting would naturally differ from a dinner in a sports bar.
Factors that affect food consumption include presence of others, atmosphere, and time of
day—all things that differed between the current study and Wansink’s study.

<table>
<thead>
<tr>
<th>Wansink*</th>
<th>McSorley</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bones Present</td>
<td>M=207.3g ± 89.0</td>
</tr>
<tr>
<td>Bones Absent</td>
<td>M=234.3g ± 77.3</td>
</tr>
</tbody>
</table>

Table 4.1: Chart of means and standard deviations comparing the results in
Wansink’s “Counting Bones” research to the current study. Wansink’s results represent
his female participants. Current results represent female lunchtime-only data for the two
“bite count absent” conditions.

Bite Presence

The second hypothesis of this study was that participants would eat fewer grams
of chicken wings when their bite count is displayed on a screen in comparison to those
participants who had their bite count reset after each wing. The results of the study did
not support this hypothesis. Participants in the bite count present condition consumed
more than those in the bite count absent condition, which was the opposite of the
predicted trend.
The effect of bite count may not have been completely as expected due to the way the bite count data were presented. Bite count was presented on a collective computer screen, rather than individual Bite Counter devices. Bite Counters are more discreet than a display, so there is a potential for gamification in this regard. Gamification is defined as “the application of typical elements of game playing (e.g., point scoring, competition with others, rules of play) to other areas of activity” (Oxford Dictionary, 2018). Gamification has been shown to help promote healthy behaviors, such as with fruit and vegetable intake in Jones and colleagues’ study. They found that fruit and vegetable consumption in elementary-aged children significantly increased when tied to a virtual narrative regarding consumption (Jones et al., 2014). This demonstrates how making a normal situation more exciting can increase that particular behavior.

Conversely, gamification could be used to increase consumption in situations where lower amounts are better. It is possible in the current study that the multicolored bite count display evoked a competitive spirit that sparked an increase in consumption. Excitement or novelty of a system can increase enjoyment, which can act as a distractor from the eating activity. This could explain the slight increase in the bite present condition over the bite count absent condition, though the difference was not significant. In order to assess the concept of gamification, this study could be replicated using Biter Counter devices instead of the 4-person display. This way, other participants cannot see each other’s bite count. The display method was originally chosen since participants can easily see how many wings the others have consumed when they are on their plates, but it is possible that the values are too colorful and salient. To see how many wings others
have eaten, participants must look at each person’s plate individually; to see how many bites others have taken, they can find all four values on the same screen. To decrease the saliency without completely hiding the bite count from others, a smartphone could be placed next to each station and a live bite count feed could update as a participant eats. This way, other participants can glance in the same direction as the bone feedback to gain bite feedback.

Another explanation could be that the “bite count reset” actually acted as the visible food record rather than the total tally of consumption. It is possible that the act of resetting after each wing was a better indicator of number of servings eaten than seeing a slow increase. Some participants reported only looking at the bite count display as they were finishing each wing, so perhaps the reset cued them to how much they were eating in this condition. In this scenario, the bite count was not what was being tallied—it was the number of resets. This idea could be further tested by adding a visual or auditory cue to the reset, such as a flash on the screen or buzzer noise.

One further explanation could be that participants in the bite count absent/bone absent condition had the most unusual set of instructions. They were instructed to watch a screen with their bite count that would reset after finishing a wing and also asked to throw their bones away in a trashcan next to their plate. It is possible that this combination of instructions, or confusion over the instructions, was enough to add stress to the eating study and cause participants to want to end the session. All participants received the exact same amount of instructions, but the other half were not as different from usual eating behavior, particularly the instruction telling participants to place their
bones on their plate. This instruction was most likely forgotten immediately after delivery, so these participants did not have as much cognitive workload during the study.

**Interaction Between Bite Count and Bone Presence**

It was hypothesized that those who received bite count feedback and bone feedback would eat the least and those that received one or the other would eat slightly more. A significant interaction between bite count and bone presence was found for grams consumed, which did not support the hypothesis. Bite count acted as a visible food record only when bones were also present. The bite absent/bone absent condition did not eat the most, as predicted, which caused the interaction. The effect of bone presence was stronger than the effect for bite count presence, which was not originally hypothesized. However, the additive effect was still observed: those who received both forms of feedback—bite count and bone presence—consumed the least out of all four conditions. This supports the original prediction. The same effect was not seen for those who received no prolonged feedback. Those in the bite absent/bone absent condition did not consume significantly more than those in the bite absent/bone present condition. As mentioned previously, these participants were not true free eaters. They still received a set of instructions that could have altered their eating behavior. Implementing a free eating condition in a laboratory setting (with researchers bussing the table instead of using the trashcans) could lead to an increase in consumption.

Despite a significant interaction for consumption, no interaction was observed for number of bites taken. This indicates that the additive effect of feedback worked for reducing number of bites taken. Those in the bite present/bone present condition took the
fewest bites, and those in the bite absent/bone absent condition took the most bites; however, there were no significant results for average bite size (grams consumed divided by number of bites taken). This difference between bites taken and grams consumed could suggest that those in the bite absent/bone absent were the most conscious of their consumption but unaware of their total bite count, so they took smaller, more frequent bites. Those in the bite count present/bone absent condition consumed the most, but took fewer bites than those in the bite count absent/bones absent condition.

**Limitations**

*Differences in Gender Consumption*

Pilot testing, as well as estimates based on Wansink’s chicken wing study, led to the assumption that ten wings per person (forty per session) would be a sufficient overestimation. It was soon revealed that male undergraduates could comfortably consume more than ten wings each. There was also a noticeable difference between number of wings consumed by males (M=10.2 wings) and females (M=4.8 wings). Using only females for the study allowed for testing of the manipulation without having to account for gender as a modifier. Due to these differences, only female students were tested from that point on in order to avoid increasing the number of wings per session and having to account for gender in analyses. However, because of the low number of wings consumed per female, this may have caused a floor effect in consumption where it was more difficult to observe the effects of bone presence and bite presence. As stated above, Wansink did not observe an effect for bones present in females, yet females in his study consumed a greater number of wings than in the current study.
Effect of Meal Time

A significant difference was found between grams consumed at lunchtime and dinnertime. This difference was not expected to have as much of an effect as it revealed in the current study and was not accounted for in the counterbalancing of conditions. For this reason, all dinnertime data were removed from the hypothesis testing results. This had a slight effect on the power of the study, but the data were more cohesive once meal time was controlled. Future studies in the laboratory will continue to use a lunch-only paradigm in order to mitigate the effects of meal time.

Effect of Pre-Meal Satiety

A negative correlation was expected from the relationship between pre-meal satiety and grams consumed. The results showed a significant negative correlation, which supported this premise. It is reasonable to expect that the hungrier a person is prior to a meal, the more they will consume under normal circumstances. Participants were instructed to not eat anything one hour before arriving for the study, but 14.9% still recorded a pre-meal satiety rating between 5 and 10 (meaning some were more than “neither hungry nor full” and less than “greatest imaginable fullness”). It was more feasible to use pre-meal satiety as a covariate rather than eliminate all “full” participants from analysis.

Implications and Future Directions

Based on these results, bite count might serve a purpose other than being a “visible food record” to those using the device. Previous studies in the lab have yielded results that suggest bite counting can help reduce intake, so further investigation on this
matter is needed. When using bite count for the first time, it is still not a comprehensible way to self-monitor, particularly when given no instructions on how to interpret it. As previously discussed, since bite count is individually scaled, it may not be as meaningful when displayed to a first-time user in this way. On the other hand, bone presence seems to have an effect such that females consume less when bones are left on the plate. This finding can assist people, when consuming foods with visible food waste, in eating less during a meal.

Future directions include using different foods or items (e.g., foods with a toothpick in each serving) to assess the generalizability of visible food records. Different methods to test the usefulness of bite count include the following: assess bite count on Bite Counters instead of a shared display, display bite count on a smartphone placed next to each participant, remove all traces of bite count in the “bite count absent” conditions rather than just resetting the value after a serving, and test effects of bite count without the interaction with a visible food record.
CHAPTER FIVE

CONCLUSION

In conclusion, the results of this study indicate that the presence of chicken bones led females in a laboratory setting to consume less compared to those who threw bones away. The significant reduction in consumption when bones are present supported the previous work of Wansink. This reaffirms the use of chicken bones as a visible food record. The same was not observed in presence of bite count, which had the opposite intended effect. Participants consumed the most when bite count was present, not absent; however, the predicted additive effect of feedback was still present since the bite present/bone present condition ate the least out of all four conditions. This study contributed to the overall understanding of visible food records, but future research must examine the value of bite count in order to provide a better understanding of its role to users.
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Schachter S, Friedman LN. 1974. The effects of work and cue prominence on eating behavior. See Ref. 115a, pp. 11–20


doi:10.2466/pms.104.1.273-276


APPENDICES
Appendix A

Chicken Wing Measurements

Number of wings measured= 681

Average wing weight: 48.1± 8.8 grams

Average bone weight: 19.4 ± 6.0 grams
Appendix B

Image of Bite Display

Example of how monitor displayed bite count to participants.
Example of how research assistants tallied bites. One assistant tallied seat 1 and seat 2 while the other tallied seat 3 and seat 4 on a separate, identical sheet.
Appendix D

Instrumented Eating Station
Appendix E

Satiety Labeled Intensity Magnitude (SLIM) Scale

Participant #: __________  Station #: ____________

Date: ____________  Time: ____________

Please rate the degree of hunger/fullness that you currently feel by putting a slash (/) mark somewhere on the line below:

- Greatest Imaginable Fullness
- Extremely Full
  - Very Full
- Moderately Full
- Slightly Full
- Neither Hungry nor Full
- Slightly Hungry
- Moderately Hungry
- Very Hungry
- Extremely Hungry
- Greatest Imaginable Hunger
Appendix F

Labeled Affective Magnitude (LAM) Scale

Participant #:_________ Station #: ______________

Date:______________ Time:______________

Please rate how much you liked or disliked the food item by putting a slash (/) mark somewhere on the line below.

<table>
<thead>
<tr>
<th>Greatest Imaginable Like</th>
<th>Like Extremely</th>
<th>Like Very Much</th>
<th>Like Moderately</th>
<th>Like Slightly</th>
<th>Neither Like/Dislike</th>
<th>Dislike Slightly</th>
<th>Dislike Moderately</th>
<th>Dislike Very Much</th>
<th>Dislike Extremely</th>
<th>Greatest Imaginable Dislike</th>
</tr>
</thead>
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<td></td>
<td></td>
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</tbody>
</table>

46
Appendix G

Protocol

Recruitment
1. Participants will be recruited via the SONA website.
2. 8 participants will be recruited per session. 4 participants will be kept for the experimental session with the remaining participants being given credit and rescheduled for another time.
   a. This will help ensure that 4 participants are run at each session, even if there are no-shows
   b. This will help with balancing gender during the study.
3. After someone signs up, send them the following e-mail:

   Dear Participant,
   Thank you for expressing interest in our study. The study includes coming into the Applied Psychophysiology Laboratory (422 Brackett Hall), where body measurements including height, weight, and Body Mass Index (BMI) will be measured, and a meal of chicken wings will be eaten with several other participants. Your session will take place at XX:XXam/pm on XX/YY (date)
   Thank you again for your interest.
   Sincerely,
   Jacqueline McSorley

Laboratory session

Materials
- Consent form
- Plate Weight Sheet
- Manual Tally Sheet
- Participant Notes Sheet
- Demographics questionnaire
- Relationship questionnaire
- 2 Satiety Labeled Intensity Magnitude (SLIM) scale
- Labeled Affected Magnitude (LAM) scale
- Large plate: Chinet Classic White Dinner Plate. 26.4cm diameter
- Moist Towelettes
- Blue plastic cups (532mL)
- 500ml liquid measuring cup.
- Napkins
- Proctor Silex 18 quart Roaster Oven
- Hot plates (2)
• Oven mitts (2)
• Protective plastic gloves
• Disposable aluminum foil steam table pans- 9”x13”
• Serving tongs
• Wings
• Sweet Baby Ray’s BBQ sauce
• Instrumented Eating Station

Food preparation
1. 1 hour and 30 minutes prior to the scheduled arrival of the participants, plug in the roaster oven and set the temperature to 450 degrees Fahrenheit for pre-heating. Allow 15 minutes for the roaster oven to pre-heat.
2. After pre-heating the roaster oven, take thirty-six wings out of the freezer in a tin pan.
3. Using the scale on top of the computer cabinet, weigh the wings prior to cooking and record the weight on the experimenter note sheet.
4. Using oven mitts, place the container holding the wings into the roaster oven.
5. Set the timer for 60 minutes.
6. Once the timer goes off and the 60-minute cook time is complete, leave oven on.
7. Put sauce on wings, then place back in roaster.
8. Leave wings in the oven until the participants are seated at the instrumented eating station.
9. Before allowing the participants to serve themselves, weigh the wings after cooking and record the weight on the experimenter note sheet.

Eating Station
10. Prepare the eating station prior to the arrival of the participants.
11. Position the table cloth so that the holes cut for the scales are located properly above each scale such that only the pressure plate of each scale is visible. Note that each scale has two strips of 3-inch long Velcro loop material in the center of the pressure plate.
12. Turn on the scales. Allow them to boot up and zero-out.
13. Adhere one large plastic aqua plate to each scale.
14. Firmly press each plate onto its respective scale’s pressure plate as to connect both pieces of Velcro. Lightly pull on each plate to ensure a secure connection of the Velcro.
15. Place a plastic cup at each station.
16. Using the liquid measuring cup, pour 450ml of water into each cup using the water fountain outside.
17. Place a napkin and two moist towelettes at each eating station.
18. Place the two hot plates in the center of the table.

**Participant folder**
19. Create four folders containing the following materials:
   a. Participant Note Sheet
   b. Demographics Questionnaire
   c. Relationship Questionnaire
   d. 2 SLIM scales (pre-meal and post-meal)
   e. LAM scale
20. On the tab of each file folder write each participant’s ID number (P followed by 1, 2, 3, or 4 depending on condition, then session number 001-036) ex: P1036
21. Place the four folders beside the table.
22. Locate enough consent forms for the session and place them on the table.

**Participants**
23. Greet the participants
24. Upon the participants’ arrival, introduce yourself and thank them again for their participation.
25. Distribute consent forms. *“Please initial the first two pages and sign the last page.”*
26. Dismiss all but four participants, and give those dismissed credit for participating.
27. Give a brief overview of the proceedings. Say the following: *“Thank you for participating in this study. I am going to give you a quick overview of what we will be doing today. First, we will take a few basic body measurements and fill out some pre-meal questionnaires and scales. You will then be allowed to serve and eat a meal of chicken wings until you are full. You will also be viewing your bite count on a monitor in front of the eating station. It will increase each time you take a bite of food. After the meal we will fill out a few more questionnaires and scales, debrief you on the study, and then you’ll be free to leave. Any questions so far?”*
28. Measure height (to the nearest ¼ inch) and weight (to the nearest ½ pound) using the Tanita WB-3000 scale. Record all measurements on the Participant Note Sheet. To take the measurements, perform the following:

**NOTE: Take all height and weight measurements with participant in socks or bare feet.**
   a. Power on the device, and wait for it to start up and zero itself.
   b. Extend the stadiometer so that it is above the participant’s head.
   c. Ask the participant to step onto the scale with their back to the stadiometer.
d. Level the stadiometer with the participant’s head, and record height and
weight.
e. Measure height to the nearest quarter inch.

29. Give each participant the demographic questionnaire. Say the following: “This
   form is to collect information regarding individual characteristics.”
30. Give each participant the relationship questionnaire. Say the following: “This
   form is to collect information regarding any possible relationships you may
   have with the other participants. If you have any questions, feel free to ask.”
31. Give each participant the first SLIM scale. Say the following: “This scale
   indexes how hungry or full you currently feel. Please mark the scale
   appropriately.”
32. Upon completion of the above steps, assign each participant a number for the
   eating station and sit them at their pre-assigned station.
33. Using oven mitts, remove the wings from the roaster oven.
34. Weigh the wings after cooking and record the weight on the plate weight sheet.
35. Place the wings on the hot plates in the middle of the eating station.
36. Place the tongs into the wings.
37. Give the participants the following instruction:
   a. “You are free to serve yourself as much as you want. After you serve
      your desired portion please wait until instructed before eating.”
   b. “Please note that there is also sensitive equipment and wiring on the
      underside of the table. Please try to avoid hitting the table with your
      knees.”
   c. “If you would like more wings at any point, please let us know so we
      can re-weigh your plate. Then you will be allowed to re-serve
      yourself. After, please wait until instructed before continuing to eat.”
   d. Then say the following depending on condition:
      1. Bones/Bite group: “Please monitor your bite count on the Bite
         Counter screen and place the bones on your plate as they
         finish them.”
      2. Bones/No Bite group: “Please place the bones on your plate as
         you finish them. Your bite count will appear on the screen
         and reset to zero after each wing you consume.”
      3. No Bones/Bite group: “Please monitor your bite count using
         the Bite Counter screen and place your bones in the trash can
         next to your plate after each wing.”
4. No Bones/ No Bite group: “Please place your bones in the trash can next to your plate after each wing. Your bite count will appear on the screen and reset to zero after each wing you consume.”

e. “Again, feel free to serve yourselves as much as you want. If you would like additional servings, let us know so we can reweigh your plate.”

38. Instruct the participants to serve themselves.

39. Once the participants serve their food, **BUT BEFORE EATING** begin recording.

a. Start the video recording **before** you start the scale recording.

b. To begin the video recording, right click on the video screen.

c. Click “Manual record.”

d. Click the colored square in the EatStat program to begin recording bite and scale data.

e. Record pre meal weight on experimenter note sheet (Wet+Plastic)

40. Make a note of any problems or anomalies that arise.

41. Begin manually counting bites with the excel program (according to condition)

42. Monitor the equipment to make sure that everything is running as it should be.

43. If the participant wants to get seconds (or thirds):

a. Record course (Waste+Plastic) weight on the experimenter note sheet.

b. Record new food weight

44. Once a participant finishes his meal, record the final Waste+Plastic.

45. Resume the data recording when the participant returns with seconds or thirds.

46. When everyone is finished, move participants back to the main table.

47. Instruct the participants to complete the LAM scale. Say the following: “This scale indexes how much you enjoyed the meal you just consumed. Please mark it appropriately.”

48. Next, instruct the participants to complete the second SLIM scale. Say the following: “This scale is identical to the one you filled out before the meal. Again, it indexes how hungry or full you feel currently. Please mark it appropriately.”

49. Once the participants have completed all of the post meal scales, collect the folders.

50. Offer a copy of the consent form to the participants to take home if desired.

51. Debrief the participants. Say the following: “The purpose of this study is to determine if viewing bite count in real time has the same effect as viewing visible food records to decrease intake during a meal. There is evidence that shows leaving bones, candy wrappers, bottle caps, etc. leads to a reduction in
overall consumption during a meal. This is most likely because we have a visual representation of how much we have consumed when we let the waste pile up in front of us. Our goal is to help people eat less and make healthier decisions when it comes to eating.”

52. Dismiss participants and award credit on SONA.
53. Once the session is finished, shut down the equipment (unless you are doing a backup) and clear the table.
54. Weigh the left over wings and record weight on experimenter note sheet. If wings are in the trash cans, place the wings back on the plate to weigh them.
55. Count number of wings consumed for each participant.
56. Record total number of bites taken for each participant.
57. Throw away wings container, plates, cups, napkins, and utensils.

**Computer Boot-up**

1. Unlock the cabinet and boot up both laptops.
2. The password for each laptop is “tiger5”.
3. Click “EatStat.exe”. This is the program that monitors the bite count and the scale data.
4. Click “Start” then “Record.” This will not actually begin recording data; it will just begin monitoring the devices. (Do this on each laptop)
5. Clicking “Record” will open a new window showing the video from two of the four cameras. The top laptop will show stations 1 and 2, and the bottom laptop will show stations 3 and 4:

<table>
<thead>
<tr>
<th>Station 1</th>
<th>Station 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>(Blank)</td>
<td>(Blank)</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Station 3         Station 4
(Blank)           (Blank)

a. Make sure that each camera is focused on the correct station.
6. If there are any errors, close all windows and restart them. If this does not fix the problem, contact the graduate assistant.

**Data Recording**

1. Once all of the participants have been allowed to serve their food, begin the recording.
2. Always start the video first and end the video last.
3. Right click on EACH video and choose “Manual Record.”
4. Within the EatStat window, click the green square button with the station number. The button will change to red.
5. Once the participants have served themselves and have begun eating, check all of the data readouts and make sure they are changing as they should.
6. However, check them from time to time to make sure that there are no errors (e.g. frozen screens, equipment failures, etc.)
7. When the graduate assistant tells you to end the recording, click the red square buttons in both EatStat windows.
8. Right click each video and click manual record again.

**Video Conversion**

**A: Before Video Conversion:**
1: Note down the approximate time when the subject has started eating their meal.
2: Once the subject has finished his meal, note down the end time and go to the corresponding camera recording folder on the relevant laptop.
3: Every recording creates the new “.dat” file. The recorded “dat” files are stored in the specific naming convention i.e. “CameraName | S00A | Year (4) | Month (2) | Date (2) | Hrs (2) | Min (2) | Sec (2) | msec (3)” and file stores the recording lasting up to 5 minutes. The file size should be around 30 MB for 5 minutes recording duration. There will be multiple dat files for one meal depending on the duration. Verify the dat files for start time and size.

**B: Video conversion:**
1: Open the “Playback System” from the “Start menu”.
2: Click “Open Recording and provide username and password as “admin/admin”.
3: Check whether the same day is highlighted in the calendar in the left corner.
4: Select the recording for required camera (as shown below) depending upon the particular subject under recording and click OK. (The top row is camera 1 and the bottom row is camera 2)
5: The video will be loaded in the playback system.
6: Scroll bar can be used to start video at required time.
7: Once the start time is set click the “Cue In” (red circled button below) this specifies the start time of video conversion. Slide the scroll to the end of the required end time and click “Cue Out” (green circled button below).
8: After this click “Save Video”. In the dialog box provide the converted file destination and name. (The file destination should be the same recording folder for that subject i.e. C00000 or C00001 and file name should be of the format “| Year (4) | Month (2) | Date (2) | Hrs (2) | Min (2) | Sec (2) | msec (3).asf” ex: “20120202113610778.asf”. It can be taken from the recorded .dat file name in the recording folder as mentioned in step A:3). The Export Format should be set to “ASF”. Set the “Use Profile” to “Windows Media 8 for Local Area Network (768 kbps) as shown below. Also check the “Export Audio”.

![Export Video/Audio dialog box]

9: Click OK and the process will start indicating the progress in the dialog.

Data Backup
1. Connect the external hard drive (found in the cabinet) to Laptop 1.
2. On the laptop, perform the following steps:
   a. Go to “Computer.”
   b. Open the “C:\” drive.
   c. Right click the “Recording” folder.
   d. Click “Copy”.
   e. Return to the “Computer” folder.
   f. Open the External Hard Drive
   g. Open Laptop 1 (if you are backing up Laptop 2, open the Laptop 2 folder instead).
   h. Right click within the folder and click “Paste.”
   i. If it asks you if you want to overwrite any files, click “Do not copy these items.”
3. Once the files are finished copying, close all windows.
4. Right click on the USB icon in the bottom right corner.
5. Click “Eject External Drive.”
6. Disconnect the external hard drive.
7. Repeat these steps for laptop 2.
8. Once all of the data has been backed up, shut down each laptop. Place the hard drive, Clorox wipes, and latex gloves in the cabinet.
9. Close and lock the cabinet.

**Clearing the Data**
1. The laptops have a limited amount of hard drive space and must be cleared at least once a week.
2. Ensure that all of the data on the laptops has been backed up.
3. Within the “C:\Recording” folder:
   a. NEVER delete the “Camera” folder or “Folder 1” or “Folder 2”
   b. Open “Camera”
   c. Delete all files within this folder.
   d. Repeat for “Folder 1” and “Folder 2”.

**Excel Bite Counter**

*Instructions*
1. Connect laptop to monitor
   a. Lightning to HDMI → HDMI to HDMI → HDMI to DVI → DVI to monitor
   b. Make sure everything is functioning properly
2. Use arrow keys or macro shortcuts (below) to tally:
   a. Opt+Command+z = tally 1
   b. Opt+Command+x = tally 2
   c. Opt+Command+b = tally 3
   d. Opt+Command+n = tally 4
3. Use macro to reset
   a. Ctrl+a = reset 1
   b. Ctrl+s = reset 2
   c. Ctrl+d = reset 3
   d. Ctrl+f = reset 4
Appendix H

Line graph of average grams consumed for each condition; the lines represent bone presence, and the x-axis represents bite presence. Pre-meal satiety is examined as a covariate in this analysis.
Appendix I

Average Wings Consumed Per Condition

Line graph of average grams consumed for each condition; the lines represent bone presence, and the x-axis represents bite presence. Pre-meal satiety is examined as a covariate in this analysis.
Appendix H

Average Number of Bites Taken Per Condition

Line graph of average number of bites taken for each condition; the lines represent bone presence, and the x-axis represents bite presence. Pre-meal satiety is examined as a covariate in this analysis.