THE ROLE OF VARIETY ON CALORIC INTAKE

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by

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THE EFFECT OF VARIETY ON CALORIC INTAKE

A Thesis

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Department of Psychology
Abstract

of

THE EFFECT OF VARIETY ON CALORIC INTAKE

by

Anthony Matthias Hairston II

Variety has been shown to increase caloric intake and has been linked to obesity. Variety was operationally defined as eating four sensorially distinct dinners across a week. Four participants (3 female, 1 male) participated in an ABAB reversal within a multiple baseline across participants design. In baseline, participants had no dietary restrictions. During treatment, variety was minimized by requiring participants to eat the same dinner meal for five consecutive days. Caloric intake and palatability rating served as the dependent variables. Results suggest that during treatment both caloric intake and palatability ratings decreased for most participants. In a follow-up experiment all methodology was identical to experiment 1, except the dependent variable was changed to caloric variability and the independent variable was changed to pre-planning a meal. Results suggest that pre-planning a meal was an effective means to minimize caloric variability across a week. Limitations and directions for future research are discussed.

_______________________, Committee Chair
Becky Penrod, Ph.D.

_______________________
Date
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# TABLE OF CONTENTS

<table>
<thead>
<tr>
<th>Acknowledgments</th>
<th>vi</th>
</tr>
</thead>
<tbody>
<tr>
<td>List of Tables</td>
<td>x</td>
</tr>
<tr>
<td>List of Figures</td>
<td>xi</td>
</tr>
</tbody>
</table>

## Chapter

1. **INTRODUCTION**.................................................................1
2. **BACKGROUND**.................................................................2
   - Methods .........................................................................9
   - Measurement of Dependent Variable ......................11
   - Interobserver Agreement and Treatment Integrity ...11
   - Experimental Design ...............................................12
   - General Procedure ...................................................13
3. **RESULTS**..........................................................16
4. **ANALYSIS OF THE DATA**........................................21
5. **EXPERIMENT 2 INTRODUCTION**...........................26
6. **EXPERIMENT 2 BACKGROUND**.................................27
   - Participants ..........................................................27
   - Measurement of Dependent Variables ....................27
   - Treatment Phase ......................................................27
   - Termination Criteria ................................................28
7. EXPERIMENT 2 ANALYSIS OF THE DATA…………………………………….29
8. FINDINGS AND INTERPRETATIONS………………………………………31
9. GENERAL DISCUSSION……………………………………………………33
Appendix A. Consent to Participate as a Research Subject……………………..34
Appendix B. Debriefing Form…………………………………………………..35
Appendix C. Screening Questionnaire…………………………………………36
Appendix D. Daily Food Inventory………………………………………………37
Appendix E. Meal Preference Rating……………………………………………38
Appendix F. Overall Meal Rank Order …………………………………………39
Appendix G. Social Validity Survey ……………………………………………40
References ………………………………………………………………………41
LIST OF TABLES

<table>
<thead>
<tr>
<th>Tables</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Difference in Caloric Intake</td>
<td>18</td>
</tr>
</tbody>
</table>

x
# LIST OF FIGURES

<table>
<thead>
<tr>
<th>Figures</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Total caloric intake</td>
<td>17</td>
</tr>
<tr>
<td>2. Palatability rating</td>
<td>19</td>
</tr>
<tr>
<td>3. Caloric variability</td>
<td>30</td>
</tr>
</tbody>
</table>
Chapter 1

INTRODUCTION

We are currently in the midst of a worldwide pandemic. Each year the number of people afflicted with obesity rises. According to the World Health Organization (WHO, 2011), since 1980 the number of people with this condition has more than doubled. Increases in the number of obese people threaten to overwhelm health systems around the globe, and has been compared to such threats as global warming and bird flu (Zimmet, 2006).

Obesity is defined as a “condition that is characterized by excessive accumulation and storage of fat in the body, typically indicated by a body mass index (BMI) of 30 or greater for adults” (Merriam-Webster 2012). Obesity is reported to be a result of taking in more calories than one expends (Raynor & Epstein, 2001). Additionally, obesity has been linked to a plethora of health issues that include but are not limited to: high cholesterol and triglycerides, type 2 diabetes, stroke, cancer, fatty liver, depression and heart disease. According to the Center for Disease Control, the latter condition was the leading cause of death in the United States in 2009 and has been for more than 85 years (Neyer, Greenlund, Denny, Keenan & Labrathe, 2007).
Chapter 2

BACKGROUND

Though the causes of obesity can be somewhat linked to genetic factors, there are environmental, social, economic and behavioral factors that contribute as well (Rogers & Shurin, 2012). One such environmental factor that is the focus of the current study is dietary variety. Dietary variety is defined as a diet consisting of foods with different sensory characteristics, such as color, flavor, and shape (Raynor & Epstein, 2001). A varied diet is common amongst animals that forage for food. It has been suggested that there may be some evolutionary basis for animals/humans to seek variety in their meals in order to facilitate a nutritionally balanced diet (Stubbs, Johnstone, Mazlet, Mbaiwa, & Ferris, 2001).

Although humans may be predisposed to seek variety in their diets to enhance their chances of survival, when food is perpetually in abundance variety seeking may become counter productive. Dietary variety has been linked to an increased consumption of food in animals as well as humans (DiBattista & Sitzer, 1994; McCrory et al., 1999; Rolls, 1979; Seigel & Pilgrim, 1958). Zylan and Brown (1995) demonstrated this correlation with male and female Sprague-Dawley rats. Forty-six males and 48 females were given either a single choice diet or a multiple-choice diet in an ABAB reversal design. In the single choice conditions rats could consume up to 45 grams of graham crackers (most preferred), and in the multiple-choice (variety) conditions, rats could consume up to 15 grams of each of the following: graham crackers, cheese nip, and soft
batch chocolate chip cookies. Results indicated that there was a statistically significant difference in the amount of food consumed during the single and multiple-choice conditions, such that rats in the multiple-choice condition ate more than rats in the single choice condition. However, this effect was not significant in the second replication. The authors suggested that this might have been due to satiation, as the variety of food presented remained the same across all phases of the experiment.

Several studies have linked dietary variety to increased consumption in humans as well (McCory et al., 1999; Seigel & Pilgrim, 1958; Stubbs, 2001). In one study, McCrory et al. analyzed 6 months worth of dietary intake data collected from 71 adult male and female participants whom had previously participated in studies on diet and body composition. Several statistical analyses were performed to determine if there was a correlation between dietary variety, energy intake and body fatness. Results suggested that there was a statistically significant positive correlation between dietary variety and daily food intake. Additionally, dietary variety and body fatness were positively correlated for all foods except vegetables. Often, excess energy intake is converted into fat by the body and stored for later use. Storage of fat inevitably leads to weight gain and potentially could lead to obesity over time (Hill & Peters, 1998).

Thus, if increasing the dietary variety increases food intake, it is logical to assume that decreased variety or dietary monotony should have the opposite effect (decrease food intake). Researchers have found this to be true (Meiselman, Graaf, & Lesher, 2000); however, the mechanism responsible for reduced intake associated with a monotonous diet is still in question. One proposed mechanism is oral habituation (i.e., satiation).
Habituation occurs when a decline in ingestive behaviors is long lasting and associated with specific stimuli (Swither-Mulvey, Miller & Hall, 1994).

Swither-Mulvey, Miller, and Hall (1994) conducted an experiment in which they attempted to prove that oral habituation is the mechanism responsible for the termination of eating. In their experiment, 6- and 12-day-old rat pups were fed through a tube implanted in the front of their mouths. This implementation allowed the researcher complete control over when and how much of the feeding liquid entered the rat pups’ mouths. Due to the site of the implementation, the rat pups were required to actively lap up, mouth and/or swallow the liquid in order to ingest it, otherwise the liquid would fall out of their mouths. To control for nutrition related satiation, the liquid consisted of two substances that had no caloric value. Additionally, the serving size was minimized to reduce gastric fill and response effort as a possible explanation for the cessation of eating.

The pups were given 30 brief injections of a non-nutritive liquid diet, spaced approximately 1 minute apart. Depending on the age of the pup each injection contained between 100-300 ml of the diet solution. Duration of mouthing behavior (movement of the jaw and/or tongue) was recorded as the dependent variable.

Results of the experiment suggested that as the number of injections increased the time spent engaging in mouthing behaviors decreased. The authors ruled out alternative explanations by providing the pups with substantially less of the liquid diet than the rat pups ate ad libitum. In an additional phase of the experiment the authors deprived the rat pups of food and water for 24 hours and achieved similar results. Thus, the authors
concluded that the decrease in mouthing behaviors was solely due to oral habituation to the liquid.

In another study, Raynor, Niemeier, and Wing (2006) suggested that habituation played a role in the decreased intake they observed when they compared two weight loss treatments. The authors limited the number of snack foods eaten by participants over an 8-week period. In their experiment the authors instructed Group A to limit the variety of snack foods they ate to 1 and compared their data to participants in Group B who were asked to limit their servings of snack foods to a maximum of 1 per day. In the restricted variety group (A) the women were instructed to choose one highly preferred snack to consume ad libitum throughout the 8-week experiment. A pre- and post-treatment log of the number of snacks eaten as well as a hedonic rating, in which participants assigned a numeric value to their perception of how pleasant tasting each snack was on a scale of 1-100, were recorded for weeks 1, 3, 5, 7, and 9. Results of the experiment were consistent with previous research findings. The variety-restricted group (A) showed a greater decline in the number of snacks eaten than did the restricted servings group (B). The decline in hedonic ratings over the course of the experiment for the repetitive snack adds further support to the theory of habituation as the underlying mechanism responsible for decreased intake. These studies suggest that the mechanism responsible for monotony and ultimately a decreased intake of calories is oral habituation.

Numerous studies have measured oral habituation with a palatability rating scale in conjunction with interventions in which variety was limited; Seigel and Pilgrim (1958) conducted a study with 79 male college students. The participants were served two
rotating daily menus. Thus, the participants consumed the same foods for lunch and supper every other day. After participants finished eating, any leftover food was weighed or counted. Participants agreed to participate in the experiment for at least three servings of each menu (6 days) and for a maximum of nine servings (18 days). Participants who continued beyond three servings were able to discontinue participation during the fifth ($N = 26$), seventh or ninth ($N = 46$) serving thereafter. After nine servings (18 days) the experiment was terminated. After the completion of each meal, the leftover portions of food were weighed, counted and/or estimated. Additionally, participants were asked to rate the palatability of the individual items for both initial servings of the daily menu and then for every other subsequent serving on a 9-point scale (1 = dislike extremely, 9 = like extremely). In order to facilitate statistical analysis after the completion of the experiment, participants were separated into two groups, those who participated for 10 days (5 servings of each menu) or less and those who participated for 18 days (9 servings of each menu). Data were analyzed by comparing the differences between the initial and terminal palatability ratings and comparing the amount of food left uneaten between individuals who participated 10 days or less and those who participated 18 days. Results of the experiment suggested that foods that are repetitively eaten progressively decline in palatability; foods with initially high palatability ratings were more resistant to the decline in palatability due to monotony than items that received an initially low rating; participants who elected to discontinue participation after 10 days left more food uneaten than those in the 18-day group, and the decline in palatability ratings were greater for those participants who dropped out of the study after 10 days, as opposed to their 18 day
counterparts. The amount of food left uneaten suggests that monotony may have been a factor in their decision to discontinue the repetitive diet.

In a follow-up study, Schutz and Pilgrim (1958) attempted to generalize results of the above study in the field. Thus, 86 male participants who worked at an army hospital were recruited for the 35-day experiment. All participants were screened and believed to be in good physical condition. Participants subsisted on a diet of 4 daily menus comprised of 41 food items (monotony) for a period of 5 weeks. Under normal conditions army hospital employee’s diets consisted of at least 150 food items (variety). All meals were served cafeteria style and each participant received approximately 4100 calories per day. As in the previous study all participants were required to complete a 9-point like-dislike food rating scale on days 9 and 37. Data were also taken individually on the amount of food served, the amount returned uneaten, and the number of servings. Results of the experiment were consistent with those of the previous study. The authors found that of the foods susceptible to a change in rating (food that did not receive a high preference rating initially) the number of repeated servings was correlated to decreased consumption and/or rejection. Specifically, of the 41 assessed food items, 14 items were significantly lower (meats and vegetables), 9 were significantly higher (cereals), and 18 did not significantly change in rating (fruits and desserts).

The above inaugural experiments laid the foundation for more in-depth research into variety/monotony and their effects on consumption. In one such experiment, Meiselman, Graaf and Lesher (2000) recruited 47 civilian employees from the Solider System Command, Natick, Massachusetts. The participants were divided into two groups
and agreed to participate in the experiment for 1 week. Both groups were required to report to the experimental kitchens for lunch between 1200 and 1300 h each day. Group 2 was designated as the monotony group and was served a standard meal of mashed potatoes, green beans, and Swedish meatballs with savory beef home-style gravy for 5 consecutive days. Group 1 was designated the variety group and received the same meal as Group 2 on Monday and Friday and different meals on Tuesday, Wednesday and Thursday. Upon reporting for lunch each group received their respective meal and a rating form. The food rating form was designed to assess each individual food item and the meal overall on a 9-point hedonic scale (extremely dislike – extremely like). After completing their meal, each participant turned in their tray and rating scale to an attendant and left the kitchen. Each participant’s uneaten food was weighed and rounded to the nearest gram.

Results of the experiment were consistent with previous findings. Specifically, food acceptance for the monotony group decreased from Monday to Friday. Significant differences were found for green beans and the overall meal, respectively. In regard to food consumption the monotony group showed a general decrease in consumption for all individual items as well as the meal overall, except for the consumption of gravy. These differences were statistically significant for green beans and meatballs. However, for the variety group, consumption increased for all items from Monday to Friday, with statistically significant increases in the consumption of meatballs, green beans and mashed potatoes.
Though these findings are consistent with previous research and strengthen the correlation between variety and intake, the authors suggested that future research could extend this study by varying the parameters in which the meal(s) are consumed as well as conducting the experiment under more natural conditions. Thus, the purpose of the current study was to replicate and extend this line of research by assessing the effects of variety/monotony with participants in a more naturalistic setting.

Methods

Participants

This study utilized four participants (1 man, 3 women) recruited via word of mouth. Participant’s ages ranged between 22 and 57. Participants selected for the study self-reported having a high variety diet consisting of at least four sensorially distinct meals for dinners per week. Sensorially distinct meals are defined as meals that differ on at least one sensory characteristic (e.g., color, flavor, shape) (Raynor & Epstein, 2001). All participants had access to a digital camera for the duration of the study. All participants were informed of the procedures involved in the experiment but were not told the purpose of the study until its conclusion, during which time they were debriefed. Savannah, a 22-year-old female, weighed 160 lbs and was 5 feet 4 inches tall. She self-reported her body type as Endomorph (low muscle, high fat) and her calculated BMI was 27.47 (overweight). Mary, a 43-year-old female, weighed 205 lbs and was 5 feet 1.5 inches tall. She self-reported her body type as Endomorph (low muscle, high fat) and her calculated BMI was 38.11 (Obese). Frank was a 30-year-old male who weighed 250 lbs and was 5 feet 11 inches tall. He self-reported his body type as Endomorph (low muscle,
high fat) and his calculated BMI was 34.87 (Obese). Debrah was a 57-year-old female who weighed 200 lbs. and was 5 feet 4 inches tall. She self-reported her body type as Endomorph (low muscle, high fat) and her calculated BMI was 33.8 (Obese).

Materials

Consent (Appendix A) and debriefing (Appendix B) forms were provided to the participants at the beginning and the end of the experiment, respectively. All participants completed a short screening questionnaire (Appendix C) designed for this experiment. Each participant agreed to participate in the experiment, and s/he was required to record the brand name, product type, preparation method, quantity prepared and quantity consumed of all foods consumed for dinner via the Dinner Food Inventory (DFI) (Appendix D) as well as complete a Meal Preference Rating (MPR) (Appendix E) for each meal until the completion of the experiment. Additionally, at the conclusion of each treatment phase the participants completed the Overall Meal Rank Order (OMRO) (Appendix F). Quantity consumed was obtained by weighing all foods consumed via an American Weigh Black Blade Digital Pocket food scale that was provided to participants. The participants were also required to take before and after pictures of each meal using their personal digital camera, next to an Empire Steel Carpenters Square (provided by the experimenter) for scale. The Myfitnesspal© Calorie Counter (MCC) website was used by the experimenter to calculate the calories consumed by each participant. Over the course of the experiment, the participants alternated between ad libitum (baseline) and variety restricted (treatment) diets. At the conclusion of the experiment the participants completed a short social validity survey (Appendix G) designed for this experiment.
Measurement of the Dependent Variables

The dependent variables were calories consumed and meal preference rating. Calories consumed was calculated via the MCC website. The experimenter entered all foods recorded via the DFI by the participant into the MCC website. The total calories consumed were calculated using the website database of specific foods and their associated caloric content. Individual meal preference ratings were obtained by averaging the individual ratings of each component of every meal.

Interobserver Agreement and Treatment Integrity

Interobserver agreement (IOA) was calculated for calories consumed. Multiple experimenters independently entered 33% of participant’s DFIs into the MCC website. IOA was calculated by dividing the smaller total number of calories recorded by the larger total number of calories recorded and multiplying the result by 100 (Cooper, Heron & Heward, 2007). Agreements were defined as correspondence between two independent calculations of calories consumed per day based on data obtained from the same DFI. Disagreements were defined as a difference of greater than 100 calories between two independent calculations of calories consumed based on the same DFI. An overall agreement percentage across DFIs was obtained by dividing the total number of agreements by the total number of agreements plus disagreements (as defined above) and multiplying by 100.

In order to enhance treatment integrity the experimenter sent participants daily prompts via email and/or text messages to return the previous day’s DFI and to complete the current DFI. If the experimenter did not receive the previous day’s DFI by Noon on
the following day the experimenter attempted to prompt the participant via text message and/or phone call. If two days elapsed without the participant completing and returning the DFI to the experimenter the participant was debriefed and terminated from the experiment.

**Experimental Design**

A single-subject ABAB reversal within a multiple baseline across participants design was used. During baseline, the participants followed their normal ad libitum diet for a period of seven days and completed the DFI and MPR for all food/drinks consumed for dinner. During the treatment phase of the experiment, the participants adhered to a variety-restricted diet for a period of five days. The variety-restricted diet consisted of one dinner quasi-randomly selected by the participant from the OMRO list of dinners consumed during baseline. Specifically, the experimenter took the 3 lowest ranked meals listed in the previous weeks OMRO and then used a random number generator (Research Randomizer.org) to select which meal the participants would consume during the next treatment phase. The 3 lowest ranked meals were selected in order to avoid selecting a highly preferred meal, that may be resistant to the effects of monotony.

During the treatment phase, as in baseline, participants completed the DFI and MPR for all food/drinks consumed for dinner. Additionally, the participants completed the OMRO for the baseline phase meals again following the treatment phase. In the first baseline phase of the experiment, data were recorded Saturday through Friday. However, data collected on Saturday and Sunday were not used for experimental analysis to control
for reactivity. Subsequent weekend days were considered free periods for the participants and no data were recorded and there were no dietary restrictions in place.

**General Procedures**

Prior to starting the baseline phase of the experiment, the participants and experimenter met to discuss the procedures of the experiment. The experimenter trained the participants on the use of the food scale, completion of the DFI, MPR and OMRO. Participants were considered trained when they demonstrated they could weigh and record a meal with 100% accuracy without assistance from the experimenter as well as complete the DFI, MPR and OMRO without error. Specifically, the experimenter walked the participants through the tasks while providing in-vivo feedback until the participants could complete the task without assistance from the experimenter.

**Baseline Phase**

The initial baseline phase commenced at 12:00 am on a Saturday morning (all subsequent baseline phases commenced at 12:00 am Monday morning). Upon waking, the participant began the ad libitum diet and recorded all foods/liquids consumed after 4:00 pm for seven consecutive days. After seven consecutive days, the participant began the first treatment phase of the experiment.

**Dinner Food Inventory**

All food/beverage(s) consumed after 4:00 pm during the experiment were recorded via the DFI. All sections of the DFI were to be completed in its entirety. Each log entry included brand name, product type, style of preparation, quantity prepared, weight, a photo of all bar codes on packages associated with the meal (if possible) and
amount consumed. If a section of the DFI did not apply to the food being consumed, “N/A” was used to indicate that this section was not applicable. All weights (measured in ounces) associated with foods to be consumed and recorded were taken prior to and after consumption but with inedible packaging removed or accounted for by including it in both pre- and post-consumption weights.

**Meal Preference Rating**

All meals were rated across several dimensions on a 9-point Likert scale. For statistical purposes the scale categories were numbered from 1 (extremely dislike) to 9 (extremely like). After finishing a meal, the participants listed and rated each individual component of the meal. The overall meal preference rating was calculated by summing the scores of the individual components, then dividing the sum by the total number of components.

**Overall Meal Rank Order**

At the end of each treatment phase all meals consumed during baseline were ranked in numerical order from 1 (most likely to consume) to 7 (least likely to consume) based on which meal the participants would prefer to eat next.

**Dietary Manipulation**

As mentioned previously, based on the participants’ DFI from the previous baseline phase, the experimenter took the three lowest ranked meals listed on the OMRO and then used a random number generator (Research Randomizer .org) to select which meal the participants consumed during the next treatment phase.
Treatment Phase

The treatment phase commenced at 12:00 am on the Monday following the completion of baseline. The participant was only allowed to consume foods/beverages that were listed in the meal log selected from the previous week after 4:00 pm. Prior to 4:00 pm, there were no dietary restrictions. Water, though not indicated as a choice, was consumed ad libitum at all times throughout the study. Upon waking, the participant began the variety-restricted diet and recorded all foods/liquids consumed after 4:00 pm for five consecutive days.

Termination Criteria

Termination criteria were met when the participant had completed all four, one-week long phases of the experiment and submitted all associated logs or the participant failed to complete and return the DFI for two consecutive days. Upon completion, the participants were debriefed and asked to fill out a validity survey, designed to assess the participants’ opinions of the restricted variety procedure. (see Appendix G).
Chapter 3

RESULTS

Total calories consumed across all sessions (days) for each participant are presented in Figure 1. Data for Debrah, Mary and Frank show a general decrease in caloric intake from baseline to treatment. Savannah’s data shows a decrease in caloric intake from the initial baseline to treatment phase. However, Savannah’s caloric intake increased during the final treatment phase.
Figure 1. Total caloric intake. Total caloric number of calories consumed per meal for all participants.
Table 1 shows the caloric intake of the treatment meal consumed during baseline and the corresponding mean caloric intake of that meal consumed across treatment phases. All participants consumed more calories of the treatment meal during baseline, than they consumed on average during treatment. The difference in caloric intake from baseline to treatment ranged from -22 to -945. However, the difference failed to reach statistical significance ($p > .05$).

### Table 1

*Difference in Caloric Intake*

<table>
<thead>
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<th>Treatment</th>
<th>Difference</th>
<th>Baseline</th>
<th>Treatment</th>
<th>Difference</th>
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<td>398</td>
<td>-22</td>
<td>1310</td>
<td>849</td>
<td>-461</td>
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<tr>
<td>Mary</td>
<td>189</td>
<td>126</td>
<td>-63</td>
<td>565</td>
<td>487</td>
<td>-78</td>
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<tr>
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<td>-945</td>
<td>1851</td>
<td>1321</td>
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<td>Frank</td>
<td>648</td>
<td>452</td>
<td>-196</td>
<td>896</td>
<td>233</td>
<td>-663</td>
</tr>
</tbody>
</table>

The overall meal palatability ratings for the treatment meals consumed during baseline and their subsequent ratings during treatment are presented in Figure 2. Results for Frank and Mary show a general decline in palatability across repeated exposures. Savannah’s palatability rating declined across repeated exposures during the initial treatment phase. In the final treatment phase the palatability rating decreased from 8.5 to 3 and then recovered to 7.5 before dropping again to 6.5. Unlike all the other participants, Debrah’s overall meal palatability showed little to no variation across treatment sessions. Specifically, Debrah gave nine of the 12 meals the highest rating (Extremely Like) in baseline as well as treatment.
Figure 2. Palatability Rating. Average palatability rating for treatment meals only, for all participants.

Interobserver agreement (IOA) was calculated for calories consumed. Multiple experimenters independently entered 33% of participants’ DFIs into the MCC website.
Agreements were defined as correspondence between two independent calculations of calories consumed per day based on data obtained from the same DFI. Disagreements were defined as a difference of greater than 100 calories between two independent calculations of calories consumed based on the same DFI. An overall agreement percentage of 100% was obtained by dividing the total number of agreements by the total number of agreements plus disagreements (as defined above) and multiplying by 100.
Chapter 4

ANALYSIS OF THE DATA

The present experiment was designed to show the relationship between variety and caloric intake. Consistent with findings of previous experiments (Meiselman, Graaf, & Lesher 2000), data from experiment 1 suggest a relationship between variety and caloric intake. When comparing the caloric intake of the treatment meal consumed in baseline and mean caloric intake during treatment, all participants showed a decrease in both treatment phases. Further, all participants consumed on average fewer calories of treatment meals during the treatment phase as opposed to baseline. Although the current results are consistent with previous research, it was difficult to control for all extraneous variables and thus there are some limitations of the current experiment that should be noted.

One possible limitation of the study was only tracking food consumed during dinner. Allowing participants to eat freely outside the defined parameters (4:00pm-11:59pm), provided an opportunity for participants to adopt new dietary strategies that may have impacted participants’ consumption during experimental manipulations. For example Mary’s, data shows that she did not consume any of the treatment meals on Fridays. During her debriefing Mary informed the experimenter that by Friday of treatment weeks she could no longer consume the treatment meal. To compensate for not eating after 4:00pm it is possible that Mary could have consumed a large meal at 3:30. To control for such a possibility future research should yoke the deprivation levels across
participants by requiring the participants to abstain from consuming food 2 hours prior to the established meal start time.

Unlike previous studies (Meiselman, Graaf, & Lesher, 2000), 1 allowed the participants to choose the meals they consumed during baseline phases. Thus, all meals consumed were of high enough preference to be selected for consumption over the myriad of options available to the average person during dinner. Therefore, it is possible that although palatability ratings in the current experiment may be comparable to those of previous research, because the meals in the current experiment were freely chosen, the current meals may have actually been more palatable.

For example, relational frame theory (RFT) suggests that all stimuli are categorized into frames of reference (Osbourne, 2003). According to RTF the cafeteria food used in early experiments could have been rated highly preferable in relation to other cafeteria food. A colloquial example of this phenomenon is the phrase “Good for cafeteria food”. The phrase “Good for...” is a qualifier added to a statement used to provide context. Thus, RFT suggests that preference ratings given during previous experiments may only be in reference to foods/meals in a related category. Therefore, it is possible that although palatability ratings from previous research and the current experiment are comparable, some food/meals with the same rating may not be equally palatable.

Subsequently, meals freely chosen in the current experiment may have actually been of a higher palatably rating than previous research. It follows that meals randomly selected from baseline for treatment in the current experiment may have been more
resistant to the effects of monotony than the treatment meals selected in previous experiments, as participants in previous studies were not free to choose their meals (Meiselman, Graaf, & Lesher, 2000). Data from Debrah’s final treatment phase provides a possible example of this phenomenon. Her meal of a fast food combo maintains a palatability rating of “extremely like” over the 5 treatment sessions (days) with 1 exception during day 3 where it drops to “like moderately”. The sustained high palatability ratings across repeated exposures suggest that this meal may have been resistant to the effects of monotony. This same phenomenon may be responsible for the decreases in caloric intake, failing to reach statistical significance.

Future experiments could address this possibility by alternating between a participant chosen treatment meal and one chosen by the experimenter that did not receive a high palatability rating, using an ABAC design. Additionally, future experiments could investigate this phenomenon by extending the treatment period for meals that are rated 8 or 9 (Like very much, Like extremely). Perhaps resistance to monotony for highly rated meals would decrease with longer treatment exposures.

Other possible explanations for the lack of a decline in palatability ratings could also be exemplified using Deborah’s data. Within meal variety could have also been a factor in the current study. During treatment meals, the number of components per meal fluctuated across the week. Specifically, on days 1 and 2, Debrah’s salad contained 5 components. On days 3 and 4 the salads contained 8 components, and on day 5, 7 components. These within meal variations may have provided a sufficient level of
variety to forestall the monotony effect. Future studies should address this possibility by holding the number of components in a meal constant across meals.

Although within meal variety is sufficient to explain the lack of a decrease in palatability ratings in Debrah’s first treatment phase, it is unlikely that within meal variety is responsible for the lack of a decrease in the second treatment phase, as the target meal only contained 3 components. Debrah’s target meal was a combo meal from a local fast food restaurant consisting of a burger, French fries and a soda. Thus, there were relatively few within meal components to suggest that within meal variety might have been responsible for sustained palatability across treatment. However, fast food in and of itself may be more resistant to the monotony effect. In a 60 minutes piece entitled “The Flavorist” the anchor reported on a multi-national corporation called Givaudan, which specializes in “fragrance and flavour” (Streeter, 2011). Jim Hassel, a chemical engineer employed by Givaudan, stated that ideally, the company is trying to create a flavor (chemically) that is irresistible, but that does not linger on the palate. Food designed or enhanced with elements like those created by Givaudan and sold to food manufactures are in essence designed to resist the effects of monotony. Hence, a combo meal containing flavor-enhancing products could sustain its palatability across consecutive exposures.

Lastly, another limitation of the current experiment is the limited tracking of consumed food. Without tracking all food consumed on a daily basis, we cannot definitively state that the decline in caloric intake during treatment was not nullified by
an increase in caloric intake at some other point during the day. To address this issue future research should require participants to track their intake all day long.
Chapter 5

EXPERIMENT 2 INTRODUCTION

Results from the current experiment point to a number of directions for future research. Perhaps the most interesting finding of the current study was the observed decrease in caloric variability from baseline to treatment phases. In all but one case, when comparing the variability of calories consumed, during baseline and treatment, the variability of calories consumed during treatment decreased. It was hypothesized that the most likely mechanism responsible for the decrease in caloric variability was planning the meal ahead of time, or in other words eliminating the option of making an impulsive decision of what to eat, resulting in varied caloric intake across meals. To investigate this hypothesis we conducted a second experiment.
Experiment 2 followed the same procedures as experiment 1 with the exception of the independent and dependent variables described below.

**Participants**

This study utilized 2 participants (1 male and 1 female) recruited via word of mouth. Participant’s ages were 33 and 37. All requirements to participate were the same as experiment 1. Matt was a 37-year-old male who weighed 208 lbs and was 6 feet 1 inch tall. He self-reported his body type as Mesomorph (high muscle, low fat) and his calculated BMI was 27.44 (overweight). Molly, a 33-year-old female, weighed 195 lbs and was 5 feet 5 inches tall. She self-reported her body type as Endomorph (low muscle, high fat) and her calculated BMI was 32.62 (Obese).

**Measurement of the Dependent Variables**

The dependent variable was variability of calories, measured by the difference between the highest caloric meal and the lowest caloric meal per phase. The caloric values of the meals consumed were calculated following the procedures outlined in experiment 1.

**Treatment Phase**

The independent variable was pre-planning what participants ate for dinner. The treatment phase commenced at 12:00 am on the Monday following the completion of baseline. Participants were required to submit a meal plan to the Experimenter the night
before a treatment day. During treatment, prior to 4:00 pm, there were no dietary restrictions or food tracking. After 4:00 pm participants were only allowed to consume foods/beverages that were listed in the previous night’s meal notification. Water, though not indicated as a choice, was consumed ad libitum at all times throughout the study. Participants recorded all foods/liquids consumed after 4:00 pm for five consecutive days.

**Termination Criteria**

Termination criteria were met when the participant had completed all four, one-week long phases of the experiment and submitted all associated logs or the participant failed to complete and return the DFI for two consecutive days. Upon completion, the participants were debriefed and asked to fill out a social validity survey, designed to assess the participants’ opinions of the restricted variety procedure (see Appendix G).
Chapter 7

EXPERIMENT 2 ANALYSIS OF THE DATA

Visual inspection of the caloric variability graph (Figure 3), suggest that there was a general decrease in caloric variability between the baseline and treatment phases for both participants. Matt’s caloric variation for baseline was 2235 calories and 574 calories during treatment. His caloric variability difference between baseline and treatment was 1661 calories. Molly’s caloric variation for baseline was 1458 calories and 619 calories during treatment. Her caloric variability difference between baseline and treatment was 839 calories.
Figure 3. Caloric variability. Total caloric number of calories consumed per meal for all participants.
Chapter 8

FINDINGS AND INTERPRETATIONS

The present experiment was designed to determine if pre-planning a meal could reduce caloric variation. Janson (2009) conducted an experiment where they attempted to identify whether inhibition or impulsivity is responsible for overeating in 63 female college students. Results of the experiment suggest that the women who overate the most tended to be those that not only had low restraint, defined as a non-chronic dieter/weight suppressor, but high impulsivity as well. The experimenters suggest that low restraint alone was not predictive of overeating. Thus, the addition of impulsivity is a crucial factor in weight management.

Results of experiment 2 are consistent with findings of previous studies in that we were able to show that by eliminating the option of making an impulsive choice by pre-planning meals, the variability of caloric intake decreased when compared to caloric intake during weeks when meals were not planned. Although Matt did decrease his variability, there was a large increase in calories consumed from baseline to treatment. Matt reported that he started consuming protein shakes in an effort to “build muscle and drop fat in my waist, I’m going for a six-pack”. Molly reported having no weight/muscle loss or gain strategies. Future studies should further examine the relationship between pre-planning, variety, and caloric intake by assessing whether these strategies remain
successful across all daily meals. Additionally, studies should examine the social validity of enacting these strategies for an extended period of time and compare the effects to other weight loss strategies.
Chapter 9

GENERAL DISCUSSION

The current studies provide preliminary evidence that limiting the variety of food consumed is effective in reducing caloric intake. The results further suggest that pre-planning meals may reduce caloric variation across meals. These strategies could potentially be used to enhance the effectiveness of existing weight-loss programs, as well as to treat weight loss as a stand-alone intervention. Many weight loss diets fail because they are impractical and unsustainable (Arthur, 2013). In fact, 2 out of 5 dieters quit within the first seven days (Arthur). The current social validity results suggest restricting variety/pre-planning meals may be a more effective means by which one could attempt to lose weight. For example, these strategies could be used as the first step in initiating a weight loss program, as they are potentially less effortful than other weight loss strategies (e.g., calorie restriction, exercise), as the current strategies do not require dieters to eliminate any specific food or restrict the amount of food consumed. Furthermore, by implementing these strategies and coming into contact with potential reinforcers such as weight loss or reduced caloric intake, participants may use these strategies for a longer period of time or may enact a more effortful strategy to facilitate weight loss.
APPENDIX A

CONSENT TO PARTICIPATE AS A RESEARCH SUBJECT

I hereby agree to participate in research, which will be conducted by Anthony Hairston and will involve the following procedures:

I will be asked to complete one questionnaire assessing my general eating habits and my perception of my body type. Additionally, for a period of four weeks I will be asked to complete a daily food log for one meal per day, and a daily meal preference rating form. The research will take place wherever I consume dinner and take approximately 30 minutes of my time per day. I understand that once I have successfully participated in the research for four weeks I will be entered into a drawing for a 1/6 chance of receiving a $100 gift/credit card.

I understand that I may not personally benefit from this research but my participation may contribute to a better understanding of research in psychology. Additionally, I understand that participation in this research may or may not produce temporary stress.

I understand that the investigator or I may discontinue my participation at any time without penalty.

Anthony Hairston verbally explained this information to me. I understand that he will answer any questions I may have during the research or at a later time. Any future questions should be directed to Anthony Hairston who can be reached at amh284@saclink.csus.edu

Signature: ____________________________ Date: ________________
Debriefing Form

Purpose
The purpose of this study was to evaluate the effects of dietary variety on caloric intake.
Further, this study aimed to assess the importance of restricting variety in reducing caloric intake.

Hypotheses and Supporting Research
Dietary variety has been linked to an increased consumption of food in animals as well as humans (DiBattista & Sitzer, 1994; McCrory et al., 1999; Rolls, 1979; Seigel & Pilgrim, 1958). Previous research (e.g., Seigel and Pilgrim, 1958; Shutz and Pilgram, 1958) has suggested that dietary monotony has been effective in reducing caloric intake. To further evaluate this, participants’ caloric intake was measured while manipulating the amount of variety in their diet.

Contact Information
If you would like further information about this study or have questions regarding this study, please contact Anthony Hairston at: amh284@saclink.csus.edu

Closing
Do you have any questions?
Thank you for participating!
Screening Questionnaire

Instructions: Complete all information below by providing the requested information or selecting the option you believe best describes you.

Name: _____________________________________________

Age: _________________

Sex: _________________

Weight: _________________

Height: _________________

Wrist Circumference (in): _________________

Body Type:
- _____ Ectomorph (Low muscle, Low fat)
- _____ Mesomorph (High muscle, Low fat)
- _____ Endomorph (Low muscle, High fat)

Body Frame Size:
- _____ Small
- _____ Medium
- _____ Large

How many times in the last seven days did you eat the same meal for dinner?

_____________

(Ex. I had pizza on Monday and then had leftover pizza on Tuesday and then ate spaghetti, salad, steak, Chinese food, and sushi the rest of the week. The answer to the above question would be 2)
APPENDIX D

DAILY FOOD INVENTORY

# Daily Food Inventory/ Event Log

Instructions: Please complete the below form in its entirety. Please log each item eaten during dinner individually. (when possible) Do not leave any individual cell with an associated product type blank. If a particular column does not apply, please indicate it with N/A. Several examples are provided for your reference.

<table>
<thead>
<tr>
<th>Product Type</th>
<th>Brand Name</th>
<th>Description</th>
<th>Quantity</th>
<th>Before consumption weight (oz)</th>
<th>After consumption weight (oz)</th>
<th>Amount consumed</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pork Chops</td>
<td>SaveMart Super Market</td>
<td>1</td>
<td>1.4</td>
<td>0</td>
<td>100</td>
<td></td>
</tr>
<tr>
<td>Rice</td>
<td>California Calrose Rice</td>
<td>1</td>
<td>1.25</td>
<td>0</td>
<td>100</td>
<td></td>
</tr>
</tbody>
</table>
APPENDIX E

MEAL PREFERENCE RATING

<table>
<thead>
<tr>
<th>Item Name</th>
<th>Dislike Extremely</th>
<th>Dislike Very Much</th>
<th>Dislike Slightly</th>
<th>Neither Like or Unlike</th>
<th>Like Slightly</th>
<th>Like Moderately</th>
<th>Like Very Much</th>
<th>Like Extremely</th>
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</table>
Appendix F

OVERALL MEAL RANK ORDER

### Overall Meal Rank Order

**INSTRUCTIONS:** List the meals eaten in the previous week in the order they were consumed in the left column. Rank the meals in order from 1 (most likely to consume) - 7 (least likely to consume) based on which meal you would prefer to eat a next.

<table>
<thead>
<tr>
<th>MEAL DESCRIPTION</th>
<th>RANK ORDER NUMBER</th>
</tr>
</thead>
<tbody>
<tr>
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</tr>
</tbody>
</table>
### Social Validity Survey

<table>
<thead>
<tr>
<th>Statements</th>
<th>Disagree Extremely</th>
<th>Disagree Very Much</th>
<th>Disagree Moderately</th>
<th>Disagree Slightly</th>
<th>Neither Agree or Disagree</th>
<th>Agree Slightly</th>
<th>Agree Moderately</th>
<th>Agree Very Much</th>
<th>Agree Extremely</th>
</tr>
</thead>
<tbody>
<tr>
<td>It was easy to eat the same dinner several times in a row.</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>I would use the restricted variety technique to attempt to lose weight in the future.</td>
<td></td>
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<tr>
<td>I would recommend this dietary strategy to a friend</td>
<td></td>
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<td></td>
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</tbody>
</table>
REFERENCES


