

The Pennsylvania State University
The Graduate School
College of Health and Human Development

**DOES SERVING A VARIETY OF VEGETABLES AT A SINGLE MEAL INCREASE
VEGETABLE INTAKE?**

A Thesis in
Nutrition
by
Jennifer Sherlock Meengs

© 2011 Jennifer Sherlock Meengs

Submitted in Partial Fulfillment
of the Requirements
for the Degree of

Master of Science

August 2011

The thesis of Jennifer Sherlock Meengs was reviewed and approved* by the following:

Barbara J. Rolls
Helen A. Guthrie Chair
Professor of Nutritional Sciences
Thesis Advisor

Terryl J. Hartman
Professor of Nutritional Sciences

Penny Kris-Etherton
Distinguished Professor of Nutritional Sciences

Gordon Jensen
Professor of Nutritional Sciences
Head of the Department of Nutritional Sciences

*Signatures are on file in the Graduate School

ABSTRACT

Previous research has shown that increasing the variety of available foods leads to increased intake; yet few studies have determined whether increased variety can be used strategically to promote intake of low-energy-dense foods such as vegetables. The present study tested whether the number of vegetables served at a meal influences vegetable consumption and energy intake. Once a week for 4 weeks, 66 adults (34 women; 32 men) were served a meal consisting of 600 g pasta (ED 1.57 kcal/g) and 600 g cooked vegetables (mean ED 0.52 kcal/g) using a counterbalanced design. At 3 meals the pasta was served with a single vegetable (broccoli, carrots, or snap peas) and at the other meal 200 g each of the 3 vegetables was served. The results showed that subjects ate significantly more vegetables when served the variety than when served any single type (mean 49 ± 9 g; $p=0.038$). The increase in vegetable intake remained significant when the variety condition was compared to each subject's preferred vegetable (mean 23 ± 7 g; $p=0.002$). Men consumed significantly less energy at the meal when broccoli or carrots were served than when peas or a variety of vegetables were served (mean 80 ± 17 kcal; $p<0.04$), but meal energy intake in women did not vary significantly across conditions. The weight status of the participants did not significantly influence the effect of variety on intake. The results of this study suggest that increasing the variety of low-energy-dense vegetables served at a meal can be used as a strategy to increase vegetable intake.

TABLE OF CONTENTS

List of Figures	vi
List of Tables	vii
Acknowledgements.....	viii
Chapter 1 – Introduction	1
Chapter 2 – Methods	8
Chapter 3 – Results	16
Chapter 4 – Discussion and Conclusion	25
References.....	32
Appendix A – Telephone Study Description	35
Appendix B – Telephone Screening Questionnaire.....	37
Appendix C – Demographic and Health Questionnaire	39
Appendix D – Eating Inventory Questionnaire	44
Appendix E – Eating Attitudes Test Questionnaire.....	47
Appendix F – Zung Questionnaire.....	49
Appendix G – Screening Consent Form	51
Appendix H – Study Welcome	54
Appendix I – Study Informed Consent	56
Appendix J – Food and Physical Activity Diary	60
Appendix K – Breakfast Meal Report	64
Appendix L – Lunch Meal Report	66
Appendix M – Discharge Questionnaires	68

Appendix N – Visual Analog Scale Questions – Hunger and Satiety	71
Appendix O – Visual Analog Scale Questions – Palatability	73
Appendix P – Visual Analog Scale Questions – Meal Characteristics	75
Appendix Q – Recipe for flavored broccoli	77
Appendix R – Recipe for pasta with sauce	79

LIST OF FIGURES

Figure 1. Vegetable Intake by Weight	17
Figure 2. Pasta Intake by Weight.....	18
Figure 3. Total Food Intake by Weight.....	18
Figure 4. Preferred vs. Variety Vegetable Intake	19
Figure 5. Vegetable Energy Intake	19
Figure 6. Pasta Energy Intake	20
Figure 7. Total Food Energy Intake.....	21

LIST OF TABLES

Table 1. Subject Characteristics.....	11
Table 2. Nutritional Information of Test Meal Foods.....	13
Table 3. Ratings of Hunger and Satiety	22
Table 4. Ratings of Palatability.....	24

ACKNOWLEDGEMENTS

I would like to thank Dr. Barbara Rolls for giving me the opportunity to pursue this goal and for always encouraging me to see it through to the end.

Thank you to Dr. Penny Kris-Etherton and Dr. Terry Hartman for serving on my thesis committee.

A very sincere thank you to everyone in the Laboratory for the Study of Human Ingestive Behavior; Liane Roe for all her patience and assistance with data analysis, and all of our current and past students and staff members who helped with this study.

And most importantly, thank you to my family. I could never have finished this degree without the help of my mom. Her guidance, support and encouragement have been present from day one. And Matthew and Meredith, you two make me feel like I can do anything. You are my heart! And I hope you will always eat your vegetables!

To

Dad

Chapter 1

Introduction

The 2010 Dietary Guidelines for Americans include recommendations to 'increase vegetable and fruit intake' and to 'eat a variety of vegetables' (1). The positive health factors associated with a diet high in fruits and vegetables are well documented, yet very few Americans are eating recommended amounts. For years, health organizations and programs such as the CDC's 5 A Day program and the Year 2000 Objectives for the United States encouraged at least 5 servings of fruits and vegetables each day (2,3), yet very few people were meeting this goal. A telephone survey of over 23,000 adults in 16 states using a food frequency questionnaire showed that only 20% of the population consumed the recommended 5 or more daily servings (4). Currently, MyPlate, previously MyPyramid, (5) gives recommended fruit and vegetable servings specific to sex, age, height, weight and activity levels; and these levels are higher than past recommendations of eating at least 5 servings of fruits and vegetables each day. Analysis of 2-day, 24-hour recall data from the 2003-2004 National Health and Nutrition Examination Survey (NHANES) documented that fewer than 1 in 10 Americans were meeting their calorie-specific MyPyramid vegetable recommendations (6). Clearly, effective strategies to increase fruit and vegetable intake are needed.

A diet rich in vegetables has been shown to reduce the risk of heart disease and stroke (7), help maintain healthy bowel status (8), and help prevent diverticulosis and diverticulitis (9). It is also likely that increased intake of particular vegetables, such as leafy greens, tomatoes, broccoli, cabbage, onions and garlic, can decrease the risk of certain cancers; including cancers of the prostate, mouth, throat, esophagus and stomach (10,11). And while vegetables are high in fiber, vitamins and other healthful nutrients, they are low in energy density (kcal/g)(ED), which

means as long as vegetables aren't deep fried or covered in high-fat sauces or condiments, large portions can be consumed in an individual's diet without adding a large amount of calories.

VARIETY

The effects of variety on food intake have been examined thoroughly, with increases in variety leading to increased intake of energy-dense foods. In a 2009 literature review by Remick et al, it was concluded that the effect of variety is not altered by internal moderators such as gender, weight and dietary restraint (12). When a variety of foods were served, intake increased compared to when a single food was served. Rolls et al. were some of the first researchers to investigate this robust effect of variety in humans (13). In one study, subjects ate a third more total weight of food when four differently filled savory sandwiches were served one flavor at a time over four consecutive courses than when just one flavor of sandwich was served over four courses. In a second study, three differently flavored sweetened yogurts were tested. On three of four eating occasions, subjects received three separate courses of one individual flavor of yogurt. On the fourth occasion they received each of the three flavors, one at time, over the three courses. Subjects consumed 19.5% more yogurt by weight in the variety condition than when a single yogurt was offered over three courses. The yogurts in this study varied in flavor, texture and color; but had similar energy densities. In a third study, three yogurts were used that were similar in energy density, color, taste and texture, but varied slightly in fruit flavor. In this study there was no increase noted when the three yogurts were served successively over three courses compared to just one flavor served three times, suggesting that that the more dissimilar the foods are, the more likely the response to variety. Little is known, however, about the effects of variety on intake of low-energy- foods, such as vegetables.

SENSORY-SPECIFIC SATIETY

Serving a variety of foods decreases sensory-specific satiety, which likely explains the resulting increase in food intake. Sensory-specific satiety (SSS) is a 'phenomenon in which hedonic ratings of a food eaten to satiation decrease more than hedonic ratings of foods not eaten to satiation' (14). Rolls et al described SSS clearly in 1981 in a series of studies that showed taste ratings in foods decreased more rapidly in foods that were served compared to foods that were not served at a meal (15). Subjects were asked to rate the pleasantness of the taste of eight foods before a lunchtime meal. They were then given one of the eight foods for lunch and instructed to eat the individual food to satiety. After the meal they again rated the taste of the original eight foods, including the one they ate for lunch. A greater reduction in taste ratings was seen for the food eaten for lunch than those just sampled before the meal.

THE COMBINED EFFECT OF SENSORY-SPECIFIC SATIETY AND VARIETY

A food is generally eaten until it has stopped tasting pleasant. By providing a variety of foods, the decrease in the hedonic ratings of those foods occurs at a slower rate (16). This is demonstrated in a study by Rolls et al. that examined the changes in hedonic taste ratings and food intake in a four-course meal (17). Across the four courses, subjects were served either one study food at all courses, the 'plain meal', or were served a different food at each course, the 'varied meal'. Before and after each course, subjects rated the taste of eight different foods, including the four study foods. In the plain meal, the taste ratings of the food that was served showed a consistent decline as the courses progressed, indicating the effect of eating that food in

the previous course. In the varied meal, however, the pleasantness of taste ratings for foods eaten in the later courses was not markedly decreased by the ingestion of other foods earlier in the meal. It is this lack of change in the pleasantness of foods that had not been eaten yet in the varied meal that may explain how variety stimulates food intake.

While a variety of foods with major differences in sensory properties are likely to increase intake more than those of similar sensory properties (13), even moderate differences can increase intakes. Epstein et al. demonstrated this in a study using 8-12 year-old children. Children were given elbow shaped macaroni and cheese to eat to satiety. They were then given a second course of the same elbow macaroni and cheese, the same brand and recipe of macaroni and cheese but using spiral noodles, or chicken nuggets. Intake of chicken nuggets and spiral macaroni and cheese were both significantly greater than the elbow macaroni and cheese in the second course, showing that just slight differences visually and texturally can increase intake (18).

Even something as simple as adding condiments to food can add enough variety to a meal to lessen the effect of sensory-specific satiety and increase food intake. In a study by Brondel et al., three conditions were tested: "monotonous", where fries followed by brownies were served alone without any additional condiments; "simultaneous", where fries were served with ketchup and mayonnaise followed by brownies with vanilla cream and whipped cream as condiments; and "successive", where after eating fries *ad libitum* ketchup and mayonnaise were offered and additional fries were eaten if desired, and then repeated with the brownies and vanilla cream and whipped cream. Intake was 40% and 35% higher in the successive and simultaneous conditions, respectively, compared to the monotonous condition. Additionally, in the successive condition,

the hedonic ratings for the fries and brownies increased after the introduction of condiments, contributing to increased intake of the foods (19).

The present study is one of the first studies to test the effect of serving a variety of low energy-dense vegetables as a strategy to increase vegetable intake. The majority of the studies testing the effect of variety on intake served foods successively over multiple courses (13,14, 17,18,19), and this study was one of the few that tested the effect of serving a variety of vegetables within a single course. Additionally, most past research tested a variety of highly palatable, high energy-dense foods and their role on increasing food and energy intake, while this study focused on the effect of serving a variety of low-energy-dense foods on intake.

EXPERIMENTAL OBJECTIVES

The purpose of this study was to examine if increasing the variety of low-energy-dense vegetables served at a meal would result in increased vegetable intake and reduced energy intake. We hypothesize that 1: Serving a variety of vegetables at a meal will increase consumption of vegetables and will decrease consumption of other foods, and 2: Serving a variety of vegetables will decrease the overall energy density consumed at the meal, and therefore decrease total energy intake.

PUBLIC HEALTH RELEVANCE

The results of this investigation will provide further insight into the extent to which variety can be used as a strategy to increase intake of a healthy, nutrient-rich, low energy-dense food, such as vegetables. With such a large percentage of Americans eating less than the

recommended intakes of vegetables, and the positive health benefits of a diet high in vegetables well known, effective strategies that increase vegetable intake are needed.

Chapter 2

Methods

Subjects

Recruitment

Subjects in this study were healthy, normal, overweight and obese males and females. Participants were recruited from the Pennsylvania State University and State College community by advertisements in the *Daily Collegian* and University listservs. Responding to the advertisements, interested individuals listened to a brief description of the study (Appendix A) and then completed a standard telephone interview (Appendix B) to ensure the following criteria were met: 20-45 years of age and in good health; not currently dieting to gain or lose weight; not an athlete in training; not pregnant or breast-feeding; not using medications known to affect appetite or food intake; non-smoker; no known food allergies to study foods; no food restrictions; reported liking and willingness to eat study foods; regularly eating three meals/day; and Body Mass Index (BMI) between 18-40 kg/m².

Screening

If screening criteria were met through the telephone interview, potential participants were brought into the laboratory and measured for weight and height (model 707; Seca Corp., Hanover, MD, USA) and they rated the taste of foods served in the study using a 100-mm visual analog scale. For inclusion in the study, all foods must have been rated ≥ 30 mm to eliminate potential subjects who strongly dislike the taste of the study foods. In addition, potential subjects completed a Demographic and Health Questionnaire (Appendix C) as well as a variety of screening questionnaires. Included in these materials were the Eating Inventory (20) (Appendix D), which assesses dietary restraint, disinhibition and tendencies towards hunger; the 26-item version of the Eating Attitudes Test (21) (Appendix E) which detects deviant attitudes to food

and eating; and the Zung Self-Rating Depression Scale (22)(Appendix F), which measures symptoms of depression. Only individuals who scored <20 on the EAT-26 and <40 on the Zung Self-Rating Depression scale were included in the study. Scores generated by the Eating Inventory were tested as covariates in the analysis of study outcomes. Subjects signed consent to complete all paperwork during the screening process (Appendix G).

Subjects who met all criteria were assigned a random dot color and three digit number for identification. They returned to the lab for a brief training session where they were given instructions on how to complete study paperwork and received study guidelines and their scheduled meal times (Appendix H). At this time subjects signed Informed Consent (Appendix I). Subjects were told that the purpose of the study was to examine the perceptions of different tastes. Subjects received financial compensation of \$50 for participation in the study. All procedures were approved by the Office for Research Protections of the Pennsylvania State University.

Sixty-nine subjects completed the study. Data from three subjects was not used in final analysis as their data was deemed influential for vegetable intake at the meal. Subject ID 438 ate all 600 g of the vegetable three times, but 250 g of peas, and > 95% of the pasta in all conditions. Subject ID 408 ate > 400 g of vegetables three times, but 180 g of peas. Subject ID 419 had low intake in week 3 (83 g broccoli + 169 g pasta) versus other weeks (200 - 500 g vegetables + 300 - 500 g pasta). Subject characteristics of those used in the data analysis are outlined in Table 1.

Table 1. Subject Characteristics

	Men (n=32)		Women (n=34)	
	Mean \pm SEM	Range	Mean \pm SEM	Range
Age (y)	27.4 \pm 1.2	20.4 – 44.5	26.5 \pm 1.3	20.1 – 44.9
BMI (kg/m²)	25.5 \pm 0.6	20.7 – 35.4	23.3 \pm 0.6	17.8 – 32.4
Weight (lb)	181.4 \pm 5.1	139.5 – 284.6	140.0 \pm 3.8	101.4 – 186.2
Height (in)	70.7 \pm 0.5	63.0 – 75.7	65.0 \pm 0.5	57.5 – 71.0
Eat-26 ¹	3.2 \pm 0.6	0 – 16	4.3 \pm 0.6	0 – 13
Zung ²	29.7 \pm 0.8	23 – 40	28.8 \pm 0.7	23 – 38
Restraint ³	6.4 \pm 0.7	1 – 12	8.0 \pm 0.7	2 – 17
Disinhibition ³	4.8 \pm 0.4	1 – 10	4.6 \pm 0.6	0 – 15
Hunger ³	4.8 \pm 0.6	1 – 14	3.9 \pm 0.4	0 – 9

¹Score on the Eating Attitudes Test (20)

²Score on the Zung Self-Rating Depression Scale (21)

³Score on the Eating Inventory (19)

Procedures

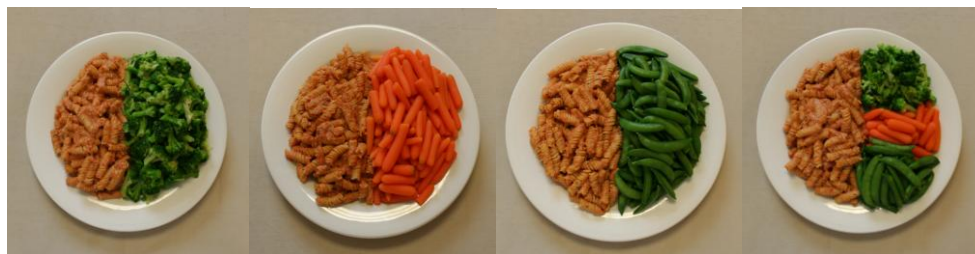
Experimental Design

This study used a cross-over design with repeated measures within subjects; thus, participants served as their own control. The order of presentation of the conditions was counterbalanced across subjects using a Latin Square. Subjects reported to the laboratory once a week for four weeks for breakfast and lunch. On each test day a standard breakfast, consisting of bagels and yogurt, was consumed *ad libitum* in order to ensure a consistent level of hunger before each of the lunch sessions. Subjects reported back to the laboratory at least 3 hours after breakfast for the manipulated lunch meal, which was also consumed *ad libitum*.

Study Test Meals

At each manipulated lunchtime meal, subjects received 600 g of pasta in sauce (New World Pasta, Harrisburg, PA; Campbell Soup Company, Camden, NJ; H.J. Heinz Company, Pittsburgh, PA.). The meal varied each week by the vegetable(s) served. Depending on condition, in addition to the pasta subjects received either 600 g of steamed, buttered baby broccoli florets (Birds Eye Foods, Inc., Rochester, NY); 600 g of steamed carrot (Hanover Foods, Hanover, PA); 600 g of steamed snap peas (Hanover Foods); or 200 g of each of the three vegetables. One liter of cold water was served with all meals. Energy density, kcal/g, of lunch study foods was tested using bomb calorimetry (Parr Instruments info). The ED of the pasta was recorded at 1.57, the buttered broccoli at 0.54, the carrots at 0.33 and the snap peas and 0.69 kcal/g. Comparison of the reported nutritional information from manufacturer's labels and the bomb calorimetry can be seen in Table 2.

To determine the amount of food and beverage consumed at each meal, all foods and beverages were weighed prior to being served to subjects and upon completion of the meal. All weights were recorded to the nearest 0.1 g. Energy intakes for each meal were calculated using the results obtained from bomb calorimetry.



Procedures

On test days, subjects were instructed to consume only foods and beverages provided by the laboratory from the time they woke up each test morning until after the lunch meal. Subjects were allowed to drink water between the meals, but were asked to refrain from drinking water one hour before each test session. Subjects were instructed to not eat in a restaurant the evening before each test day, and to refrain from drinking alcohol the day before each test day.

Additionally, subjects were asked to keep their amount of food eaten and the level of physical activity the day before each test day as consistent as possible across sessions. To encourage

Table 2: Nutritional Information of Test Meal Foods based on Food Labels¹

Food	Amount Served (g)	CHO² g	Pro g	Fat g	Fiber g	Energy Kcal	ED per label Kcal/g	ED tested Kcal/g²
Pasta with sauce	600	143.8	32.9	22.8	10.4	880.1	1.46	1.57
Birds Eye Baby Broccoli Florets with added lite butter and butter flavoring	200	9.4	2.35	0	4.7	70.5	0.44	0.54
Hanover Petite Whole Carrots	200	13.2	0	0	2.2	55.0	0.30	0.33
Hanover Sugar Snap	200	12.6	7.56	0	7.56	75.6	0.36	0.69

¹Amounts given are for the Variety condition. In each individual vegetable condition, 600 g of vegetable was served

²Kcal/g results using bomb calorimetry

compliance, subjects completed a food and physical activity diary the day before each test session (Appendix J).

On test days, subjects reported to the lab at their scheduled time and were seated in an individual testing booth. Before each meal, they completed a meal report (Appendices K and L) to verify that they were feeling well and following study protocols. At all meals, subjects were instructed that they could eat as much or as little of all the foods as they would like. Subjects were not permitted to take any reading material into the testing booth and were instructed to turn off electronic devices such as cell phones.

Subjects completed a discharge questionnaire (Appendix M) after lunch on the final session.

Ratings of hunger, satiety, and food characteristics

Before and after each test session, subjects completed a series of 100-mm visual analog scales (23) to rate their hunger, thirst, and satiety as assessed by fullness. For example, the question “How full do you feel right now?” was marked with anchors of “Not at all full” and the left side, and “Extremely full” on the right side (Appendix N). Subjects were instructed to mark their response on the scale with a single, vertical line.

Subjects used the same type of 100-mm scale during the lunch meal to rate the taste, texture and appearance of study foods (Appendix O). Before and after each lunchtime meal, subjects were given small samples of the pasta and each of the three vegetables. The samples were presented on a tray in the same order each session and subjects were instructed to complete the rating of the samples in the order they were presented.

As the lunchtime meal was served, subjects were presented with an additional booklet that used the 100-mm scale to compare the serving size of the entrée and the vegetables to their

usual portion size of entrée and vegetables, with anchors of “A lot smaller” and “A lot larger” (Appendix P).

Data Analysis

Data were analyzed using a mixed linear model with repeated measures (Statistical Analysis Software, version 9.1, 2003, SAS Institute, Inc., Cary, NC). The fixed effects in the model were experimental condition (the number and type of vegetable served) and study week. The model type = Compound Symmetry. The primary outcomes for the study were vegetable intake, food intake, and energy intake at each meal. Secondary outcomes were participant ratings of hunger, satiety, and food characteristics. Subject characteristics were investigated as covariates in the main statistical model. Pairwise p-values were adjusted for multiple comparisons by the Tukey method. Results are reported as mean \pm standard error and were considered significant at $p < 0.05$.

Chapter 3

Results

Effect of Vegetable Variety on Vegetable, Pasta and Total Food Intake

Serving a variety of vegetables increased vegetable intake in both men and women ($p < 0.04$), with no significant differences between the sexes ($p < 0.98$). Mean intakes include 210 ± 13 g when broccoli was served individually, 172 ± 11 g for carrots, 162 ± 10 g for snap peas, and 230 ± 10 g when all three vegetables were served. Vegetable intake in the variety condition was 20 ± 8 g greater than vegetable intake when just broccoli was served, and 58 ± 9 and 67 ± 8 g than when carrots and snap peas were served, respectively (Figure 1). Subjects consumed significantly more broccoli than carrots and peas when served individually.

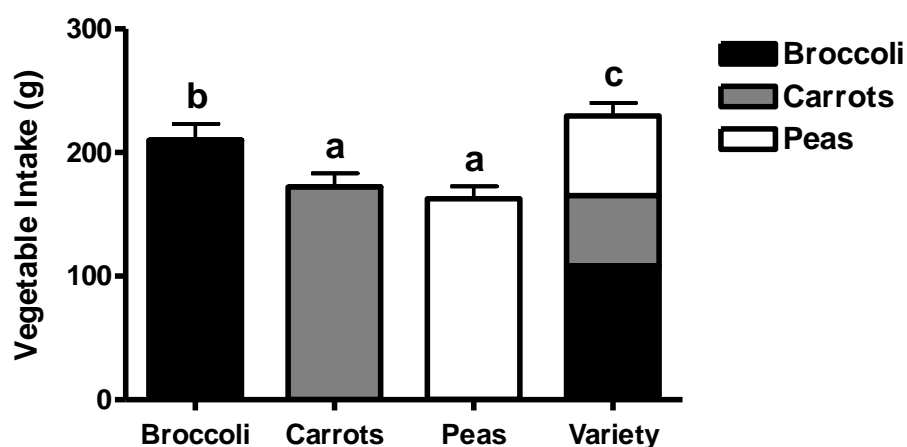


Figure 1: Mean vegetable intake (\pm SEM) by type of vegetable served. Means with different letters are significantly different ($p < 0.04$).

Unlike vegetable intake, pasta intake was affected by the sex of participants ($p < 0.008$), with men consuming more pasta than women. Women consumed a relatively consistent amount of pasta in each condition: 308.8 ± 18 g, 333.8 ± 20 g, 308.4 ± 18 g, and 306.6 ± 17 g in the broccoli, carrots, snap peas, and variety conditions, respectively. Men, however, consumed more pasta in the peas, 423.8 ± 21.6 g, and variety, 415.9 ± 20.9 g, conditions than in the broccoli condition, 372.3 ± 22 g ($p < 0.04$). Pasta intake in the carrot condition, 402.5 ± 21.6 g, did not significantly differ from any of the other conditions (Figure 2).

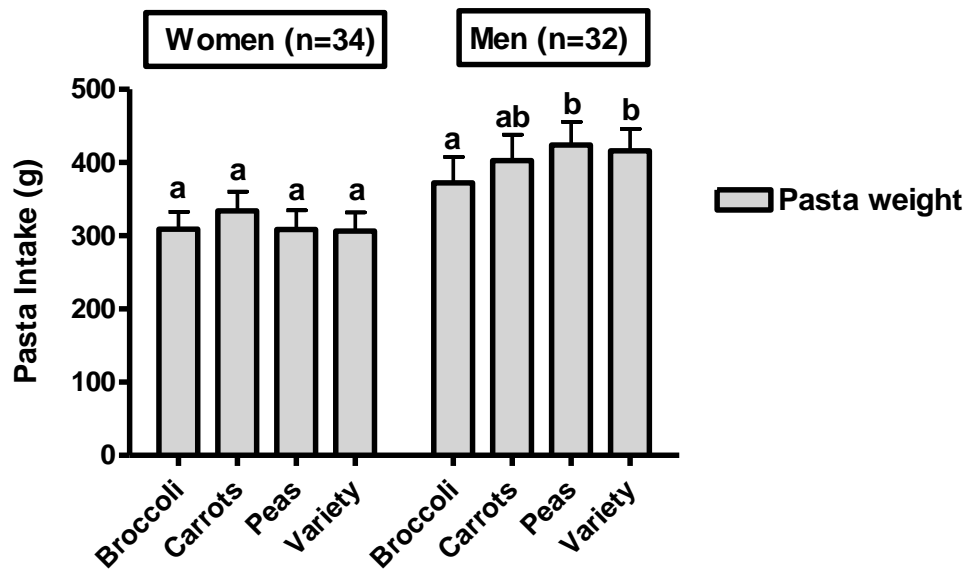


Figure 2: Mean pasta intake (\pm SEM) by type of vegetable served. Means with different letters are significantly different ($p < 0.04$).

Total food intake was greater in men than women ($p < 0.03$); and in both sexes, total food intake was greater in the vegetable variety condition ($p < 0.0001$) (Figure 3).

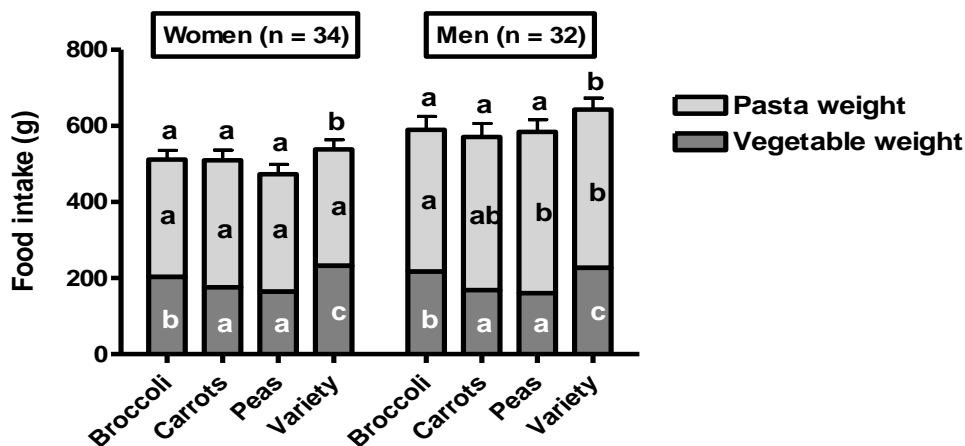


Figure 3: Mean total food intake (\pm SEM) by condition. Means with different letters are significantly different ($p < 0.04$).

At discharge, subjects rank ordered the vegetables served from favorite to least favorite. When comparing vegetable intake from the variety condition to the intake of the favorite

vegetable served alone, intake remained greater when all three vegetables were served, with a mean of 25 ± 8 g greater intake in the variety condition (Figure 4).

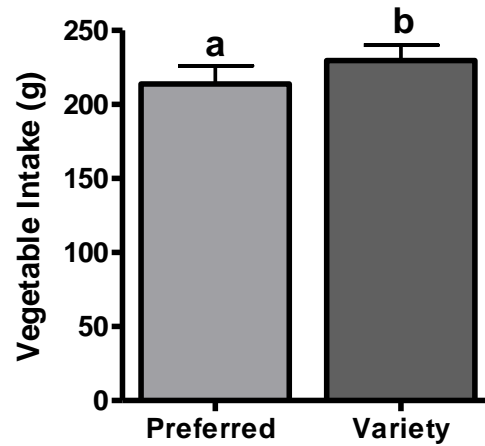


Figure 4: Mean vegetable intake (\pm SEM). Means with different letters are significantly different ($p < 0.002$).

Effect of Vegetable Variety on Energy Intake

Both men and women ate less energy ($p < 0.0001$) from vegetables in the carrot condition, 56 ± 4 kcal, than the other conditions: 112 ± 7 for both broccoli and snap peas, and 121 ± 6 for the variety condition (Figure 5).

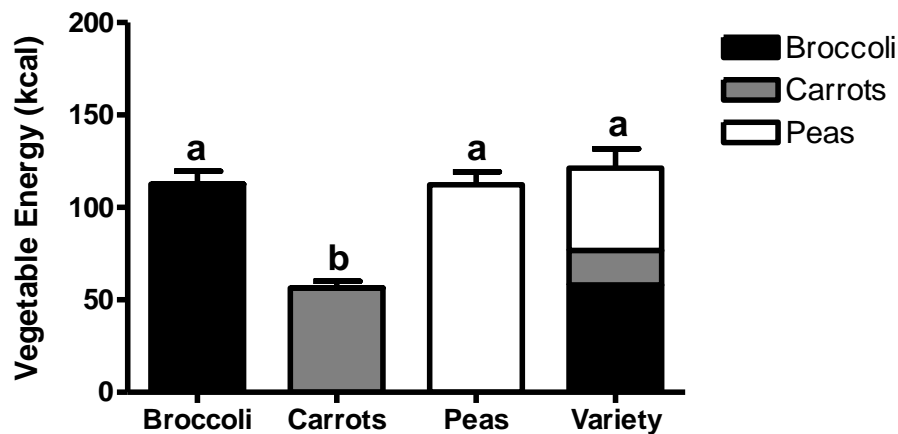


Figure 5: Mean Vegetable energy intake (\pm SEM). Means with different letters sign. different ($p < 0.0001$)

While women ate a relatively consistent amount of energy from the pasta in each condition, men consumed less energy from the pasta in the broccoli condition than in the snap peas and variety conditions ($p < 0.043$). Energy from pasta in the carrot condition did not differ from the other conditions (Figure 6).

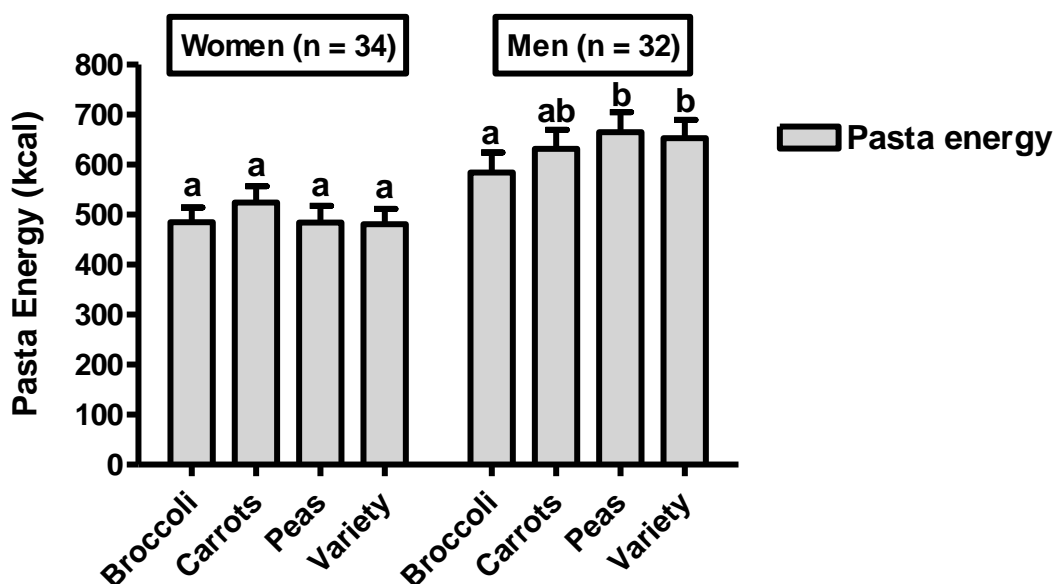


Figure 6: Mean pasta energy intake (\pm SEM). Means with different letters are significantly different ($p < 0.043$).

Total energy intake at the meal was greater for men than women ($p < 0.008$). Total meal energy intake in women resulted in no significant differences; but men ate greater total energy in the snap peas and variety conditions, mean 774 ± 27 kcal, than the broccoli and carrot conditions, mean 694 ± 27 kcal ($p < 0.043$) (Figure 7). No significant differences in meal energy intake were noted when comparing the variety condition to each subject's preferred condition.

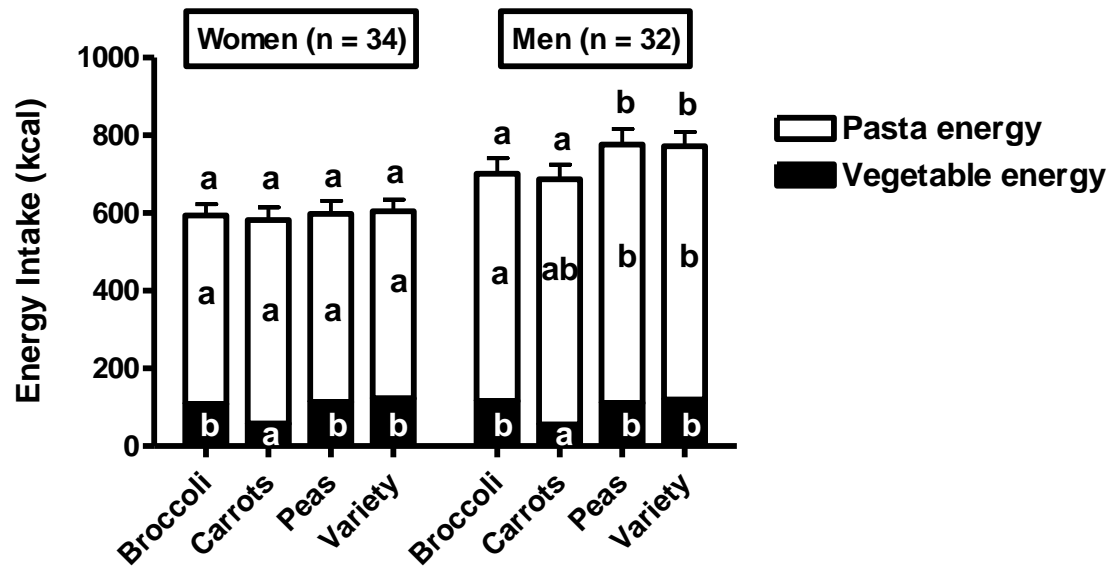


Figure 7: Mean total energy intake (\pm SEM). Means with different letters are significantly different ($p < 0.043$).

Effect of Vegetable Variety on Hunger and Satiety Ratings

There were no differences in ratings of hunger, thirst, prospective consumption, nausea, or fullness before or after lunch across conditions (Table 3). Similarly, no differences were noted in the same ratings measured before and after the breakfast meal (data not shown).

Table 3. Ratings of Hunger and Satiety – Before and After Lunch¹

	Broccoli		Carrots		Snap Peas		Variety	
	Before Meal	After Meal ²	Before Meal	After Meal ²	Before Meal	After Meal ²	Before Meal	After Meal ²
How hungry do you feel right now?	65.9 ± 2.0	6.6 ± 0.8	66.3 ± 1.7	5.8 ± 0.8	64.7 ± 1.7	7.0 ± 0.8	68.2 ± 1.9	6.6 ± 0.8
How thirsty do you feel right now?	64.0 ± 2.7	24.6 ± 2.5	68.8 ± 2.1	23.6 ± 2.5	66.0 ± 2.4	22.9 ± 2.5	67.7 ± 2.4	22.8 ± 2.5
How much food do you think you could eat right now?	65.7 ± 1.8	9.1 ± 1.2	64.3 ± 1.9	9.1 ± 1.2	63.6 ± 1.7	9.8 ± 1.2	66.5 ± 1.5	8.9 ± 1.2
How nauseated do you feel right now?	3.6 ± 0.7	6.7 ± 1.4	4.0 ± 0.9	6.3 ± 1.4	3.8 ± 0.8	6.4 ± 1.4	3.6 ± 0.7	7.0 ± 1.4
How full do you feel right now?	21.8 ± 2.2	85.4 ± 1.3	19.6 ± 2.3	86.9 ± 1.3	20.3 ± 2.1	86.6 ± 1.3	19.4 ± 2.2	86.9 ± 1.3

¹ Values are before and after meal ratings measured in millimeters (mean ± SEM). There were no significant differences in any ratings by sex or condition

² After-meal rating was adjusted for before-meal rating using analysis of covariance

Effect of Vegetable Variety on Food Characteristics and Palatability Ratings

The rating of the serving size of the vegetables, compared to the participant's usual serving size, differed significantly across conditions ($p < 0.0001$). Participants rated the size of the vegetables (85 ± 2 mm) when all three vegetables were served as significantly smaller than the serving size of any single type of vegetable (91 ± 1 mm). There were no significant differences across conditions for ratings of the size of the entrée, the size of the meal, the amount of fat in the meal, or the amount of calories in the meal (data not shown).

In before-meal taste ratings, the pasta was rated the most pleasant in taste (78.0 ± 0.9 mm). The broccoli was rated the best tasting of the three vegetables (71.9 ± 1.2 mm). The snap peas and carrots were ranked lower in taste (62.8 ± 1.1 mm and 62.1 ± 1.2 mm), but still well-liked. Women rated all foods higher in taste than men rated the taste of the study foods. Before meal texture ratings of the carrots and snap peas were lower than that of the broccoli ($p < 0.001$), with men giving lower texture ratings than women ($p < 0.03$). Before meal ratings of prospective consumption of each vegetable also resulted in lower ratings for the carrots and snap peas than the broccoli ($p < 0.001$); yet no differences were noted between sexes.

When comparing after-meal taste, texture and prospective consumption ratings of the variety condition to the condition where the vegetables were served individually, carrots and snap peas declined more in taste ratings than the broccoli; while broccoli was rated to have a larger decline in the pleasantness of the texture. No differences were noted in prospective consumption of the vegetables after the meal (Table 4).

Table 4. Ratings of Palatability – After Lunch^{1 2}

	Food Rated	Single Condition	Variety Condition
Taste	Broccoli	52.8 ± 3.8	57.7 ± 2.7
	Carrots	42.8 ± 3.3 ^a	50.0 ± 2.4 ^a
	Snap Peas	40.5 ± 3.7 b	48.4 ± 2.6 b
	Pasta	58.8 ± 2.1	60.6 ± 2.5
Texture	Broccoli	50.2 ± 3.6 c	57.4 ± 2.5 c
	Carrots	49.8 ± 3.5	52.4 ± 2.4
	Snap Peas	45.6 ± 3.5	46.7 ± 2.4
	Pasta	59.3 ± 1.9	61.2 ± 2.3
Prospective Consumption	Broccoli	13.5 ± 2.5	13.9 ± 1.8
	Carrots	8.7 ± 2.5	11.2 ± 1.7
	Snap Peas	8.6 ± 2.1	8.6 ± 1.5
	Pasta	11.9 ± 1.4	13.7 ± 1.7

¹ Values are before and after meal ratings measured in millimeters (mean ± SEM).

² After-meal rating was adjusted for before-meal rating and intake using analysis of covariance

^a p=0.024

^b p= 0.037

^c p= 0.046

From the analysis of covariance, none of the characteristics (see Chapter 1, Table 1) affected the relationship between the experimental variable and the results.

Chapter 4

Discussion and Conclusions

Main Findings

This study demonstrated that variety can be used as a strategy to increase intake of healthy, low-energy foods such as vegetables. The development of strategies to increase vegetable intake has become a main area of research in recent years, but the majority of past studies have focused on changing portion size as the method to increase vegetable intake. While the effect of portion size is robust for most foods, our research has indicated that vegetables may be different. In a study in which we increased the portion size of all foods served over two 11-day periods by 50%, vegetables were the one food group that did not increase in response to the increased portion size (24). There were likely too many other highly palatable foods competing with the vegetables.

Before testing the effects of variety on intake of vegetables, it is important to further consider how vegetable intake can be affected by the amounts of other types of foods that are available. We tested the impact of increasing the portion size of vegetables at a multi-component meal with two different methods: by adding vegetables (Addition) to a meal and by substituting vegetables (Substitution) for other meal components (25). In the Addition study, we systematically increased the portion size of the vegetable, steamed broccoli, at the meal; but kept the other meal components, beef in au jus and rice pilaf, constant. As the portion size of the broccoli increased, broccoli intake increased and intake of the beef and rice remained constant. Increasing vegetable intake did not affect meal energy intake. In addition to differing portion sizes of broccoli, two different energy densities of broccoli were tested: 0.04 and 0.08 kcal/g. Since both versions of the broccoli were low in energy-density, they did not significantly increase overall energy intake at the meal. In the Substitution study, as the amount of broccoli increased, the portion sizes of the beef and rice decreased proportionately, so that there was a

consistent weight of food served in each condition. Substituting broccoli for the other meal components led to a significant increase in vegetable intake. Intake of the meal components decreased leading to a significant reduction in meal energy intake. Again the effect of energy density of the broccoli was critical and overall energy intake was reduced more with the 0.04 ED broccoli than the 0.08 ED broccoli. For both studies, when the portion size of the broccoli was doubled from 180 to 360 g, intake increased by 60 g, which is equivalent to roughly 3/4 of a recommended serving size of cooked broccoli.

Because portion size affects vegetable intake, it was unclear how increasing the variety of vegetables served would affect intake when the portion of each individual vegetable was smaller in the variety condition. Decreasing the portion size of the individual vegetables could reduce effects of variety by limiting intake of the most preferred vegetable. In all conditions, a total of 600 grams of vegetable was served: either 600 grams of an individual vegetable or 200 grams of each of the three vegetables in the variety condition. It was possible that if one vegetable was strongly preferred over the others, serving only 200 grams rather than 600 grams would limit intake. Broccoli was the most preferred of the vegetables, with 41 subjects ranking it as their preferred vegetable, but the snap peas and carrots were also well-liked with 14 subjects ranking the snap peas and 11 subjects ranking the carrots as their preferred vegetable. Despite preferences for particular vegetables, offering more variety was associated with an increase in vegetable intake of 25 ± 8 grams. To help ensure that larger serving sizes of preferred vegetables did not limit the effect of variety, the data were more closely examined to see if any subjects ate all of a particular vegetable in the variety condition. Six subjects ate all of the broccoli and two subjects ate all of the snap peas (defined as eating > 190 g of a single vegetable) in the variety

condition. When these subjects were removed from analysis, the results of variety were unchanged when comparing the intake of the preferred vegetable to the variety condition.

Effects on Energy Intake and Energy Density

It was hypothesized that serving a variety of vegetables would decrease intake from the pasta and therefore the overall energy density and total energy consumed at the meal. Since the proportions of the vegetables and pasta did not change in this study, as they did in previous research, it is not surprising that the intake from the pasta did not decrease. The results from this study demonstrate the importance of choosing low-energy-dense vegetables, whether alone or as part of a variety at a meal, if the energy content of a meal is a concern.

When choosing the vegetables to be served in the study, the goal was to try to match the EDs of the vegetables as closely as possible while still serving well-liked, popular vegetables. Our past research had shown that doubling the ED of a vegetable could significantly increase energy intake at a meal from the vegetable, so vegetables of similar ED would be desirable (25). Much time was spent talking with grocery store management to gather information on the most commonly purchased frozen vegetables in the region, and based on the nutrition labels and recipe analysis in Nutritionist Pro, it was believed the three vegetables chosen for this study had very similar EDs: the broccoli at 0.40 kcal/g, the snap peas at 0.38 kcal/g, and the carrots at 0.30 kcal/g. (Chapter 2, Table 2) However, when the energy content of these vegetables was tested more accurately using bomb calorimetry, discrepancies in the nutrition lab and Nutritionist Pro recipe analyses were discovered. Unintentionally, a new confound was introduced to the study with the ED of the study vegetables now ranging from the carrots at 0.33 kcal/g to the snap peas at 0.69 kcal/g.

Due to these variations in energy density, both men and women consumed significantly fewer calories from vegetables in the carrot condition. Even though subjects ate more vegetables in the variety condition they did not eat more calories from the vegetables when compared to the broccoli and snap pea conditions and this is likely due to the lower ED carrots decreasing the overall ED of vegetables consumed.

The findings of this study concur with past studies of variety in that an analysis of covariance indicated no impact on vegetable intake of subject characteristics such as age, weight status, BMI, restraint or disinhibition.

Flavoring of vegetables

Only one of the vegetables used in this study had any additional flavoring: the broccoli. The reason for flavoring the broccoli was to keep it consistent with the broccoli used in past studies (25). Broccoli can be a very bitter tasting vegetable, especially to people who are sensitive to thiourea compounds present in broccoli, Brussels sprouts, cabbage and kale. When we added a small amount of light, whipped butter and butter-flavored crystals, subjects found the taste very pleasant and gave it very high hedonic ratings. However, seasoning or flavorings were not added to the carrots or snap peas. It is important to note that the flavoring added calories to the broccoli. Based on mean intakes, in the condition where only broccoli was served, approximately 30 calories came from the flavoring, and in the variety condition, approximately 15 calories were from the added flavoring.

The broccoli was the vegetable rated the most pleasant in taste, and was the most preferred at discharge ranking. The flavoring may have led to this result. In addition to having

the highest pre-meal taste ratings, broccoli had the smallest decline in post-meal taste ratings when adjusted for pre-meal ratings and intake.

Study design

This study was not designed to directly test sensory-specific satiety as all three vegetables were being served at one time. To test the effect of sensory-specific satiety, the vegetables would need to have been served individually in successive courses. But this is not a practical approach to take in a real world setting, and one of our goals was to test the effect of variety as a strategy that could be easily implemented in an eating occasion at home or away from home. Therefore, we served the vegetables all at one time and on the same plate. Additionally, to demonstrate declines in hedonic ratings of the served foods due to sensory-specific satiety, subjects would have had to have been served more than the 4 samples of food they received before and after meals, and this would have been a cumbersome and unrealistic step in a study that aimed to mimic a real world setting as much as possible.

Past research that has resulted in increased vegetable intake through increasing portion size has also resulted in much waste of vegetables (25). Doubling the amount of vegetable from 180 to 360 grams did result in an increase in vegetable intake of 60 grams. But it could be argued that the portion sizes served were unrealistic and lead to excessive waste to obtain a significant increase in vegetable intake. The portion size of vegetable was very large in this present study, but it was necessary to serve a large amount of each vegetable in the single condition so that there was still enough of each vegetable present in the variety condition, especially when it was unknown if the effect would be present when compared to the favorite of the vegetables. However, since the total portion size of vegetable remained the same across conditions, the

variety condition resulted in vegetable increases ranging from 20 grams to 67 grams without having to increase the amount of vegetable served.

Limitations and Future Research

A limitation of this study is that we only obtained before- and after-meal taste ratings of the four foods served in the study, and did not test sensory-specific satiety of the vegetables. This study would also be strengthened by testing vegetables matched for energy density.

Future research building off this study could include serving the variety of vegetables mixed together, as in a stir fry, instead of serving them in a manner where they could easily be consumed individually. Also, if a variety of vegetables were increased in portion size and substituted for other meal components, would this lead to decreased energy intake at a meal?

Implications

The results from this study suggest that advising people to serve a variety of vegetables at a meal can be a practical strategy to increase vegetable intake. But an important part of the message would have to include being mindful of the energy density of the vegetables, as we have seen in this study that vegetables with a higher energy density, such as starchy vegetables, may have the potential to increase the energy content of the meal. With the food industry providing dozens of vegetable mixes and blends, often in microwave-ready steam bags, this is advice that health professionals can offer as a strategy to increase vegetable intake that is easy and affordable.

References

1. U.S. Department of Agriculture and U.S. Department of Health and Human Services. *Dietary Guidelines for Americans, 2010*. 7th Edition, Washington, DC: U.S. Government Printing Office, December 2010.
2. Centers for Disease Control and Prevention. *5 A Day Works!* Atlanta: U.S. Department of Health and Human Services; 2005.
3. Healthy People 2000: National Health Promotion and Disease Prevention Objectives. Washington, DC: US Dept of Health and Human Services; 1991. DHHS publication PHS 91-50213.
4. Serdula M, Coates R, Byers T, Simoes E, Mokdad A, Subar A. Fruit and vegetable intake among adults in 16 states: results of a brief telephone survey. *Am J Public Health* 1995;85: 236-239.
5. MyPyramid.gov. U.S. Department of Agriculture.
<http://www.mypyramid.gov/pyramid/index.html>. Retrieved 2011-05-09.
6. Kimmons J, Gillespie C, Seymour J, Serdula M, Blanck HM. Fruit and vegetable intake among adolescents and adults in the United States: percentage meeting individualized recommendations. *Medscape J Med*. 2009; 11:26.
7. Hung HC, Joshipura KJ, Kiang R, et al. Fruit and vegetable intake and risk of major chronic disease. *J Natl Cancer Inst* 2004;96:1577-84.
8. Lembo A, Camilleri M. Chronic constipation. *N Engl J Med* 2003;349:1360-68.
9. Aldoori WH, Giovannucci EL, Rockett HR, Sampson L, Rimm EB, Willett WC. A prospective study of dietary fiber and symptomatic diverticular disease in men. *J Nut* 1998; 128:714-19.
10. Giovannucci E, Liu Y, Platz EA, Stampfer MJ, Willett WC. Risk factors for prostate cancer incidence and progression in the Health Professionals Follow-up Study. *Int J Cancer* 2007; 121:1571-78.
11. World Cancer Research Fund, American Institute for Cancer Research. *Food, Nutrition, Physical Activity, and the Prevention of Cancer: a Global Perspective*. Washington DC: AICR, 2007.
12. Remick AK, Polivy J, Pliner P. Internal and external moderators of the effect of variety on food intake. *Psychol Bull* 2009; 135:434-451.
13. Rolls BJ, Rowe EA, Rolls ET, Kingston B, Megson A, Gunary R. Variety in a meal enhances food intake in man. *Physiol Behavior* 1981; 26:215-221.

14. Raynor HA, Epstein LH. Dietary variety, energy regulation, and obesity. *Psychol Bull* 2001; 127:325-341.
15. Rolls BJ, Rolls ET, Rowe EA, Sweeney K. Sensory specific satiety in man. 1981. *Physiol Behav* 1981; 27:137-142.
16. Rolls, BJ. Sensory-specific satiety and variety in the meal. *Dimensions of the Meal: The Science, Culture, Business and Art of Eating*. 2000; 107-116.
17. Rolls BJ, Van Duijvenvoorde PM, Rolls ET. Pleasantness changes and food intake in a varied four-course meal. *Appetite* 1984; 5:337-348.
18. Epstein LH, Robinson JL, Roemmich JN, Marusewski AL, Roba LG. What constitutes food variety? Stimulus specificity of food. *Appetite* 2010; 54:23-29.
19. Brondel L, Romer M, Van Wymelbeke V, Pineau N, Jiang T, Hanus C, Riguad D. Variety enhances food intake in humans: Role of sensory-specific satiety. *Physiol Behav* 2009; 97:44-51.
20. Stunkard AJ, Messick S. The three-factor eating questionnaire to measure dietary restraint, disinhibition, and hunger. *J Psychosom Res* 1985;29:71-83.
21. Garner DM, Olsted MP, Bohr Y and Garfinkel PE. The Eating Attitudes Test: psychometric features and clinical correlates. *Psychol Med* 1982;12:871-878.
22. Zung WWK. A self-rating depression scale. *Arch Gen Psychiatry* 1965;12:63-70.
23. Hetherington MM, Rolls BJ. Methods of investigating human eating behavior. *In* F. Toates, N. Rowland (ed.), *Feeding and Drinking*. Elsevier Science Publishers B V. Amsterdam. 1987.
24. Rolls BJ, Roe LS, Meengs JS. The effect of large portion sizes on energy intake is sustained for 11 days. *Obesity* 2007; 15:1535-1543.
25. Rolls BJ, Roe LS, Meengs JS. Portion size can be used strategically to increase vegetable consumption in adults. *Am J Clin Nutr* 2010; 91:913-22.

Appendix A

Telephone Study Description

Screening Summary

Participants in our study can earn up to \$50. You will be asked to eat breakfast and lunch in our lab one day a week for 4 weeks. Meals are served Monday through Thursday and you select the day of the week that is best for your schedule. All meals in the lab will take 20 to 30 minutes. Breakfast is scheduled between 7:15 and 9:15 and lunch between 11:15 - 1:15. Does this fit into your schedule?

You will be able to eat as much or as little of the foods as you like at all meals. All foods served are commercially available. On each test day, you will rate your hunger, thirst and other sensations. In addition, you will be asked to complete a food and activity diary the day before each test day. We ask that the day before each test day you drink no alcohol and maintain your usual level of physical activity. On the test days, we ask that you not consume any foods or beverages, other than water, that are not provided to you by the lab, until after the lunch meal.

You will be paid \$5 for each day completed, consisting of breakfast and lunch, for \$20; and a bonus of \$30 for completion of all 4 test sessions for a total of \$50.

Are you interested in participating in this study?

With your permission, I need to ask you a series of questions. Your answers will remain confidential. Is this OK with you?

Appendix B

Telephone Screening Questionnaire

Pre-screening Questionnaire

Date: _____

Age: _____ Date of Birth: _____

Height: _____ Weight: _____

Do you smoke? No Yes

Are you currently taking any prescription or "over the counter" medications regularly? No Yes
If yes, what? _____

Are you currently dieting to gain or lose weight? No Yes

Are you an athlete in training? No Yes

Do you have any food allergies or intolerances? No Yes

Do you have any sugar/sweetener or sodium restrictions? No Yes

Do you have any food restrictions related to religious practices? No Yes:

Are you a vegetarian? No Yes

If no, are there any meats that you exclude from your diet? _____

Do you like and are willing to eat:

Pasta in red sauce yes no

broccoli yes no

carrots yes no

sugar snap peas yes no

Do you regularly eat 3 meals per day? No Yes

If no, what is your usual daily pattern of meals?

Would you be willing to refrain from eating after 10:00 pm the evening before test sessions? No Yes

Would you be willing to refrain from drinking alcoholic beverages the evening prior to each test day? No Yes

Are you pregnant or breast feeding? No Yes

Where did you hear about the study? _____

Have you participated in any other studies in our lab? No Yes

If yes, what study and when? _____

Are you a: _____ Undergraduate semester standing: _____ major: _____

_____ Graduate major: _____

_____ Penn State Staff

_____ State College Resident

If criteria are satisfied, take their name and ask them to come to the lab to fill out questionnaires and to have their weight & height recorded.

Name: _____ Phone: _____ Appointment: _____

Appendix C

Demographic and Health Questionnaire

Subject Profile

Name _____ Date _____

Address _____

Phone (w) _____ (h): _____

Age: _____ Date of Birth: _____ Sex: M F

Height: _____ Weight: _____

Do you smoke: ☐ Yes ☐ No If yes, how many cigarettes per day? _____

Ethnicity (*please check only one*):

- ☐ HISPANIC OR LATINO
☐ NOT HISPANIC OR LATINO

Race (*please check only one*):

- ☐ AMERICAN INDIAN/ALASKAN NATIVE ☐ WHITE
☐ ASIAN ☐ HAWAIIAN/PACIFIC ISLANDER
☐ BLACK OR AFRICAN AMERICAN

What time do you usually eat the following meals?

Breakfast: _____ Dinner: _____
 Lunch: _____ Snack(s): _____

Are there foods you don't eat because they are not good for you or disagree with you?

☐ Yes ☐ No

If yes, what foods? _____

Are there any foods you don't eat because of medication you are on? ☐ Yes ☐ No

If yes, what foods? _____

Are there any foods you make it a point to eat because you feel they are good for your health?

☐ Yes ☐ No

If yes, what foods? _____

Are there any foods you don't eat because they are difficult to chew? ☐ Yes ☐ No

If yes, what foods? _____

Are you currently under a physician's care? ☐ Yes ☐ No

Do you have, or have you had any of the following?

- | | |
|---|---|
| <input type="checkbox"/> High blood pressure | <input type="checkbox"/> Diabetes |
| <input type="checkbox"/> Heart trouble | <input type="checkbox"/> Ulcers (of the digestive system) |
| <input type="checkbox"/> Thyroid or other glandular disorders | <input type="checkbox"/> Other stomach/intestinal disorder |
| <input type="checkbox"/> Liver disease | <input type="checkbox"/> Kidney disease |
| <input type="checkbox"/> Anemia | <input type="checkbox"/> Depression |
| <input type="checkbox"/> Cancer | <input type="checkbox"/> Respiratory illness (asthma, etc.) |
| <input type="checkbox"/> Other, please specify _____ | |

Are you presently taking medication (over the counter and/or prescription)? ☐ Yes ☐ No

If yes, please specify: _____

Have you ever received radiation therapy? ☐ Yes ☐ No

Have you ever received chemotherapy? ☐ Yes ☐ No

Please answer the following questions concerning your weight history:

Current weight: _____

Highest past adult weight (*excluding pregnancy*): _____

When did this occur? _____

Lowest past adult weight: _____ When did this occur? _____

Have you experienced any weight change in the last 6 months? ☐ Yes ☐ No

If yes, did you gain or lose? _____ How much? _____

When did this weight change occur? _____

Do you have any of the following eating related problems? Please check all those that apply:

- | | |
|--|---------------------------------------|
| <input type="checkbox"/> Sore mouth | <input type="checkbox"/> Nausea |
| <input type="checkbox"/> Swallowing problems | <input type="checkbox"/> Vomiting |
| <input type="checkbox"/> Chewing problems | <input type="checkbox"/> Diarrhea |
| <input type="checkbox"/> Choking problems | <input type="checkbox"/> Constipation |
| <input type="checkbox"/> Salivation problems | |
| <input type="checkbox"/> Other, please specify _____ | |

Are you currently on any kind of special diet? ☐ Yes ☐ No

If yes, what kind (low-salt, low-fat, etc.)? _____

What type of exercise do you participate in regularly? _____

How many times a week do you exercise? _____

How long is each exercise session? _____

Do you take any kind of vitamin/mineral supplement? ☐ Yes ☐ No

If yes, what kind do you use and how often do you take them?

Please circle the statement that best describes you:

I prefer the meat
(poultry, fish, beef)
part of a meal

I prefer the vegetable
part of a meal

I prefer the starch
part of a meal

I have no preference

Below are statements that you will answer about your current eating habits. Please indicate the extent to which you agree with each, using the following scale. (Circle one number for each statement.)

1 – Never

2 – Rarely

3 – Sometimes

4 – Often

5 – Always

Current eating habits:

I clean my plate: 1 2 3 4 5

I eat my meals about the same time each day: 1 2 3 4 5

I decide how much food is served to me: 1 2 3 4 5

What do you think is the purpose of the research conducted in this lab?

Females only:

- 1) In the previous 12 months, has your menstrual cycle been (*please check only one*):

☐

Regular (normal cycles of approximately equal length)

☐

Irregular (missed cycles, cycles of varying length, marked changes in flow)

Please explain

☐

I did not menstruate in the last 12 months

- 2) How many days does your menstrual cycle last (from the beginning of the menstrual period to the beginning of the next period)? _____

- 3) Have you taken any hormones (birth control pills, Depo-Provera®, hormone replacement therapy, etc.) in the past year? _____

- 4) Have you given birth in the past 12 months? ☐ Yes ☐ No

- 5) Are you planning to become pregnant within the next 12 months? ☐ Yes ☐ No

- 6) When was the first day of your last menstrual cycle? _____

Appendix D

Eating Inventory Questionnaire

Read each of the following 36 statements carefully. If you agree with the statement or feel that it is true as applied to you, answer true by circling the appropriate answer. If you disagree with the statement, or feel that it is false as applied to you, answer false by circling the appropriate answer.

- | | |
|--|---|
| 1. When I smell a freshly baked pizza, I find it very difficult to keep from eating, even if I have just finished a meal.
(T) (F) | 19. Being with someone who is eating often makes me hungry enough to eat also.
(T) (F) |
| 2. I usually eat too much at social occasions, like parties and picnics.
(T) (F) | 20. When I feel blue, I often overeat.
(T) (F) |
| 3. I am usually so hungry that I eat more than three times a day.
(T) (F) | 21. I enjoy eating too much to spoil it by counting calories, counting grams of fat, or watching my weight.
(T) (F) |
| 4. When I have eaten my quota of calories/fat, I am usually good about not eating any more.
(T) (F) | 22. When I see a real delicacy, I often get so hungry that I have to eat right away.
(T) (F) |
| 5. Dieting is so hard for me because I just get too hungry.
(T) (F) | 23. I often stop eating when I am not really full as a conscious means of limiting the amount that I eat.
(T) (F) |
| 6. I deliberately take small helpings as a means of controlling my weight.
(T) (F) | 24. I get so hungry that my stomach often seems like a bottomless pit.
(T) (F) |
| 7. Sometimes things just taste so good that I keep on eating even when I am no longer hungry.
(T) (F) | 25. My weight has hardly changed at all in the last two years.
(T) (F) |
| 8. Since I am often hungry, I sometimes wish that while I am eating, an expert would tell me that I have had enough or that I can have something more to eat.
(T) (F) | 26. I am always hungry so it is hard for me to stop eating before I finish the food on my plate.
(T) (F) |
| 9. When I feel anxious, I find myself eating.
(T) (F) | 27. When I feel lonely, I console myself by eating.
(T) (F) |
| 10. Life is too short to worry about dieting.
(T) (F) | 28. I consciously hold back at meals in order not to gain weight.
(T) (F) |
| 11. Since my weight goes up and down, I have gone on reducing diets more than once.
(T) (F) | 29. I sometimes get very hungry late in the evening or at night.
(T) (F) |
| 12. I often feel so hungry that I just have to eat something.
(T) (F) | 30. I eat anything I want, any time I want.
(T) (F) |
| 13. When I am with someone who is overeating, I usually overeat too.
(T) (F) | 31. Without even thinking about it, I take a long time to eat.
(T) (F) |
| 14. I have a pretty good idea of the number of calories/grams of fat in common foods.
(T) (F) | 32. I count calories/grams of fat as a conscious means of controlling my weight.
(T) (F) |
| 15. Sometimes when I start eating, I just can't seem to stop.
(T) (F) | 33. I do not eat some foods because they make me fat.
(T) (F) |
| 16. It is not difficult for me to leave something on my plate.
(T) (F) | 34. I am always hungry enough to eat at any time.
(T) (F) |
| 17. At certain times of the day, I get hungry because I have gotten used to eating then.
(T) (F) | 35. I pay a great deal of attention to changes in my figure.
(T) (F) |
| 18. While on a diet, if I eat food that is not allowed, I consciously eat less for a period of time to make up for it. | 36. While on a diet, if I eat a food that is not allowed, I often then splurge and eat other high calorie foods.
(T) (F) |

Each question in this section is followed by a number of options. After reading each question carefully, choose one option which most applies to you, and circle the appropriate answer.

37. How often are you dieting in a conscious effort to control your weight?

- | | | | |
|--------|-----------|---------|--------|
| 1 | 2 | 3 | 4 |
| rarely | sometimes | usually | always |

38. Would a weight fluctuation of 5 lbs affect the way you live your life?

- | | | | |
|------------|----------|------------|-----------|
| 1 | 2 | 3 | 4 |
| not at all | slightly | moderately | very much |

39. How often do you feel hungry?

- | | | | |
|--------------------|-------------------------|---------------------|---------------|
| 1 | 2 | 3 | 4 |
| only at meal times | sometimes between meals | often between meals | almost always |

40. Do your feelings of guilt about overeating help you to control your food intake?

- | | | | |
|-------|--------|-------|--------|
| 1 | 2 | 3 | 4 |
| never | rarely | often | always |

41. How difficult would it be for you to stop eating halfway through dinner and not eat for the next four hours?

- | | | | |
|------|--------------------|----------------------|----------------|
| 1 | 2 | 3 | 4 |
| easy | slightly difficult | moderately difficult | very difficult |

42. How conscious are you of what you are eating?

- | | | | |
|------------|----------|------------|-----------|
| 1 | 2 | 3 | 4 |
| not at all | slightly | moderately | extremely |

43. How frequently do you *avoid* "buying large" on tempting foods?

- | | | | |
|--------------|--------|---------|---------------|
| 1 | 2 | 3 | 4 |
| almost never | seldom | usually | almost always |

44. How likely are you to shop for low calorie or low fat foods?

- | | | | |
|----------|-----------------|-------------------|-------------|
| 1 | 2 | 3 | 4 |
| unlikely | slightly likely | moderately likely | very likely |

45. Do you eat sensibly in front of others and splurge alone?

- | | | | |
|-------|--------|-------|--------|
| 1 | 2 | 3 | 4 |
| never | rarely | often | always |

46. How likely are you to consciously eat slowly in order to cut down on how much you eat?

- | | | | |
|----------|-----------------|-------------------|-------------|
| 1 | 2 | 3 | 4 |
| unlikely | slightly likely | moderately likely | very likely |

47. How frequently do you skip dessert because you are no longer hungry?

- | | | | |
|--------------|--------|----------------------|------------------|
| 1 | 2 | 3 | 4 |
| almost never | seldom | at least once a week | almost every day |

48. How likely are you to consciously eat less than you want?

- | | | | |
|----------|-----------------|-------------------|-------------|
| 1 | 2 | 3 | 4 |
| unlikely | slightly likely | moderately likely | very likely |

49. Do you go on eating binges even though you are not hungry?

- | | | | |
|-------|--------|-----------|----------------------|
| 1 | 2 | 3 | 4 |
| never | rarely | sometimes | at least once a week |

50. To what extent does this statement describe your eating behavior?

"I start dieting in the morning, but because of any number of things that happen during the day, by evening I have given up and eat what I want, promising myself to start dieting again tomorrow."

- | | | | |
|-------------|----------------|-------------------------------|------------------------|
| 1 | 2 | 3 | 4 |
| not like me | little like me | pretty good description of me | describes me perfectly |

51. On a scale of 1 to 6, where 1 means no restraint in eating (eat whatever you want, whenever you want it) and 6 means total restraint (constantly limiting food intake and never "giving in"), what number would you give yourself?

- 1 eat whatever you want, whenever you want it
- 2 usually eat whatever you want, whenever you want it
- 3 often eat whatever you want, whenever you want it
- 4 often limit food intake, but often "give in"
- 5 usually limit food intake, rarely "give in"
- 6 constantly limiting food intake, never "giving in"

Appendix E

Eating Attitudes Test Questionnaire

Instructions:

Please place an (x) under the column which applies best to each of the numbered statements. All of the results will be strictly confidential. Most of the questions relate to food or eating, although other types of questions have been included. Please answer each question carefully. Thank you.

ALWAYS	VERY OFTEN	OFTEN	SOMETIMES	RARELY	NEVER	
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	1 Am terrified about being overweight.
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	2 Avoid eating when I am hungry.
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	3 Find myself preoccupied with food.
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	4 Have gone on eating binges where I feel that I may not be able to stop.
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	5 Cut my food into small pieces.
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	6 Aware of the caloric content of foods that I eat.
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	7 Particularly avoid foods with a high carbohydrate content (e.g. bread, potatoes, rice, etc.).
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	8 Feel that others would prefer if I ate more.
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	9 Vomit after I have eaten.
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	10 Feel extremely guilty after eating.
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	11 Am preoccupied with a desire to be thinner.
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	12 Think about burning up calories when I exercise.
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	13 Other people think that I am too thin.
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	14 Am preoccupied with the thought of having fat on my body.
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	15 Take longer than others to eat my meals.
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	16 Avoid foods with sugar in them.
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	17 Eat diet foods.
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	18 Feel that food controls my life.
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	19 Display self control around food.
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	20 Feel that others pressure me to eat.
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	21 Give too much time and thought to food.
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	22 Feel uncomfortable after eating sweets.
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	23 Engage in dieting behavior.
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	24 Like my stomach to be empty.
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	25 Enjoy trying rich new foods.
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	26 Have the impulse to vomit after meals.

Appendix F

Zung Depression Questionnaire

Please answer the questions by marking in the box that best describes your response. If a question does not apply, mark the box that is closest to answering the question.

	None or a little of the time	Some of the time	Good Part of the time	Most or all of the time
1. I feel downhearted, blue, and sad				
2. Morning is when I feel the best				
3. I have crying spells or feel like it				
4. I have trouble sleeping through the night				
5. I eat as much as I used to				
6. I enjoy looking at, talking to, and being with attractive women/men				
7. I notice that I am losing weight				
8. I have trouble with constipation				
9. My heart beats faster than usual				
10. I get tired for no reason				
11. My mind is as clear as it used to be				
12. I find it easy to do the things I used to				
13. I am restless and can't keep still.				
14. I feel hopeful about the future				
15. I am more irritable than usual				
16. I find it easy to make decisions				
17. I feel that I am useful and needed				
18. My life is pretty full				
19. I feel that others would be better off if I were dead				
20. I still enjoy the things I used to do				

Appendix G

Screening Consent Form

Informed Consent Form for Biomedical Research
The Pennsylvania State University

ORP OFFICE USE ONLY
DO NOT REMOVE OR MODIFY
IRB#22902 Doc. #2
The Pennsylvania State University
Office for Research Protections
Approval Date: 03/24/2009 DWM
Expiration Date: 03/23/2010 DWM
Biomedical Institutional Review Board

Title of Project: Perceptions of Different Tastes - 4

Principal Investigator: Barbara J. Rolls, Ph.D.
226 Henderson Building, University Park, PA 16802
814-863-8482; bjr4@psu.edu

Other Investigator(s): Jennifer Meengs
226 Henderson Building, University Park, PA 16802
814-863-8482; jas138@psu.edu

1. **Purpose of the study:** The purpose of this phase of the research study is to determine if you meet the criteria to be a participant in this laboratory's human ingestive behavior studies.
2. **Procedures to be followed:** It will take you approximately 45 minutes to complete this packet of questionnaires. These questionnaires are to determine whether or not the studies conducted at our laboratory are appropriate for you. You will be weighed and your height measured. Our studies require a considerable amount of preparation and, in order to assure reliable results for the studies, it is very important that participants fulfill all criteria of the studies.

Because of strict subject criteria, it may be determined that we cannot have you participate in the current study. There are a variety of reasons why an individual may not be chosen for a particular study. Often the number of responses from potential participants exceeds the number of individuals needed for the study. If you are not chosen to participate at this time, your information will be kept on file and you may be called later to participate in another study.

3. **Discomforts and risks:** There are no risks in participating in this research beyond those experienced in everyday life. Some of the questions are personal and might cause discomfort. If, as a result of filling in the questionnaires, you feel that you would benefit from individual counseling, you may contact:

Psychological Clinic at Penn State University
314 Moore Building
University Park, PA 16802
Phone: (814) 865-2191

Your responses to the questionnaires will be reviewed by a staff member. If any of the questionnaires indicate that you may benefit from professional treatment (i.e. counseling or physician's care), you will be notified by a staff member via telephone within 3 days of review of your questionnaire packet.

4. **Benefits:** If you qualify to become a participant in a study at the Human Ingestive Behavior Laboratory, you will be contributing to our understanding of human eating behavior.
5. **Duration/time of the procedures and study:** It will take approximately 30 to 45 minutes to complete the screening materials. There is no compensation for completing these materials.

6. **Right to Ask Questions:** Contact Jennifer Meengs at (814) 863-8482 with any questions, concerns or complaints about this research. You can also call this number if you feel harmed as a result of your participation in this research. If you have questions about your rights as a research participant, contact Penn State University's Office for Research Protections at (814) 865-1775.
7. **Confidentiality:** Your participation in this research is confidential. You will be identified by subject number and an assigned dot color. The investigator and her assistants will have access to your identity and to information that can be associated with your identity. In the event of any publication or presentation resulting from the research, no personally identifiable information will be shared.
8. **Voluntary Participation:** Your decision to be in this research is voluntary. You can stop at any time. You do not have to answer any questions you do not want to answer. Refusal to take part in or withdrawing from this study will involve no penalty or loss of benefits you would receive otherwise.

You must be 18 years of age or older to take part in this research study.

If you agree to take part in this research study and the information outlined above, please sign your name and indicate the date below.

You will be provided with a copy of this consent form to keep for your records.

The following may review and copy records related to this research: The Office of Human Research Protections in the U.S. Dept. of Health and Human Services; The U.S. Food and Drug Administration (FDA) if applicable; The Penn State University Biomedical Institutional Review Board; The Penn State University Office for Research Protections.

.

Date

Date of Birth

Participant's Signature

Date

Person Obtaining Consent's Signature

Appendix H

Study Welcome Form

Subject ID: _____

Welcome to the study! Please remember the following guidelines throughout the duration of the study. If you have any further questions, please do not hesitate to call the Food Lab at 863-8482.

- Do not eat or drink anything outside the lab, other than water, between breakfast and lunch on the day of your test session. Also, do not eat after 10 PM the evening before your test session.
- Record your food intake in the Food and Activity Diary for all meals and snacks the day before your test session.
- Keep your intake the day before each session consistent with the previous week. Please eat similar portion sizes at the same mealtime each week. Also, do **NOT** eat in a restaurant on the evening before each session.
- Keep your activity level consistent with the previous week for the day before and the day of your test session. Record your physical activity in the Food and Activity Diary.
- Do not consume alcohol 24 hours before arriving at the lab and throughout each test session day.
- Do not consume water 1 hour before a meal in the lab.

Your appointments are listed below:

	Date	Breakfast Time	Lunch Time
Appointment 1			
Appointment 2			
Appointment 3			
Appointment 4			

Appendix I

Informed Consent

Informed Consent Form for Biomedical Research
The Pennsylvania State University

ORP OFFICE USE ONLY
DO NOT REMOVE OR MODIFY
IRB#22902 Doc. #1
The Pennsylvania State University
Office for Research Protections
Approval Date: 03/24/2009 DWM
Expiration Date: 03/23/2010 DWM
Biomedical Institutional Review Board

Title of Project: Perceptions of Different Tastes - 4

Principal Investigator: Barbara J. Rolls, Ph.D.
226 Henderson Building, University Park, PA 16802
814-863-8482; bjr4@psu.edu

Other Investigator(s): Jennifer Meengs
226 Henderson Building, University Park, PA 16802
814-863-8482; jas138@psu.edu

1. **Purpose of the study:** The purpose of this research is to investigate the perceptions of different tastes at a meal.
2. **Procedures to be followed:** You will be asked to eat breakfast, lunch and dinner in our lab on 4 different test days. During these meals you may eat as little or as much as you wish. On test days, you will only be permitted to eat and drink foods that are provided to you by the lab until after the dinner meal. You may drink water between meals, but we ask that you not drink any water one hour before a test meal. Throughout the test days you will be asked to rate your hunger, thirst and other sensations. You will also be asked to rate the sensory qualities of food items throughout the sessions. You will be asked to complete a Food and Activity Diary the day before each test day. You will be asked to keep the amount of food eaten at dinner the night before each test session as consistent as possible each week and to refrain from eating or drinking (other than water) after 10:00 p.m. on the evening before each test day. You will also be asked to refrain from drinking alcohol and maintain your usual activity level the night before each test day. Questionnaires at meals will ask if you have consumed any alcohol. If you are a minor and admit to alcohol use, that information will remain confidential. All foods served are commercially available.

You will complete a questionnaire about your general well being during each session. You may also be asked to rate the sensory properties (i.e. taste, texture) of various foods and to record your hunger, thirst, fullness and nausea periodically during test days. At the end of the study, you will be asked to complete a debriefing questionnaire.

Since each participant can have a great impact on the study, it is important that you carefully adhere to the guidelines of the study. If you feel that this is not possible, please do not join the study.

If during any session you think that some factor may have influenced your behavior or responses, please notify the experimenter immediately. Since we have specific requirements for participants in this study, we reserve the right to reschedule or drop you from the study at any time. If that happens, you will be compensated for any time that you have already given to the study.

3. **Discomforts and risks:** There are no risks involved in eating the test meals and filling out questionnaires. It may be possible that someone could have an allergic reaction to one of the food items or food item ingredients. Allergies will be screened prior to study participation.
4. **Benefits:** You will be aiding in our understanding of human eating behavior.
5. **Duration/time of the procedures and study:** Each test meal will take approximately 15-30 minutes, for no more than 1 ½ hour each test day. It will take approximately 15 minutes to record food intake and physical activity before each test day. Total time involved: 4 to 8 hours.
6. **Statement of confidentiality:** Your participation in this research is confidential. You will be identified by subject number and an assigned dot color. The investigator and her assistants will have access to your identity and to information that can be associated with your identity. In the event of any publication or presentation resulting from the research, no personally identifiable information will be shared. The following may review and copy records related to this research: The Office of Human Research Protections in the U.S. Dept. of Health and Human Services; The U.S. Food and Drug Administration (FDA) if applicable; The Penn State University Biomedical Institutional Review Board; The Penn State University Office for Research Protections.
7. **Right to ask questions:** Contact Jennifer Meengs at 863-8482 with questions, complaints, concern about this research. You also can call this number you feel this study has harmed you. If you have questions about your rights as a research participant, contact The Pennsylvania State University's Office for Research Protections at (814) 865-1775.
8. **Payment for Participation:** In addition to test meals, you will be paid \$5.00 for each completed test day, consisting of a breakfast, lunch and dinner for \$20; and an additional \$30 payment if you complete all 4 test sessions, for a possible total of \$50.00. Payment will not be made until the completion of the study, unless you withdraw from the study, and then you will be paid for sessions completed.
9. **Voluntary participation:** Participation is voluntary. You can stop at any time. You do not have to answer any questions you do not want to answer. Since we have specific requirements for participants in this study, we reserve the right to reschedule or drop you from the study at any time. If that happens, you will be compensated for any time that you have already given to the study. Refusal to take part in or withdrawing from this study will involve no penalty of loss of benefits you would receive otherwise.
10. **Injury Clause:** In the unlikely event you become injured as a result of your participation in this study, medical care is available but neither financial compensation nor free medical treatment is provided. By signing this document, you are not waiving any rights that you have against The Pennsylvania State University for injury resulting from negligence of the University or its investigators.

You must be 18 years of age or older to take part in this research study.

If you agree to take part in this research study and the information outlined above, please sign your name and indicate the date below.

You will be given a copy of this signed and dated consent for your records.

Participant Signature

Date

Person Obtaining Consent

Date

Appendix J

Food and Activity Diary

Food and Activity Diary

ID _____

Date _____

S M T W

Please record all foods and beverages that are consumed the day before your session begins. Please remember to not eat anything after 10:00pm and do not eat in a restaurant the night before your session begins. In completing this worksheet, please try to be as accurate as possible and include as much detail as you can (e.g. the brand names of foods, amounts, meal or snack times, beverages). Do not forget to include condiments such as butter, ketchup, mustard, and jelly. If you run out of spaces, please use the back of this form. Also, please leave excess spaces blank. For example, if you have not eaten an appetizer at dinner, please leave that space blank.

If you have any questions about completing this food diary, please call the Food Lab at 863-8482. Thank you for your cooperation.

Breakfast — Foods and beverages (including brand names)

Time: _____ Place: _____

Foods: _____

Beverages: _____

Lunch - Foods and beverages (including brand names):**Time:** _____ **Place:** _____**Main Dish:** _____
_____**Side Dishes (ex. Vegetables, salads, etc.):** _____
_____**Desserts/sweets:** _____**Beverages:** _____
_____**Dinner - Foods and beverages (including brand names):****Time:** _____ **Place:** _____**Main Dish:** _____
_____**Side Dishes (ex. Vegetables, salads, etc.):** _____
_____**Bread/rolls:** _____**Desserts/sweets:** _____**Beverages:** _____
_____**Snacks (all day) -** _____**Snack/Time Consumed:** _____**Snack/Time Consumed:** _____**Snack/Time Consumed:** _____

Physical Activity

Please record all physical activity for the day before your test session. Please remember to keep it as consistent as possible each week. Thank you.

Before breakfast:

Between breakfast and lunch:

Between lunch and dinner:

After dinner:

Appendix K

Breakfast Meal Report

Breakfast Report

Subject ID: _____ Date: _____ Week: _____ Day: _____

1. Have you felt well in the last 24 hours?

_____ Yes _____ No

If No, please explain: _____

2. Have you taken any medication in the last 24 hours?

_____ Yes _____ No

If Yes, please list: _____

3. Did you get a good night's sleep last night?

_____ Yes _____ No

If No, please explain: _____

4. Have you maintained your usual level of physical activity the last 24 hours?

_____ Yes _____ No

If No, please explain: _____

5. Have you consumed any foods or caloric beverages since 10 PM last night?

_____ Yes _____ No

If Yes, please indicate what food(s) and approximate amount(s):

6. Have you consumed alcohol in the past 24 hours?

_____ Yes _____ No

If Yes, what type and how much: _____

Appendix L

Lunch Report

Lunch Report

Subject ID: _____ Date: _____ Week: _____

1. Have you felt well since breakfast/lunch?

_____ Yes _____ No

If No, please explain:

2. Have you taken any medication since breakfast/lunch?

_____ Yes _____ No

If Yes, please list:

3. Have you consumed any foods or beverages since breakfast/lunch, other than water?

_____ Yes _____ No

If Yes, please indicate what food(s) and approximate amount(s):

Appendix M

Discharge Questionnaire

Discharge Questionnaire

Use the back of this questionnaire if additional space is needed.

1. What do you think the purpose of this study was?

2. Were there any factors that affected how much food you ate? Yes No
If yes, please explain:

3. Did you notice any differences between any of the sessions? Yes No
If yes, please explain:

4. Do you have any specific comments about this study? Do you have any
comments that may help us with future studies?

Thank you for your participation!!!

Food Lab Staff & Students

1. Of the foods served to you at the lunch time meals, please rank your preference for the foods with 1 being your favorite, 2 being your 2nd favorite, etc ending with 4 being your least favorite of the foods.

_____ Broccoli

_____ Carrots

_____ Pasta

_____ Snap Peas

Appendix N

Visual Analog Scale – Hunger and Satiety

How hungry do you feel right now?

Not at all _____ Extremely
hungry hungry

How thirsty do you feel right now?

Not at all _____ Extremely
thirsty thirsty

How much food do you think you could eat right now?

Nothing _____ A large
at all amount

How nauseated do you feel right now?

Not at all _____ Extremely
nauseated nauseated

How full do you feel right now?

Not at all _____ Extremely
full full

Appendix O

Visual Analog Scale - Palatability

How pleasant is the taste of this food right now?

Not at all pleasant _____ Extremely pleasant

How pleasant is the texture of this food right now?

Not at all pleasant _____ Extremely pleasant

How much of this food do you think you could consume right now?

Nothing at all _____ A large amount

Appendix P

Visual Analog Scale Questions – Meal Characteristics

How does the size of this serving of entrée compare to your usual portion of entrée?

A lot smaller _____ A lot larger

How does the size of this serving of vegetable compare to your usual portion of vegetable?

A lot smaller _____ A lot larger

How does the size of this serving of starch compare to your usual portion of starch?

A lot smaller _____ A lot larger

How does the size of this total meal compare to your usual meal portion size?

A lot smaller _____ A lot larger

How many calories do you think this total meal has?

No calories at all _____ Extremely high in calories

How much fat do you think this total meal has?

No fat at all _____ Extremely high in fat

Appendix Q

Recipe for Flavored Broccoli

Vegetable variety broccoli recipe:

568.7 g steamed broccoli

19.9 g Land o Lakes Light Whipped Butter

11.4 g Molly McButter Butter Flavor Sprinkles

Appendix R

Recipe for Pasta with Sauce

Recipe for pasta with sauce

357.8 g cooked spiral pasta

159.0 g Prego Traditional Sauce

61.4 g Classico Alfredo Sauce

21.7 g Kraft Parmesan Cheese