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HOW CHANGES IN THE VARIETY OF VEGETABLES AFFECT VEGETABLE INTAKE
AND ENERGY INTAKE IN A MEAL

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ABSTRACT

Background: Only 1 in 10 Americans meet the MyPyramid recommendations for daily vegetable intake; thus, effective techniques to increase vegetable intake are required. Increasing the variety of food served at a meal has been shown to increase intake. This is the first study to examine the effect of increasing the variety of vegetables offered simultaneously at a meal.

Objectives: To determine whether increasing the variety of vegetables served simultaneously at a meal 1) increases vegetable consumption and 2) decreases meal energy intake, without affecting levels of hunger.

Subjects: 66 men and women between the ages of 20-45 years from a university population.

Intervention: Individuals ate breakfast and lunch in a laboratory setting once a week for 4 weeks. Each week at lunch, they were served one of four conditions in a counterbalanced order. Each condition had an equal portion of the main dish and varied in the vegetable served. In three of the conditions, an individual vegetable was served; in the remaining condition, the three vegetables were served side-by-side.

Statistical Analyses: Data were analyzed using a mixed linear model with repeated measures.

Results: Vegetable intake increased when offering a variety of vegetables without resulting in a greater meal energy intake and without affecting ratings of hunger. Serving a variety of vegetables attenuated the decrease in ratings of pleasantness of the vegetables.

Conclusion: These findings suggest that increasing the variety of vegetables served simultaneously at a meal is an effective method to increase vegetable intake without differentially influencing ratings of hunger.

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Part I.
Introduction

Introduction

With 68% of the US population classified as overweight or obese¹ and 112,000 excess deaths caused by obesity each year², it has become critically important to develop effective and realistic nutritional strategies to assist in weight loss. Altering the properties of food is a strategy to reduce energy intake; one of the ways food can be altered is by reducing its **energy density**, that is, the energy content in a given weight of food (kcal/g). It has been demonstrated that in similar conditions, people tend to eat a consistent *weight or volume* of food at a meal; therefore, energy intake is significantly influenced by the energy density of the foods they eat³⁻⁵. Of course, if food were altered such that people no longer desired to eat it, the problem would not be solved. Studies have shown that reducing the energy density of a meal can be achieved without affecting palatability, defined as “the hedonic evaluation of oro-sensory food cues under standardized conditions”⁶, even if the subjects are aware of the change in energy density⁷⁻¹⁰. Furthermore, a reduction in energy density can reduce energy intake without greatly affecting the level of hunger. In a 2007 study, by Ello-Martin et al., two groups of obese women were advised to follow reduced energy diets—a reduced fat (RF) group and a reduced fat plus fruits and vegetables (RF+FV) group. The RF+FV group had a significantly lower energy density diet (1.23 ± 0.02 kcal/g, versus 1.46 ± 0.02 kcal/g) and significantly greater weight loss, yet reported less hunger than the RF group¹¹. Since palatability and hunger levels can be controlled, reducing the energy density of a meal is a realistic and effective approach to reducing energy intake and promoting weight loss.

One of the ways to reduce energy density of a meal is to incorporate foods that are low in fat, high in water content, and rich in complex carbohydrates, such as vegetables¹². In a series of studies by Gustaffson et al., levels of satiety (i.e. feeling full or gratified beyond the point of

satisfaction) were increased by adding vegetables to a meal; in addition, a direct correlation was found between the level of satiety and the water and fiber content of the vegetable^{13,14}. A study examining the 2003-2004 NHANES survey found that less than 1 in 10 Americans met their My Pyramid recommendation for vegetable consumption¹⁵. This finding can be explained by a number of factors affecting vegetable intake. The food people choose to eat is largely driven by price. Government subsidies heavily favor energy-dense, palatable foods, shifting consumers towards processed foods and away from vegetables. In addition to cost, there are a number of other reasons—a preference for salty and sugary foods, less time to cook or garden, etc.—that vegetable consumption is low. This leads to a central question in the fight against obesity and in nutrition in general: what is the best approach to increase vegetable intake among the population?

One of the proven ways to increase intake is to increase the **variety** of food offered. A study by McCrory and colleagues found a positive association between dietary variety and intake across 10 different food groups¹⁶. Similarly, a 2009 study, in which subjects were offered fries and brownies alone or fries and brownies with condiments, showed an overall increase in energy intake with the latter condition (1195 ± 552 vs. 1485 ± 582 kcal)¹⁷. Both of these findings demonstrate that increasing variety increases intake. Although this association can have negative consequences if applied to high-energy dense foods, desirable results can be achieved if variety is increased among low-energy dense foods. Even if the subject eats a larger portion due to the variety, the overall energy intake is likely to be reduced as a result of the low energy density.

Dietary variety has also been associated with a number of positive health outcomes. In a cross-sectional study of 1112 children aged 6-7 years, a positive correlation was found between dietary variety and a number of biochemical markers of health, including increased plasma levels

of retinol, alpha and beta-carotene, lycopene, and vitamin E¹⁸. Another study, by Bernstein et. al, exhibited that elderly people with varied diets had better health profiles, including higher HDL and a lower incidence of cancer, than those with unvaried diets¹⁹. Both of these results suggest that dietary monotony, as suggested by many “fad” diets, is not a healthy weight-loss method.

One of the key points in understanding why an increase in variety is associated with an increase in intake is a phenomenon called **sensory-specific satiety** (SSS), which has been defined experimentally as the difference between the change in the pleasantness of the food that has just been eaten and the change in the foods that were tasted but not eaten²⁰. SSS was first described in rats by the French physiologist Jacques Le Magnen²¹. Later, it was examined in monkeys, who would not eat a certain food after they were fed to satiety for that food but would continue to eat other foods they had not developed satiety towards²². A human example: if fed a large portion of rice, a subject would experience a satiety associated with the sensory properties of rice. A subsequent offering of a choice of rice would be declined in favor of a food with different sensory properties, such as a chocolate dessert. This change in hedonic response to rice is what is referred to as SSS. By increasing the variety of foods served at a meal, the effect of SSS is lessened and a person will eat more. SSS occurs within 2 minutes after the food has been consumed²³ and the effects of SSS were found by Rolls to be most pronounced in adolescents²⁴, with no relationship to body mass index⁹. Additionally, in a study by Snoek and colleagues, no difference in SSS was found between normal weight and obese women²⁵. These findings weaken the hypothesis that overweight individuals are more susceptible to SSS. Since it is not involved in the etiology of obesity, the property of SSS can be used advantageously in weight loss treatments among all individuals.

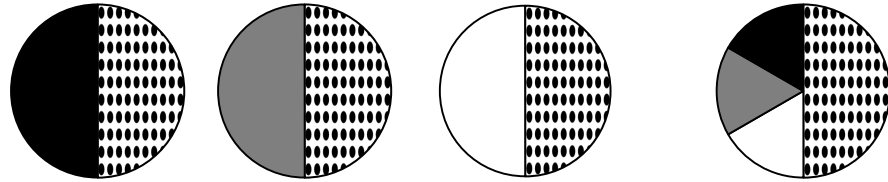
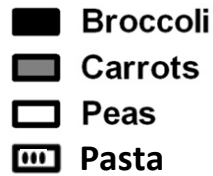
A working knowledge of how energy density, food variety and SSS affect intake is crucial when attempting to modify eating behavior to assist in weight loss. There have been many studies looking at the effects of variety when offered foods successively, but few have examined the simultaneous offering of a variety of foods. Additionally, while many studies have looked at increasing the variety of high-energy dense foods such as snack foods, there has been very little research on increasing the variety of vegetables served at a meal. Epstein and colleagues examined the effect of variety in children using only one vegetable, carrots, which was offered alongside other non-vegetable snack foods²⁶. This experiment examined how serving a variety of low-energy dense vegetables in a meal affects vegetable intake. It was hypothesized that 1) increasing the variety of vegetables would increase vegetable consumption and 2) the increase in vegetable consumption would displace intake of the more energy-dense main dish, and thus decrease meal energy intake without affecting hunger and satiety ratings.

Part II.**Methods**

Methods

Study Design

The study used a crossover design with four experimental conditions. On one day a week for four weeks, subjects were given a standard breakfast meal followed by a lunch meal three hours later. All subjects received the same breakfast meal in all conditions. The lunch meal consisted of two portions of equal weight (600g each): an entrée and a vegetable portion. The entrée portion, pasta with sauce, was identical (weight: 600g, ED: 1.5 kcal/g) in all conditions. The vegetable portion was either one of the vegetables (broccoli, carrots, or peas) served alone or, in the fourth condition, equal weights (200g) of the three vegetables served side-by-side. The four conditions were presented in a counterbalanced order across subjects (Appendix 1). Figure 1 on the following page shows the composition of the four conditions.

Figure 1. Meal Composition

	Condition 1	Condition 2	Condition 3	Condition 4
Meal weight (g)			1200	
Pasta weight (g)			600	
Vegetable weight (g)			600 ¹	
Pasta energy density (kcal/g) ²			1.57	
Vegetable energy density (kcal/g) ²	0.54	0.33	0.69	
Meal energy (kcal)	1416	1416	1560	1392
Meal energy density (kcal/g)	1.18	1.18	1.30	1.16

¹condition 4 having 200 g of each vegetable

²from bomb calorimeter (Parr Instruments, 1261 Isoperibol Bomb Calorimeter)

Subjects

Men and women in the State College community were recruited through advertisements in the Daily Collegian newspaper and the Penn State faculty and staff newswire (Appendix 2). A phone interview was conducted to identify potential subjects. If the subject was still interested in participating after being read a summary of the study (Appendix 3), he/she completed a telephone pre-screening questionnaire (Appendix 4). The subjects who met the pre-screening criteria for the study were instructed to come to the lab to complete a Demographics and Health Questionnaire (Appendix 5), to have their weight and height measured, and to do taste ratings for the foods to be used in the study. Initial screening criteria included the following: body weight of 100-200 pounds, at least 20 years of age, BMI < 40, not on a diet to gain or lose weight, not

taking medications known to affect appetite, not pregnant or breastfeeding, not a smoker, not an athlete in training, no sodium restrictions, no intolerances or allergies to foods used in the study, regularly eat 3 meals per day, willing to refrain from consuming alcoholic beverages on the night before and the day of the study each week, willing to not eat after 10PM the evening before the study session, and answer yes when asked if they are willing to eat pasta in red sauce, steamed broccoli, steamed carrots, and steamed sugar snap peas. Acknowledging that these foods are not often eaten in the morning, screening times were scheduled after 10:00AM to minimize any temporal influence on taste ratings. A Food List (Appendix 6) was used to identify willingness to eat foods served in the study and all appointment times were scheduled according to the Availability Sheet (Appendix 7) for each subject.

After removing shoes and heavy coats and measuring weight and height, the subjects were seated in a testing booth and given two copies of the Screening Consent Form (Appendix 8) and Screening Questionnaire packet (also contained ZUNG (Appendix 9), EAT-26 (Appendix 10) and Eating Inventory questionnaires (Appendix 11)). A Palatability visual analog scale booklet (PVAS) (Appendix 12), food samples, and instructions on how to rate the taste of the food samples (Appendix 13) were also given to the subject. The 100-mm PVAS used anchors of 'Not at all Pleasant' and 'Extremely Pleasant'. The food samples included the pasta with red sauce, the three vegetables (separately), a potato chip, and plain yogurt. Subjects were excluded from the study if ZUNG > 40, EAT-26 > 20, or if the PVAS taste rating of any of the foods used in the study (pasta and/or vegetables) were < 30. If a subject had a total ZUNG score \geq 60 (a measure of depression) or an EAT-26 score \geq 20, a referral was made to contact Counseling and Psychological Services (CAPS) at Penn State. Appendix 14 shows the script of the follow-up phone call used to refer subjects to CAPS.

Subjects who met all criteria and who still wanted to participate in the study were assigned a subject number and color. Prior to the start of the study, each subject completed a brief training session. During the training session, the subjects: received their subject number and color, were shown how to check in for their session, were instructed not to take any personal items into the testing booth, were asked to sign two copies of the study Consent Form (Appendix 15), and were given a Welcome Sheet (Appendix 16) with study rules, meal dates and times.

The characteristics of the subjects in this study are shown in Table 1 on the following page.

Table 1. Subject Characteristics

Characteristic	Women (n=34)		Men (n=32)	
	Mean \pm SE ¹	Range	Mean \pm SE	Range
Age (y)	26.5 \pm 1.3	20.1 – 44.9	27.1 \pm 1.2	20.4 – 44.5
Height (m)	1.7 \pm 0.0	1.5 – 1.8	1.8 \pm 0.0	1.5 – 1.9
Weight (kg)	63.5 \pm 1.7	46.0 – 84.5	82.3 \pm 2.3	63.3 – 129.1
BMI (kg/m ²)	23.3 \pm 0.6	17.8 – 32.4	25.5 \pm 0.6	20.7 – 35.4
TEE if low active (kcal/d) ²	1976 \pm 23	1714 – 2276	2675 \pm 40	2260 – 3320
TEE if active (kcal/d)	2459 \pm 28	2129 – 2815	3232 \pm 48	2741 - 4063
Dietary restraint score ³	8.0 \pm 0.7	2.0 – 17.0	6.4 \pm 0.7	1.0 – 12.0
Disinhibition score ³	4.6 \pm 0.6	0.0 – 15.0	4.8 \pm 0.4	1.0 – 10.0
Hunger score ³	3.9 \pm 0.4	0.0 – 9.0	4.8 \pm 0.6	1.0 – 14.0
Depression score ⁴	28.8 \pm 0.7	23.0 – 38.0	29.7 \pm 0.8	23.0 – 40.0
Eating attitudes score ⁵	4.3 \pm 0.6	0.0 – 13.0	3.2 \pm 0.6	0.0 – 16.0

¹SE = standard error

²TEE = total energy expenditure, estimated from subject sex, age, height, weight, and activity level²⁷.

³Eating Inventory (Appendix 11)

⁴Zung self-rating questionnaire (Appendix 9)

⁵EAT-26 (Appendix 10)

Test Foods and Meal Manipulation

This study used a simple design of 4 experimental conditions (Figure 1). All four conditions included pasta with red sauce with a fixed energy density (ED = 1.57) and quantity (600 grams). In three of the conditions, a single vegetable was served. In the remaining condition, the three vegetables were served side-by-side.

The study was originally designed such that the vegetables chosen would be the most popular vegetables consumed. To determine which vegetables were consumed the most, the manager of the frozen foods section at the local Giant supermarket was consulted. The best-selling vegetables were, in order: corn, peas, broccoli, carrots, green beans and cauliflower. Corn was not chosen due to its high energy density, so the next three best-selling vegetables—peas, broccoli, and carrots—were included in the study. After tasting the vegetables, the researchers decided that the broccoli had a bitter taste and differed in palatability from the other vegetables. It was therefore decided that butter and butter flavoring would be added to the broccoli, similar to what someone would do in a natural setting. Due to the addition of butter, the energy density of the broccoli increased. The vegetables varied in energy density as they naturally do. A bomb calorimeter (Parr Instruments, 1261 Isoperibol Bomb Calorimeter) was used to measure the energy density of the vegetables and pasta following study completion.

The test foods for the lunch meal were spiral pasta (Reinhart Food Services, Milwaukee, WI) with red pasta sauce (Prego Traditional, The Campbell Soup Company, Camden, NJ), alfredo sauce (Classico Alfredo, The Campbell Soup Company, Camden, NJ) and parmesan cheese (Parmesan Cheese, Kraft Foods of North America, Glenview, IL, 60025), steamed broccoli (Baby Broccoli Florets, Birds Eye Foods, Inc., Rochester, NY), carrots (Premium Petite Whole Carrots Steam in Bag, Hanover Foods Corp., Hanover, PA), and sugar snap peas

(Premium Sugar Snap Peas Steam in Bag, Hanover Foods Corp., Hanover, PA). Butter (Land O'Lakes, Inc., Arden Hills, MN) and butter flavoring (Molly McButter, Alberto-Culver USA, Inc., Melrose Park, IL) were added to the broccoli. A 1-liter container of water was served with the meal, salt and pepper were available in each testing booth, and a mint (Andes Candies LP, Delavan, WI) was served following the meal. Pictures of the lunch foods are shown in Appendix 16.

Breakfast foods in the study included two plain bagels (Sara Lee Corp., Downer's Grove, IL), a condiment bowl with two packets each of regular cream cheese (Philadelphia Cream Cheese, Kraft Foods of North America, Glenview, IL, 60025), light cream cheese (Philadelphia Cream Cheese- Light, Kraft Foods, Chicago, IL), grape jelly and strawberry jam (The J.M. Smucker Co., Orrville, OH 44667), and butter (Land O'Lakes, Inc., Arden Hills, MN) as well as an 8-ounce container of orange juice (Healthy Kids Orange Juice, Tropicana Products, East Bradenton, FL), a 6-ounce container of blueberry or strawberry yogurt (Yoplait USA Inc., Carson, CA), a 1-liter container of water, and tea (Bigelow Tea Company, Fairfield, CT) or coffee (The Eight O'Clock Coffee Company, Inc., Montvale, NJ) if the subjects selected a hot beverage during the training session.

Procedures

On one day a week for 4 weeks, subjects ate breakfast and lunch in the laboratory. Upon arrival to the laboratory, the subject was taken to a cubicle for their breakfast meal. The subject was not permitted to listen to music, read, or have phone conversations during their meal. Additionally, the subject was instructed not to eat after 10PM on the night before the test day, to maintain normal physical activity levels, and not to eat at a restaurant or drink any alcohol on the night before the test day. To monitor protocol adherence, subjects were given a Food and Activity Diary (Appendix 18) in which they documented all food intake and physical activity on the day before their testing day.

Breakfast

After being taken to their cubicle, the subject's Food and Activity Diary was collected and the subject was instructed to complete a Breakfast Report (Appendix 19) and Hunger Visual Analogue Scale booklet (HVAS) (Appendix 20). The Breakfast Report was used to make sure the subject adhered to study protocol pertaining to their intake and activity levels before breakfast. The HVAS gave a quantitative measurement of nausea, which could result in atypical eating behavior, and also measured the subject's perception of how much they could eat, their hunger, fullness, and thirst based on a 100 mm scale. The subject's test meal was rescheduled to a later date if they had a nausea rating of over 50 mm from the HVAS or if they violated study protocol.

Each subject received the same standard breakfast at their scheduled breakfast time, between the hours of 7:15AM and 9:15AM. Each subject's breakfast time was the same during each day for all 4 weeks so that there would be no variance in their satiety level when arriving for their breakfast. The breakfast meal consisted of 2 plain bagels, 2 packets each of regular

cream cheese, light cream cheese, butter, strawberry preserves and grape jelly, orange juice, water, and either hot coffee or tea according to the subject's preference during the training session. Each food item was weighed on a scale before the breakfast meal and recorded on the Breakfast Intake Sheet (Appendix 21). After being given the breakfast meal, the subject was instructed to eat as much or as little as he/she wanted and to ring a bell when finished to notify the study assistant. No time constraint was placed on the meal. After finishing the breakfast meal, the tray was collected and the subject was told that they may leave after filling out a second HVAS. The amount of each food item left after the subject finished breakfast was weighed and recorded on the Breakfast Intake Sheet. The total amount of each food item consumed was determined by subtracting the post-breakfast weight from the pre-breakfast weight. In the period after breakfast and before lunch, the subject was instructed not to eat or drink anything except water.

Lunch

A minimum of 3 hours later, between the hours of 11:15AM -1:15PM, the subject came back to the lab for their lunch meal. The subject completed a Lunch Report (Appendix 22) and an HVAS before a tray was brought out with samples of the foods to be served at lunch. The four samples were served hot in separate 2-ounce soufflé cups containing a bite-sized portion each of the broccoli, carrots, snap peas, or pasta. After being given the taste rating instructions, the subject ate the samples, filled out four PVAS booklets, one for each food item, and rang the bell when they finished. Next the subject was given the test meal corresponding to their condition along with a 1-liter container of water, a Meal Perception VAS booklet (MPVAS) (Appendix 23) and instructions on how to eat the meal in conjunction with the MPVAS (Appendix 24). The MPVAS measured how the meal compared to the subject's normal meal

size, how the vegetable and pasta portions compared to the subject's normal portion sizes, and how many calories and fat the subject thought were in the total meal. There was no time limit for eating the meal, but the total time it took the subject to eat the meal was measured and recorded by the researcher. The subject rang the bell after he/she was finished the meal and then was given another tray with the four food samples and four PVAS booklets, one for each sample. After rating the samples, the subject rang the bell and was given another HVAS, a Reminder Sheet for their next appointment (Appendix 25), a Food and Activity Diary for their next appointment, and an Andes Mint. Last, the subject was instructed to eat the mint in the booth and leave the wrapper behind and was allowed to leave after completion of the HVAS. All foods and any remaining water was weighed after the meal by the study assistant and recorded on the Meal Intake Sheet (Appendix 26) corresponding to the correct condition. All foods were weighed before and after the meal to the nearest 0.1 grams. On the fourth week, having completed all four conditions, the subject was given a Discharge Questionnaire (Appendix 27) in which they rated their order of preference of the pasta, broccoli, snap peas and carrots.

Measuring Outcomes

The primary outcome of the study was the vegetable gram intake. Additional outcomes were vegetable energy intake, meal energy intake, changes in appetite ratings, changes in hedonic response to foods, and vegetable preference.

Gram Intake: All food was weighed before and after the meal. The gram intake for each food item was calculated by subtracting the post-meal weight from the pre-meal weight.

Energy Intake: The energy intake for each food item was determined by using multiplying the energy density by the gram intake.

Changes in Appetite Ratings: Changes in hunger, thirst, nausea, how much total food the subject thought they could eat and how full they thought they were as reported in the HVAS booklets were measured and reported as differences in means (after-meal minus before-meal).

Changes in Hedonic Response to Foods: In order to measure SSS, there must be an uneaten food with different sensory properties than the food that has just been eaten. For example, consider condition 1, the broccoli condition, where the uneaten foods are the carrots and peas while the eaten food is the broccoli. The sensory properties of the three vegetables did not differ enough to measure SSS. Therefore, rather than measuring SSS, a measurement of the change in hedonic response for each food item was determined by examining the differences in palatability ratings (after-meal minus before-meal). The change in hedonic response for each food item in the variety condition was compared to the change in hedonic response for that food item in its respective “single vegetable” condition.

Vegetable Preference: Subjects reported their most preferred vegetable after having completed all four conditions. The gram intake of the preferred vegetable in its “single vegetable” condition was compared to the total vegetable gram intake in the variety condition.

Statistical Analysis

Data were analyzed using a mixed linear model with repeated measures (SAS 9.1; SAS Institute, Inc., Cary, NC). The fixed factors in the model were experimental condition, study week, and participant gender; the factor of food preference was also examined. Interactions of factors were tested for significance before examining their main effects. For making multiple pairwise comparisons between means, the significance level was adjusted using the Tukey-Kramer method. Differences between the characteristics of women and men were examined using t tests. Results were considered significant at $p < 0.05$ and are reported as mean \pm SEM.

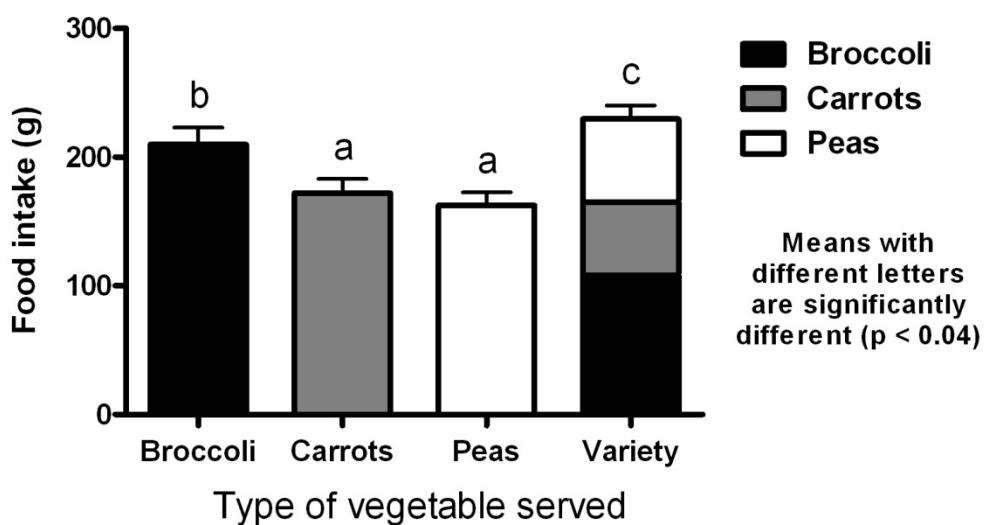
Part III.
Results

Results

Vegetable Intake

Figure 2 shows that the vegetable gram intake in condition 4 was significantly higher than all other conditions (versus condition 1: $p = 0.038$; versus conditions 2 and 3: $p < 0.0001$) and was higher in condition 1 compared to condition 2 ($p = 0.0009$) and condition 3 ($p < 0.0001$).

Figure 2. Gram Intake of Vegetables



Means are reported for both sexes combined because there were no differences in vegetable intake between sexes across all conditions.

Meal Intake

Figures 3 and 4 on the following page compare the gram intake of the meal to the energy intake of the meal.

Looking at the entire meal (the pasta and vegetable portions together), the gram intake was significantly higher in condition 4, the variety condition, compared to all other conditions (versus condition 1: $p = 0.03$; versus condition 2: $p = 0.004$; versus condition 3: $p < 0.0001$). There was an overall difference observed for pasta gram intake across all conditions for men and women ($p < 0.0001$); subjects ate more pasta in the carrot condition compared to the broccoli condition ($p = 0.04$), as shown in Figure 3.

Figure 4 shows that the energy intake of the entire meal was lower in the carrot condition compared to the pea and variety conditions, with an intermediate energy intake in the broccoli condition. The vegetable energy intake was significantly lower in condition 2 compared to all other conditions (versus conditions 1 and 3: $p < 0.0001$; versus condition 4: $p = 0.0001$). Pasta energy intake was lower in the broccoli condition compared to the carrot condition.

When comparing the vegetable gram intake in Figure 3 to the vegetable energy intake in Figure 4, different trends are seen due to the variations in energy density of the vegetables. The vegetable energy intake in the pea condition was higher due to the high ED of the peas. Additionally, the vegetable energy intake in the variety condition was lower due the high proportion of broccoli (middle ED) consumed.

Figure 3. Meal Gram Intake

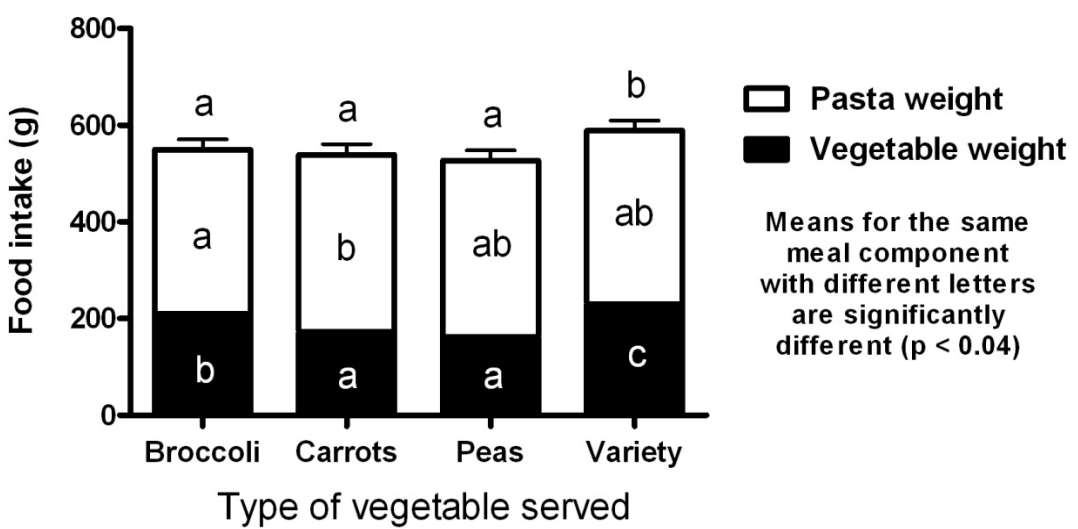
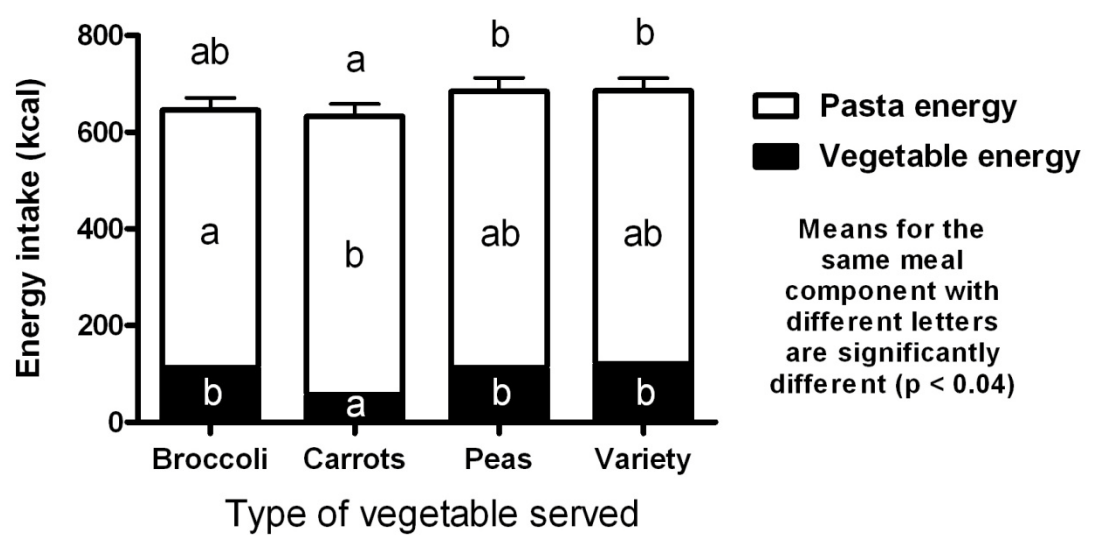


Figure 4. Meal Energy Intake



The total food, pasta, and vegetable intakes are reported as both gram and energy measures in Table 2 below.

Table 2. Food Intake During Lunch Meal⁺

	Condition 1	Condition 2	Condition 3	Condition 4
	Broccoli	Carrots	Peas	Broccoli, Carrots, Peas
	Mean ± SE	Mean ± SE	Mean ± SE	Mean ± SE
Total Intake				
Weight (g)	549.4 ± 21.6 ^a	539.2 ± 22.1 ^a	526.8 ± 21.5 ^a	589.2 ± 20.4 ^b
Energy (kcal)	646 ± 25 ^{ab}	633 ± 25 ^a	684 ± 28 ^b	686 ± 26 ^b
Pasta Intake¹				
Weight (g)	339.6 ± 14.5 ^a	367.1 ± 15.1 ^b	364.3 ± 15.8 ^{ab}	359.6 ± 15.0 ^{ab}
Energy (kcal)	533 ± 23 ^a	576 ± 24 ^b	572 ± 25 ^{ab}	565 ± 24 ^{ab}
Vegetable Intake				
Weight(g)	209.9 ± 13.2 ^b	172.1 ± 10.9 ^a	162.5 ± 10.0 ^a	229.6 ± 10.5 ^c
Energy (kcal)	113 ± 7 ^b	56 ± 4 ^a	112 ± 7 ^b	121 ± 6 ^b

⁺ means with different letters in the same row are significantly different ($p < 0.05$)

¹weight, energy intake have same p-values because gram intake is multiplied by a constant (ED)

Vegetable Preference

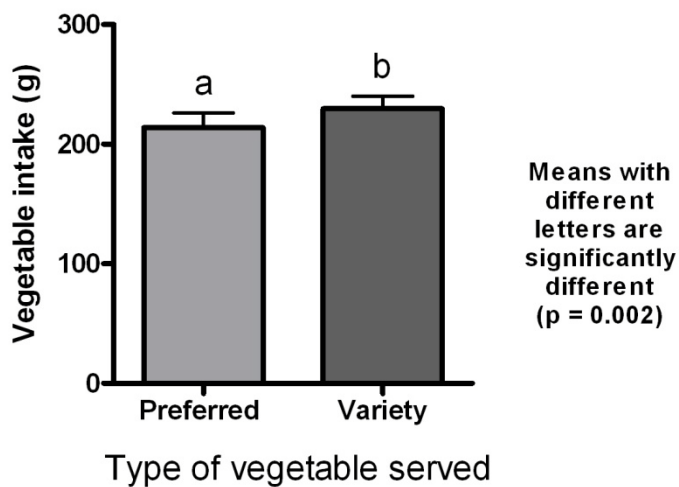
The most preferred vegetable was the broccoli followed by carrots, and peas, as shown in Table 3 below.

Table 3. Vegetable Preference

Preferred Vegetable	Number of Subjects (n = 66)
Broccoli	41
Carrots	14
Peas	11

When comparing the vegetable gram intake of the preferred vegetable (211 ± 11 grams) to the vegetable gram intake in the variety condition (233 ± 11 grams), the intake in the variety condition was significantly greater (Figure 5).

Figure 5. Vegetable Intake: Preferred vs. Variety



Appetite Ratings

The differences (after-meal minus before-meal) in hunger, thirst, and nausea ratings as well as prospective consumption (“how much”) and how full the subjects thought they were are shown in Table 4 below.

Table 4. Differences in Appetite Ratings Before and After Lunch Meal⁺

	Condition 1	Condition 2	Condition 3	Condition 4
	$\Delta\text{Mean}^1 \pm \text{SE}$	$\Delta\text{Mean}^1 \pm \text{SE}$	$\Delta\text{Mean}^1 \pm \text{SE}$	$\Delta\text{Mean}^1 \pm \text{SE}$
Hunger	-59.6 ± 2.2^a	-60.4 ± 2.0^a	-57.7 ± 2.1^a	-61.7 ± 2.3^a
Thirst	-39.8 ± 3.8^a	-45.3 ± 3.0^a	-43.1 ± 3.3^a	-44.8 ± 3.2^a
Nausea	2.9 ± 1.5^a	2.4 ± 1.3^a	2.5 ± 1.4^a	3.2 ± 1.4^a
How Much	-56.4 ± 2.1^a	-55.2 ± 2.3^a	-54.0 ± 2.0^a	-58.1 ± 1.9^a
Fullness	63.3 ± 3.2^a	68.1 ± 2.6^a	67.1 ± 2.5^a	68.0 ± 2.6^a

⁺means with different letters in the same row are significantly different ($p < 0.05$)

¹difference in means, calculated as (after-meal minus before-meal)

No significant differences were observed when comparing across all conditions for the differences in appetite ratings (all $p > 0.05$).

Hedonic Response Ratings

Changes in hedonic response were determined using the difference in means (after-meal minus before-meal) as reported from the PVAS booklets, measuring the taste, texture, and prospective consumption of each food item.

Taste

Table 5. Differences in Taste Ratings of Foods Before and After Lunch Meal⁺

	Single Vegetable Condition	Variety Condition
Food Rated	$\Delta\text{Mean}^1 \pm \text{SE}$	$\Delta\text{Mean}^1 \pm \text{SE}$
Broccoli	-21.5 ± 2.8^a	-13.5 ± 2.7^b
Carrots	-18.1 ± 2.8^a	-12.5 ± 2.5^a
Peas	-18.8 ± 2.9^a	-13.8 ± 3.0^a
Pasta ²	-19.0 ± 1.4^a	-18.2 ± 2.7^a

⁺ means with different letters in the same row are significantly different ($p < 0.05$)

¹ Difference in means, calculated as (after-meal minus before-meal)

² For the pasta rating, the single vegetable condition is the mean over all three vegetables

The negative values in Table 5 indicate that the taste ratings were lower after the meal than before the meal. The taste rating broccoli in the variety condition decreased less when compared to the broccoli condition. The taste ratings of the carrots and peas did not differ between the “single vegetable” and variety conditions.

Texture**Table 6. Differences in Texture Ratings of Foods Before and After Lunch Meal⁺**

Food Rated	Single Vegetable Condition	Variety Condition
	$\Delta\text{Mean}^1 \pm \text{SE}$	$\Delta\text{Mean}^1 \pm \text{SE}$
Broccoli	-20.7 ± 2.7^a	-13.9 ± 2.5^b
Carrots	-13.7 ± 3.1^a	-12.5 ± 2.4^a
Peas	-19.3 ± 2.6^a	-16.7 ± 2.9^a
Pasta ²	-15.1 ± 1.4^a	-14.0 ± 2.6^a

⁺ means with different letters in the same row are significantly different ($p < 0.05$)

¹ difference in means, calculated as (after-meal minus before-meal)

² For the pasta rating, the single vegetable condition is the mean over all three vegetables

As shown in Table 6, the texture rating of the broccoli in the variety condition decreased less than in the broccoli condition. The texture rating of the carrots and peas in their “single vegetable” conditions did not differ compared to the variety condition. Similarly, the texture rating of the pasta did not vary between the “single vegetable” and variety conditions.

Prospective Consumption

Table 7. Differences in “How much?” Ratings of Foods Before and After Lunch Meal⁺

	Single Vegetable Condition	Variety Condition
Food Rated	$\Delta\text{Mean}^1 \pm \text{SE}$	$\Delta\text{Mean}^1 \pm \text{SE}$
Broccoli	-46.8 ± 3.1^a	-42.0 ± 2.7^a
Carrots	-43.8 ± 2.5^a	-39.7 ± 2.6^a
Peas	-44.3 ± 2.6^a	-42.4 ± 2.5^a
Pasta ²	-56.8 ± 1.5^a	-58.1 ± 2.0^a

⁺ means with different letters in the same row are significantly different ($p < 0.05$)

¹ Difference in means, calculated as (mean after meal – mean before meal)

² For the pasta rating, the single vegetable condition is the mean over all three vegetables

No significant differences were observed for prospective consumption ratings when comparing between the “single vegetable” and variety conditions.

Mean Palatability Ratings of Different Foods

The mean taste, texture, and prospective consumption ratings of the foods before each meal, collapsing the data across conditions, are shown in Table 8 below. Means with different letters in the *same column* are significantly different ($p < 0.05$).

Table 8. Mean Palatability Ratings of Foods Before Each Meal⁺

Food Rated	Taste	Texture	How Much
	Mean ¹ ± SE	Mean ¹ ± SE	Mean ¹ ± SE
Broccoli	71.9 ± 1.2 ^b	72.2 ± 1.1 ^b	57.3 ± 1.2 ^b
Carrots	62.1 ± 1.2 ^a	64.8 ± 1.1 ^a	50.1 ± 1.2 ^a
Peas	62.8 ± 1.1 ^a	64.4 ± 1.1 ^a	51.0 ± 1.2 ^a
Pasta	78.0 ± 0.9 ^c	74.7 ± 1.0 ^b	69.4 ± 1.0 ^c

⁺means with different letters in the same column are significantly different ($p < 0.05$)

¹Mean palatability rating of sample assessed before the meal across all conditions

Taste: The mean taste rating of the pasta was higher than all of the vegetables. Broccoli had a higher mean taste rating compared to the carrots and peas.

Texture: The carrots and peas had a lower texture rating than the broccoli and pasta. The carrots did not vary significantly from the peas. Similarly, the texture rating of the broccoli did not vary significantly from the pasta.

How Much: Subjects thought they could consume more pasta than any of the three vegetables. Additionally, subjects thought they could eat more broccoli than both carrots and peas.

Part IV.**Discussion**

Discussion

Food Intake

The main finding of the study that serving a variety of vegetables increased the weight of vegetables consumed is in conjunction with the previous literature, which has shown that increasing the variety of foods offered at a meal will increase food intake^{16,17}. The increase in vegetable intake did not affect ratings of hunger, thirst, nausea, the prospective consumption of food, or fullness, suggesting that increasing vegetable variety may be an effective and realistic approach to increasing vegetable consumption. Additionally, although the total weight of food consumed was higher in the variety condition, the energy intake of that condition was not higher, except when compared with the very low-energy dense carrot condition.

Two properties of the vegetables that influenced their intake were: 1) natural variations in their energy densities and 2) the natural difference in their palatability, as evidenced by the unequal distribution in the vegetable preference results. As shown in Figure 1, the energy density of the broccoli (ED = 0.54 kcal/g), carrots (ED = 0.33 kcal/g), and peas (ED = 0.69 kcal/g) was slightly different. The natural variations in energy density of the three vegetables resulted in differences in vegetable and meal energy intake. For example, although the gram intake of carrots and peas did not vary significantly (172.1 ± 10.9 grams for carrots versus 162.5 ± 10.0 grams for peas), the energy intake of the peas was twice the energy intake of the carrots (112 ± 7 kcal for peas versus 56 ± 4 kcal for carrots) due to the energy density of the peas (ED = 0.69 kcal/g) being twice that of the carrots (ED = 0.33 kcal/g). This also affected the meal energy intake, which was greater in the pea condition than the carrot condition (Figure 2). However, although the peas have twice the ED as the carrots, both of these vegetables are considered low-energy dense foods. It is more meaningful to look at the ED of vegetables

compared to other foods (e.g. pasta, a high-energy dense food, ED = 1.57) than it is to look at the percent difference in ED between the vegetables. Furthermore, the energy density of vegetables is not typically controlled in a practical setting. The vegetables in this study were served in their natural state and were prepared as most people would prepare them (i.e. according to the instructions on the package). So, because the energy density was not adjusted, the results are applicable to the typical eating behaviors of humans in an uncontrolled setting.

Effects of Vegetable Preference and Palatability

As seen in Table 3, 62% of the subjects selected the broccoli as their most preferred vegetable, whereas only 21% preferred the carrots and 17% preferred the peas. Table 8 also describes the palatability, showing that the broccoli had a higher taste, texture, and “how much” rating than the carrots and the peas. Similar to how people would alter the taste of their vegetables at home, butter and butter flavoring were added to the broccoli, while the carrots and peas were served without added flavoring. These differences in palatability are reflected in the vegetable intake results, which show that the gram intake of the broccoli was significantly higher than both the gram intake of the carrots and the gram intake of the peas (Table 2). Since people tend to eat a consistent weight or volume of food at a meal, the high broccoli intake in the broccoli condition displaced some of the pasta intake. The pasta intake was lower in the broccoli condition, when the most preferred vegetable (broccoli) was served, than in the carrot condition. Similarly, when examining the contribution of each vegetable within the variety condition, the broccoli intake is higher than both the carrot and pea intakes (broccoli: 108.3 grams; carrots: 56.8 grams; peas: 64.5 grams; SE = 10.5) due to the preference for the broccoli.

Changes in Hedonic Response

As shown in Tables 5 and 6, the palatability rating for the broccoli decreased less (after-meal minus before-meal) in the variety condition compared to the single vegetable (broccoli) condition. This suggests that the decrease in palatability is attenuated by serving a variety of vegetables simultaneously at a meal. Supporting this suggestion is the finding that broccoli accounted for 47% of total vegetable intake in the variety condition, greater than the 39% proportion it accounted for in the single vegetable conditions considered together (Figure 2). It appears that, even when offering low-energy dense vegetables with similar sensory properties, a simultaneous offering of the three vegetables positively influences the hedonic response compared to when the vegetables are served singly.

Future Studies

Several changes in the design of the study could be made to explore and expand the present findings. First, larger portions of the vegetables could be served in the variety condition. In the current study, equal portions (200 grams) of the three vegetables were served in the variety condition such that they combined to match the portion served in the single vegetable conditions (600 grams). Typically, a subject did not finish the 600 gram portion in the single vegetable condition, even if it was their favorite vegetable; however, it was not uncommon for the subject to eat the entire 200 gram portion of their favorite vegetable in the variety condition. If finishing their favorite vegetable, the subject had to next choose between the two less-preferred vegetables. It is possible that the subject would have eaten more of his/her favorite vegetable in the variety condition if more was offered. By offering 600 grams of each vegetable in the variety condition, this prediction could be examined. A hypothesis could be made that the subject would have a greater vegetable intake due to the increased availability of their preferred vegetable. A

2007 study by Rolls found that, when examining the effect of portion size on intake over an 11-day period, a 50% increase in portion size of all food components led to increased energy intake (423 ± 27 kcal; $p < 0.0001$) but did not result in an increased vegetable intake²⁸. However, a study published in 2010 by Rolls, where subjects were offered vegetables in 3 portion sizes (180, 270, or 360 g) and 2 energy densities (0.8 or 0.4 kcal/g), found that an increase in the vegetable portion resulted in greater vegetable consumption (60 ± 5 grams; $p < 0.0001$)²⁹. It would be interesting to see if these findings held true when offering a variety of vegetables simultaneously at a meal.

In addition to increasing the portion size of the vegetables in the variety condition, more vegetables could be offered. If five vegetables (instead of three), for example, were offered simultaneously at a meal, the decrease in hedonic response for the vegetables could be reduced even more. This change, however, may reduce the applicability of the findings to typical eating behaviors; people do not normally include five vegetables simultaneously in a meal, unless the meal is a vegetable soup, salad, or other vegetable medley. Similarly, the energy densities and palatability of the vegetables could be matched, but again this alteration may not be applicable outside of a controlled laboratory setting. Finally, an additional change to the design of the study could be an expansion of the study population. Study participants came from a healthy, mostly white, middle-class, university population and had predominantly normal BMIs (women: 23.3 ± 0.6 ; men: 25.5 ± 0.6). Although previous studies have suggested that obese individuals are not more prone to the effects of sensory-specific satiety than normal-weight individuals when offering sandwiches and snack foods (pears, cheese, and chicken)²⁵, there has been no research looking at how obese and normal-weight individuals differ in their response to increasing vegetable variety.

Conclusion

The results of the present study suggest that increasing the variety of vegetables served simultaneously at a meal increases vegetable consumption, via an attenuation of the decrease in the change in hedonic response, without affecting ratings of appetite. This finding is an important step toward the investigation of methods to increase vegetable intake. It is also in accordance with goals, set by the Nutrition Service of the USDA, the Dietary Guidelines for Americans, and the MyPyramid food guidance system, to increase the variety of vegetables in children.

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Appendix 1.
Counterbalanced Order of Conditions Across Subjects

Subject	Order of Conditions	Subject	Order of Conditions
401	3241	442	1423
402	1423	443	4312
403	4312	444	2134
404	2134	445	3241
405	3241	446	1423
406	1423	447	4312
407	4312	448	2134
408	2134	449	3241
409	3241	450	1423
410	1423	451	4312
411	4312	452	2134
412	2134	453	3241
413	3241	454	1423
414	1423	455	4312
415	4312	456	2134
416	2134	457	3241
417	3241	458	1423
418	1423	459	4312
419	4312	460	2134
4192	4312	461	3241
420	2134	462	1423
421	3241	463	4312
422	1423	464	2134
423	4312	465	3241
424	2134	466	1423
425	3241	467	4312
426	1423	468	2134
427	4312		
428	2134		
429	3241		
430	1423		
431	4312		
432	2134		
433	3241		
434	1423		
435	4312		
436	2134		
437	3241		
438	1423		
439	4312		
440	2134		
441	3241		

Appendix 2.
Recruitment Advertisements

Food Lab Looking for Research Participants!!

A *Penn State University* Food Lab needs people **between 20 and 45** years of age to participate in a study of human eating behavior.

The study consists of completing a few brief questionnaires and eating breakfast and lunch in our lab 1 day/week for 4 weeks.

You will be compensated for your time and will be aiding in our understanding of human eating behavior.

Please call Jennifer @ 863-8482 for more information about the study.

Food Lab Looking for Research Participants!!

The Food Lab in 226 Henderson Bldg needs people **between 20 and 45** years of age to participate in a research study of human eating behavior.

The study consists of completing a few brief questionnaires and eating breakfast and lunch in our lab 1 day/week for 4 weeks.

You will be compensated for your time and will be aiding in our understanding of human eating behavior.

Please call Liz @ 863-8482 for more information about the study.

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Appendix 3.
Screening Summary

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 4.
Telephone Pre-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 5.
Demographics 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?

Appendix 6.
Food List

Please cross off and foods that you are not willing to eat:

Blueberry yogurt
Strawberry yogurt
Bagels
Cream cheese
Orange Juice

Chicken Parmesan
Roast Beef
Rice
Pasta with tomato sauce
Parmesan Cheese
Broccoli with butter
Sugar Snap Peas
Carrots

Chocolate Mint
Chocolate chip cookies

Appendix 7.
Availability Sheet

Availability Sheet

Thank you for taking the time to fill out the attached questionnaires. We will contact you by telephone if we find that you meet our eligibility requirements for this study.

If chosen for this study, what days of the week would you be able to come into the laboratory for breakfast, lunch and dinner? All meals will take approximately 20 to 30 minutes. Please pick all days and times that fit into your schedule.

*Please circle **all meal times** that will fit into your schedule. All meals must be at least 3 hours apart.*

<i>Day</i>	<i>Breakfast</i>	<i>Lunch</i>
MONDAY	7:15 7:30 7:45 8:00 8:15 8:30 8:45 9:00 9:15	11:15 11:30 11:45 12:00 12:15 12:30 12:45 1:00 1:15
TUESDAY	7:15 7:30 7:45 8:00 8:15 8:30 8:45 9:00 9:15	11:15 11:30 11:45 12:00 12:15 12:30 12:45 1:00 1:15
WEDNESDAY	7:15 7:30 7:45 8:00 8:15 8:30 8:45 9:00 9:15	11:15 11:30 11:45 12:00 12:15 12:30 12:45 1:00 1:15
THURSDAY	7:15 7:30 7:45 8:00 8:15 8:30 8:45 9:00 9:15	11:15 11:30 11:45 12:00 12:15 12:30 12:45 1:00 1:15

Appendix 8.
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 9.
Zung Questionnaire

Instructions: Please answer the questions by marking an X 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 people of the opposite sex				
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 do				
13. I am restless and can't sleep				
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 10.
EAT-26

Instructions: Please place an X in the column which applies best to each of the numbered statements. All of the results will be strictly confidential. Please answer each question carefully.	ALWAYS	VERY OFTEN	OFTEN	SOMETIMES	RARELY	NEVER
1. I am terrified about being overweight.						
2. I avoid eating when I am hungry.						
3. I find myself preoccupied with food.						
4. I have gone on eating binges where I feel that I may not be able to stop.						
5. I cut my food into small pieces.						
6. I am aware of the caloric content of foods that I eat.						
7. I particularly avoid foods with a high carbohydrate content (such as bread, potatoes, or rice).						
8. I feel that others would prefer if I ate more.						
9. I vomit after I have eaten.						
10. I feel extremely guilty after eating.						
11. I am preoccupied with a desire to be thinner.						
12. I think about burning up calories when I exercise.						
13. Other people think that I am too thin.						
14. I am preoccupied with the thought of having fat on my body.						
15. I take longer than others to eat my meals.						
16. I avoid foods with sugar in them.						
17. I eat diet foods.						
18. I feel that food controls my life.						
19. I display self-control around food.						
20. I feel that others pressure me to eat.						
21. I give too much time and thought to food.						
22. I feel uncomfortable after eating sweets.						
23. I engage in dieting behavior.						
24. I like my stomach to be empty.						
25. I enjoy trying rich new foods.						
26. I have the impulse to vomit after meals.						

Appendix 11.
Eating Inventory

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 "T".

If you disagree with the statement, or feel that it is false as applied to you, answer false by circling the "F".

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 sad or 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 or 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 it 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 ten years.	T	F
8. Since I am often hungry, I sometimes wish that an expert would tell me that I have had enough to eat or that I can have some more.	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 or grams of fat in common foods.	T	F	32. I count calories or 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.	T	F	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

Please continue on page 2

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 rarely 2 sometimes 3 usually 4 **always**

38. **Would a weight fluctuation of five pounds affect the way you live your life?**

1 not at all 2 slightly 3 moderately 4 very much

39. **How often do you feel hungry?**

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

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

1 never 2 rarely 3 often 4 always

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

1 easy 2 slightly difficult 3 moderately difficult 4 very difficult

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

1 not at all 2 slightly 3 moderately 4 extremely

43. **How frequently do you avoid buying a large amount of tempting foods?**

1 almost never 2 seldom 3 usually 4 almost always

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

1 unlikely 2 slightly likely 3 moderately likely 4 very likely

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

1 never 2 rarely 3 often 4 always

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

1 unlikely 2 slightly likely 3 moderately likely 4 very likely

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

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

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

1 unlikely 2 slightly likely 3 moderately likely 4 very likely

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

1 never 2 rarely 3 sometimes 4 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 not like me 2 a little like me 3 pretty good description of me 4 describes me perfectly

51. On the following 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 limit food intake, never “give in”

Appendix 12.
Palatability Visual Analog Scale

Subject Number:

Experiment:

Date:

Run:

How pleasant is the taste of this food right now?

Not at all _____ Extremely
pleasant pleasant

How pleasant is the texture of this food right now?

Not at all _____ Extremely
pleasant pleasant

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

Nothing _____ A large
at all amount

Appendix 13.
Taste Rating Instructions

Taste Rating Instructions

1. Beginning with the Broccoli, please eat the entire sample and then answer the 3 questions in the booklet labeled Broccoli.
2. Next eat the entire sample of the Carrots and answer the 3 questions in the booklet labeled Carrots.
3. Continue with the samples of Snap Peas and Pasta (in that order) and answer the questions in the labeled booklet for each food.
4. Please ring the buzzer when you are finished with your samples.

Appendix 14.
CAPS Script

Criteria for Counseling Referral and Script for Follow-up Phone Call

Subjects meeting one or more of the following criteria will be telephoned by a senior staff member.

1. Zung Self-Rating Scale – measures depression – A total score ≥ 60
2. Eating Attitudes Test – tests for eating disorders – A total score ≥ 20

Script for follow-up phone call

Date: _____ Call made by: _____

NON-STUDENTS

This is _____ calling from the Food Lab at Penn State. You recently completed some questionnaires in our office. The Biomedical Institutional Review Board recommends that I call you regarding your score on the (*Zung Self-Rating Scale / Eating Attitudes Test*). This questionnaire is used to measure (*depression / eating disorders*). Your score indicates that you may (*be depressed / have an eating disorder*). I want to stress that this questionnaire is used for screening and that I am not giving you a diagnosis. I am, however, recommending that you follow up this phone call by contacting your personal physician or Psychological Clinic at Penn State (314 Moore Building, 865-2191).

Do you have any questions about this information?

If you do seek further care, you can give my name to your doctor or to a counselor at the Psychological Clinic should they require further information.

STUDENTS

This is _____ calling from the Food Lab at Penn State. You recently completed some questionnaires in our office. The Biomedical Institutional Review Board recommends that I call you regarding your score on the (*Zung Self-Rating Scale / Eating Attitudes Test*). This questionnaire is used to measure (*depression / eating disorders*). Your score indicates that you may (*be depressed / have an eating disorder*). I want to stress that this questionnaire is used for screening and that I am not giving you a diagnosis. I am, however, recommending that you follow up this phone call by contacting your personal physician or CAPS (Counseling & Psychological Services) at Penn State (221 Ritenour Building, 863-0395).

Do you have any questions about this information?

If you do seek further care, you can give my name to your doctor or to a counselor at CAPS should they require further information.

Appendix 15.
Consent Form

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 16.
Welcome Sheet

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:

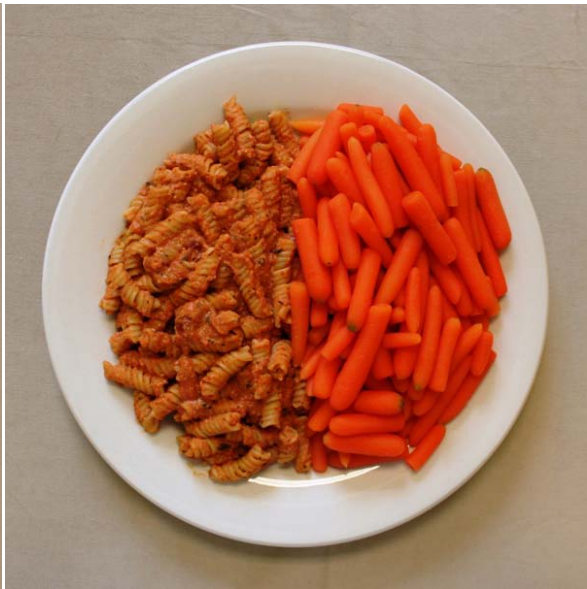
	Date	Breakfast Time	Lunch Time
Appointment 1			
Appointment 2			
Appointment 3			
Appointment 4			

Appendix 17.
Pictures of Lunch Foods

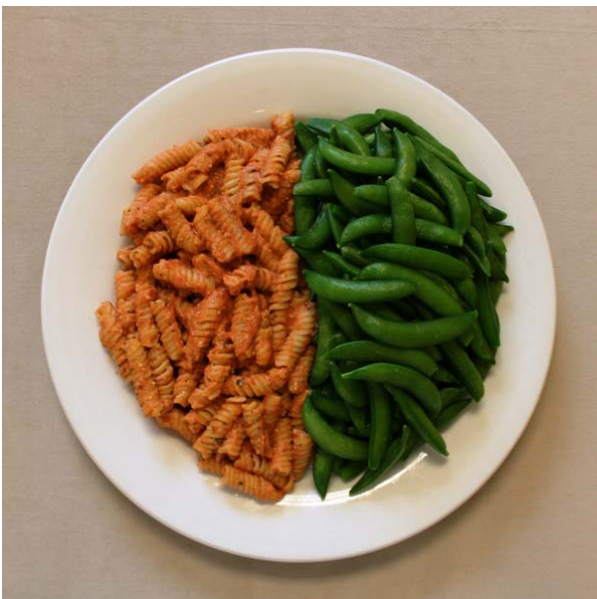
Condition 1



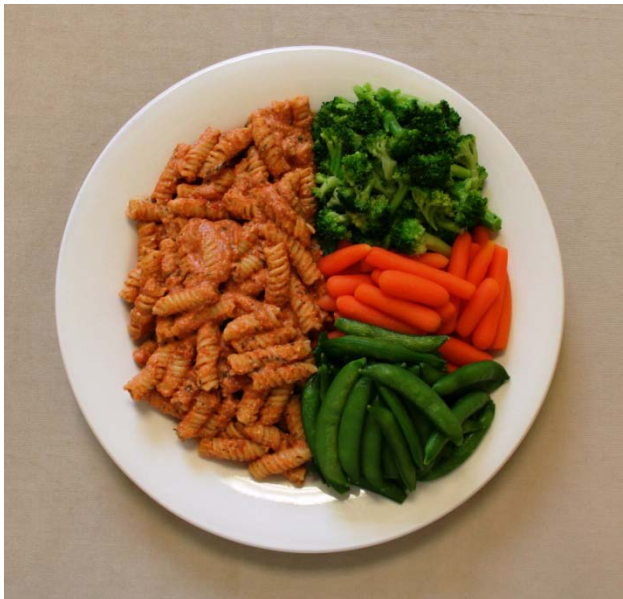
Condition 2



Condition 3



Condition 4



Appendix 18.
Food and Activity Diary

Food and Activity Diary

ID _____

Date _____

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 19.
Breakfast Report

Breakfast Report

Subject ID: _____ Date: _____ Week: _____

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 20.
Hunger Visual Analog Scale

Subject Number:

Experiment:

Date:

Run:

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 21.
Breakfast Intake Sheet

Vegetable Variety

ID#: _____

Date: _____

Session: _____

Check 1 _____ Check 2 _____

Condition: _____

Breakfast	Pre-Weight		Post-Weight	Amount
	w/out plate	w/plate		
Bagels (2)				
Yogurt				
Regular Cream Cheese (2)				
Lite Cream Cheese (2)				
Butter (2)				
Jelly (4)				
Orange Juice				
Coffee/Hot Tea				
Creamer (4)				
Sugar (4)				
Water (1liter)				

Disk 1: _____

Disk 2: _____

Appendix 22.
Lunch Report

Lunch and Dinner Report

Subject ID: _____ Date: _____ Week: _____

1. Have you felt well since breakfast?

_____ Yes _____ No

If No, please explain:

2. Have you taken any medication since breakfast?

_____ Yes _____ No

If Yes, please list:

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

_____ Yes _____ No

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

Appendix 23.
Meal Perception VAS

Meal Characteristics VAS

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 24.
Meal Instructions

Meal Instructions

1. Before you begin eating, please answer the first 2 questions in the booklet and compare the serving sizes of the food items on your plate to what you would usually serve yourself if you were eating at home. Use the Pasta for the Entrée.
2. Then compare the entire size of this meal to what you would consider your normal meal size (3rd question).
3. Finally, please answer the last 2 questions in the booklet.
4. You may then eat as much or as little of the meal as you would like, and we ask that you do not mix the foods together on the plate.
5. Please ring the bell when you are finished with your meal.

Appendix 25.
Appointment Reminder

Subject ID: _____

Your next appointment at the lab is listed below. If you have any further questions, please do not hesitate to call the Food Lab at 863-8482.

Next Appointment:

Dates: _____ **Breakfast:** _____ **Lunch:** _____

Food Diary and Activity Reminders:

- Do not eat or drink anything outside the lab, other than water, between meals on each test session day. Also, do not eat after 10 PM the evening before your test session.
- Record your food intake in the Food and Activity Diary for 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 each week for the day before each session and throughout each test day. 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.

Complete the attached Food and Activity Diary the day before your scheduled appointment and return it at breakfast each week.

Thank You!

Appendix 26.
Meal Intake Sheets

Condition 1

Intake Sheets – Vegetable Variety

ID#: _____

Date: _____

Check 1 _____

Session: _____

Check 2 _____

Condition: 1 - Broccoli

Food Item	Food Only		Post-weight	Weight Consumed
Broccoli (600g)				
Pasta (600 g total)	Weight w/out bowl	Weight w/ bowl	Weight w/ bowl	
Pasta cooked (358g)				
Prego Sauce (159g)				
Classico Alfredo (61.4g)				
Parmesan Cheese (21.7g)				
Cold Water (1 Liter)				

Time: _____

Disk 1: _____ Disk 2 : _____

Condition 2

Intake Sheets – Vegetable Variety

ID#: _____

Date: _____

Check 1 _____

Session: _____

Check 2 _____

Condition: 2 - Carrots

Food Item	Food Only		Post-weight	Weight Consumed
Carrots (600g)				
Pasta (600 g total)	Weight w/out bowl	Weight w/ bowl	Weight w/ bowl	
Pasta cooked (358g)				
Prego Sauce (159g)				
Classico Alfredo (61.4g)				
Parmesan Cheese (21.7g)				
Cold Water (1 Liter)				

Time: _____

Disk 1: _____ Disk 2 : _____

Condition 3

Intake Sheets – Vegetable Variety

ID#: _____

Date: _____

Check 1 _____

Session: _____

Check 2 _____

Condition: 3 - Snap Peas

Food Item	Food Only		Post-weight	Weight Consumed
Snap Peas (600g)				
Pasta (600 g total)	Weight w/out bowl	Weight w/ bowl	Weight w/ bowl	
Pasta cooked (358g)				
Prego Sauce (159g)				
Classico Alfredo (61.4g)				
Parmesan Cheese (21.7g)				
Cold Water (1 Liter)				

Time: _____

Disk 1: _____ Disk 2 : _____

Condition 4

Intake Sheets – Vegetable Variety

ID#: _____

Date: _____

Check 1 _____

Session: _____

Check 2 _____

Condition: 4 - Variety

Food Item	Food Only		Post-weight	Weight Consumed
Broccoli (200g)				
Carrots (200g)				
Snap Peas (200g)				
Pasta (600 g total)	Weight w/out bowl	Weight w/ bowl	Weight w/ bowl	
Pasta cooked (358g)				
Prego Sauce (159g)				
Classico Alfredo (61.4g)				
Parmesan Cheese (21.7g)				
Cold Water (1 Liter)				

Time: _____

Disk 1: _____ Disk 2 : _____

Appendix 27.
Discharge Questionnaire

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

Academic Vita of Samuel P. Scott

Name: Samuel Pew Scott

Address: 524 N Burrowes St. Apt. 5
State College, PA 16803

E-Mail Id: sps5032

Education:

Major: Nutritional Sciences, Basic Science Option
Honors: Dean's List every semester

Thesis Title: How Variations in the Variety of Vegetables Affect Vegetable Intake and Total Energy Intake in a Meal

Thesis Supervisor: Dr. Barbara Rolls

Work Experience:

The Laboratory for the Study of Human Ingestive Behavior
University Park, PA

Undergraduate Research Assistant

Spring 08-present

Supervisor: Jennifer Meengs

- Prepared and weighed food for research subjects
- Served and instructed subjects at breakfast and lunch
- Recorded data using statistical analysis software (SAS)

International Program in Nutrition, Sede di Roma, Rome, Italy

Teaching Assistant

Summer 09

Supervisor: Claudia Probart

- Oversaw transportation of 22 students from United States to Italy
- Organized travel within Italy
- Assisted with student living options in Rome
- Collected and organized course materials
- Facilitated communication between students and professors

Chadds Ford Tree Service, Chadds Ford, PA

Fall 04 – Spring 06

Ground Crew Member

Supervisor: Rob King

- Worked on a team to remove damaged trees and complete landscaping projects
- Operated heavy machinery
- Cut, stacked, and delivered firewood

Awards:

The Mary Burket Morrow Scholarship, College of Health and Human Development
Schreyer Travel Ambassador Grant for study in Italy, Honduras, and New Zealand

Professional Memberships:

Alpha Epsilon Delta Honors Society
Penn State Global Medical Brigades
Penn State Pre-Dental Society
Blue and White Society
Penn State Alumni Association

Academic Vita of Samuel P. Scott, page 2

Community Service Involvement:*Global Medical Brigades, Honduras*

Spring 09

Pharmacist and Medical Supplies Organizer

Supervisor: James Evert

- Raised \$90,000 for medical supplies
- Traveled with students and doctors to rural areas of Honduras
- Gave free medical care to over 1800 Hondurans

American Red Cross, State College, PA

Blood Drive Volunteer

Fall 08- Spring 09

- Set up blood drive room and equipment
- Organized blood donor lists
- Assisted donors after giving blood

International Student Volunteers, Rio Muchacho Organic Farm, Ecuador

Environmental Worker

Summer 07

Supervisor: Nicola Mears

- Learned about sustainable agriculture/permaculture
- Completed daily tasks on the farm
- Promoted food security and environmental awareness
- Built a school garden, playground, and mural

International Education:*The University of Otago, Dunedin, New Zealand*

Fall 09

- Studied plant biology
- Studied human metabolism of vitamins and minerals
- Member and resident of Toroa International House

International Program in Nutrition, Rome, Italy

Summer 08

- Studied international nutrition policy, planning, and awareness
- Focused on the Mediterranean diet and Italian culture
- Attended events at the International Wine Academy

Language Proficiency:

Spanish (4 years)

Italian (1 year)