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THE EFFECT OF PORTION SIZE AND ENERGY DENSITY ON ENERGY INTAKE
IN PRESCHOOL CHILDREN

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ABSTRACT

Background: Studies on the effects of portion size (PS) and energy density (ED) on energy intake (EI) in children are not as common as studies in adults, and the few studies that have been done on children have had inconsistent results. This study will further explore the effects of PS and ED on energy intake in preschool children. Children's dietary intake should be better understood so that strategies can be developed to help reduce children's energy intake in order to reduce childhood overweight and obesity.

Objective: To test the interaction between portion size and energy density on pre-school children's energy intake

Subjects: Subjects were 2- to 6-year-old children (n=51) in university daycare facilities.

Intervention: In this crossover study, preschool children were served a test lunch once a week for 6 weeks. The lunches were either high-ED or low-ED (100% or 142%) and included three different portion sizes (100%, 150%, or 200%). The test foods included macaroni and cheese, chicken, a vegetable, applesauce, and ketchup and were eaten ad libitum.

Main outcome measures: Food intake (grams) and energy intake (kcal) were measured.

Statistical analysis: A mixed-linear model tested the effect of portion size and energy density on food intake and energy intake. Results are reported as mean \pm standard error.

Results: Meal food intake by weight was significantly influenced by portion size but not by energy density. Doubling the portion size increased food intake by 33% (68.5 g) and energy intake by 27% (60 kcal). The high-ED meal increased energy intake by 42% (94 kcal). Portion size and energy density together increased total intake by 174 ± 21 kcal or 89%. Food intake and energy intake were not affected by children's age or sex.

Conclusions: Portion size and energy density are independent and additive in increasing energy intake in preschool children. Reducing portion size and energy density may be an effective strategy to promote healthy weight and weight management in children.

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Introduction

Literature Review

Childhood obesity affects over one third of children and adolescents in the United States and is now also seen in countries where obesity was formerly rare (1, 2). Overweight is defined as a body mass index (BMI) between the 85th percentile and the 95th percentile for children of similar age and sex and obesity is defined as a BMI over the 95th percentile for children of similar age and sex; these parameters are based on the Center for Disease Control's (CDC) growth charts for children 2 years of age and older (3). About 24 million children in the United States are overweight or obese with about 13 million of them being obese (4). In 2009, the number of children between the ages of 5 and 17 who were overweight or obese was 5 times higher than the number in 1974, with low SES, low education, and high unemployment households having an inordinately higher occurrence of obesity and overweight (4).

The trajectory of these pediatric weight problems is attributable in part to the "nutrition transition" of the last half a century or so. A nutrition transition is the alteration in the nation's dietary patterns toward foods that are high in fats and low in water content (high-energy dense foods) and away from fruits, vegetables, and whole grains (5). The nutrition transition also includes the transformation of portion size (PS). Empirical evidence has shown that from 1977, portion sizes have been increasing both inside and outside the home, correlating with the increased prevalence of overweight and obesity (6). Portion sizes have increased so dramatically in the past few decades that many people no longer know what constitutes an appropriate serving of food; this was coined "portion distortion (7)." This environmental shift in portion size is thought to have an effect on the positive energy balance contributing to the nation's pediatric weight problems.

Because perception of appropriate portion size appears to have been lost, some studies in adults and children have aimed to study the ability of children to accurately estimate portion sizes and their preference for portions of different foods. A study done by Foster et al.(8) used two sets of photos depicting portion sizes appropriate for adults and children respectively. These photos were shown to children in order to assess the children's ability to accurately estimate how much food was shown in the pictures. They found that the children were better able to estimate portion size based on the age-appropriate photos as opposed to the adult photos. This indicates that children have a greater awareness of the amount of food before them if the portion size is appropriate for their age.

Another study done by Colapinto et. al (9) assessed children's portion size preference for French fries, meats, vegetables, and potato chips. The researchers also collected heights, weights, and used a child food frequency questionnaire to assess dietary intake. The children preferred larger portion sizes of meat, French fries, and potato chips while preferring smaller portions of vegetables; this trend was especially evident in low socioeconomic status (SES) children. The researchers suggested that marketing targeted at children and restaurant food environments could be contributing to this preference for larger portions of high-energy density (ED) foods.

There are many reasons why portion size has increased so dramatically in our country. As food became more abundant, people could buy and eat more than they used to; as people bought and ate more than they used to, the increased amount of food bought and eaten became more acceptable. The size of some packaged foods in super markets is easily two or more times the size of what they were when first introduced as a product (7). Compared to when fast food chains were first starting out, fast food portion sizes are about 2 to 5 times larger than they were while restaurant portion sizes have increased to 250% of what they once were (7, 10). Dishware is larger than before, distorting appropriate portions of food and making them look smaller (11). Even some of the entrees in classic cookbooks like *The Joy of Cooking* have seen a substantial

increase from first publication (7). The ample supply of food and the societal norm (even demand) that has made large portion sizes acceptable is affecting the health of the nation by promoting increased food intake and positive energy balance. This effect of portion size on increased food intake has been shown many times over in research on both adults and children.

In one of the first studies done on portion size and children's food intake, Fisher et al. (12) conducted a study that assessed not only if food intake was greater with larger portion sizes, but whether bite size was also greater; associations with self-served portions and the children's weight were also assessed. On two different days, the children were served either an age-appropriate portion entree or a larger portion entree; at a different time, the children were weighed and given the opportunity to serve themselves the same entree. It was found that the children increased their food intake by 25% when the entree was doubled in size, but consumed 25% fewer calories when they could serve themselves. It was also found that increased intake is the result of larger bite sizes and a lack of compensatory reduction of the intake of other foods included in the meal.

Another study by Fisher et al. explored the effects of increased portion size versus self-selected portions on children's food intake (13); a secondary objective was to determine whether there is a clear point at which children no longer rely on satiety cues to drive eating but are instead influenced more by the environment. The children (aged 2 to 9) were given a dinner of reference, doubled, and self-selected portion sizes on separate occasions. As was found in previous studies, the children ate 29% more food when served the doubled portion, but they decreased food intake when allowed to serve themselves. Larger bite size was once again associated with increased food intake. These findings also suggested that if age-related shifts in intake response exist, they are likely to be less noticeable than once proposed.

The idea that age affects intake was the result of the first study done on portion size effect in children aged 3 and 5 by Rolls et al. (14). The children were given three meals with the entree

portion size being one of three different conditions (small, medium, large). It was found that the 5-year old children ate more of the entree proportional with increased portion size, while portion size did not affect food intake in the 3-year olds. This research suggests that there is a point in a child's development when his or her food intake is determined by more than just hunger, such as the environment, culture, or eating expectations; however, this age related difference has not been replicated, as can be seen in the study discussed above by Fisher et al (13).

The effect of increased food intake with increased portion size is also evident when the entire meal is manipulated for portion size as opposed to just the entree. A study done by Mrdjenovic and Levitsky (15) used a 5- to 7- day consecutive 24-hr recall in addition to manipulated test meals (lunch and two snacks) to determine long term effects of increased portion size on children's food intake. Like the results found by Rolls et al., the children ate more food with an increased portion size and the 24-hour diet recall revealed there was no compensation later for the extra food eaten.

Children appear to eat based on the amount that is served to them. Because children are frequently not in control of the amount of food they are given to eat, the cultural norm of increased portion size affecting caregivers of children could also be contributing to the positive energy balance in children. The results of these studies suggest that serving increased portion sizes of food to children could assert an obesogenic influence on their energy balance, setting them up for chronic health problems early in life.

While portion size seems to be a strong determinant of pediatric overweight and obesity, another aspect of the nutrition transition is also contributing to positive energy balance in adults and children both: energy density. Energy density (ED) is the amount of energy (calories) per gram weight of food; lower energy dense foods provide fewer calories per gram of food while high-energy dense foods, like those with high fat content and low water content, provide more calories per gram. A study using NHANES data that sought to explore a relationship between

child weight status and dietary ED found that obese children had higher ED diets (16). Another study using NHANES III data showed that high-ED diets in the United States corresponded with high energy, fat, and low-nutrient-dense food intake, while there was a negative correspondence with micronutrient, fruit, and vegetable intake (17). These nutrient trends within energy density groupings are a cause for concern considering the pervasiveness of high ED foods in the western diet. There is consistent evidence that increasing the ED of food will increase the number of calories consumed while decreasing the ED of food will decrease the number of calories consumed.

Bell et al. (18) conducted a study on how energy density affects food intake independent of the entree's fat content or palatability. This study was done on women who were given an ED-manipulated lunch and dinner entree and an evening snack in addition to a fixed breakfast for 2 days. This was repeated for 3 weeks with the entree ED different each week. Though the entrees differed in energy content, the palatability was not sacrificed or altered. The study showed that the subjects ate a similar amount of food for each of the three meals; therefore, ED did not have an effect on the amount of food consumed. However, because the ED was increased across conditions, the highest ED condition resulted in greater energy intake.

Another study conducted around the same time looked at the effects of subtle ED differences on energy intake (EI) over the course of 14 days. Subjects ate in a metabolic suite during the course of the study and were given ad libitum access to food from 1 of 3 conditions: low-ED (LED), medium-ED (MED), and high-ED (HED). The condition was consistent throughout the 14-day period. The subjects eating the HED diet gained on average 0.95 kg over the course of the study while the subjects on the LED diet lost 1.20 kg even though weight of food consumed was not significantly different between the LED, MED, and HED diets (19).

There has been a shift from studies done on increasing ED to the effects of reducing the ED of an entree or meal. In one study by Leahy et al., preschool children were served a test lunch

with an ED-manipulated entree once a week for 6 weeks; one entree was HED and the other was a 30% reduced LED entree. Consumption of the LED entree resulted in a significant entree energy reduction of 25% and a lunch energy reduction of 18% (20). Another study by Leahy et al. tested the effects of energy density on multiple meals over the course of 2 days for 2 weeks. The children were served a HED breakfast, lunch, and afternoon snack over the course of two days during 1 week and the LED breakfast, lunch, and snack during a different week. During both weeks, the children ate a similar amount of food regardless of ED. During the LED week, their energy intake was reduced by 14% (21). The results of these studies show that ED does not determine the amount of food that children consume at a meal, but that ED does influence children's energy intake; increasing ED leads to increased EI, while decreasing the ED leads to decreased EI.

Because both portion size and energy density have an influence on energy intake in children, research shifted from looking at these two effects separately to exploring their potential relationship. An early study on these combined effects on energy intake by Kral et al. (22) used an ED-manipulated entree (HED or LED) of 3 different portion sizes served to women once a week for 6 weeks. The women were served breakfast, lunch and dinner. When given the HED highest portion size entree, the subjects ate 56% more energy as compared with the LED smallest portion size entree. The results of this study suggest an independent and additive effect of portion size and energy density on increasing energy intake.

This independent and additive relationship of portion size and energy density was found in the reverse as well; reducing portion size and energy density were found to work together to decrease energy intake in a subject pool of young women. The subjects were given meals ad libitum in which all foods were manipulated for PS and ED for 2 consecutive days a week for 4 weeks. Portion size and energy density were varied between a reference (100%) and a reduced

level (75%). The study revealed that there were significant reductions in energy intake over the course of the 2 days with the reduced PS and ED condition (24).

While the effects of manipulating PS and ED together have been well researched and well established in adults, though results of studies done with children are not as clear. Understanding how PS and ED influence food intake and energy intake in children is important for recognizing the mechanisms behind pediatric weight problems and identifying how to change those problems and promote health.

The first study to look at the effects of portion size and energy density in preschool children was done by Fisher et al. in 2007 (23). The children were served a meal with a macaroni and cheese entree varying in ED (1.3 kcal/g and 1.8 kcal/g) and PS (250g or 500g). Manipulation of the entree energy density was achieved by adding butter to the HED entree and water to the otherwise unmodified LED entree. The other test foods contributed 408 calories and were fixed. There was a portion size effect, with children consuming 33% more grams of food in the larger portion size condition than the smaller one, while ED had no effect on gram intake. Gram intake of the fixed foods did not vary with the portion size of the entree. When served either the larger PS or the HED entree, the children ate 33% more energy; the HED entree contributed to an 18% greater total meal EI and the largest portion size contributed to a 15% greater total meal EI. The effect of PS and ED were independent and additive in increasing the EI of the entree by 76% and the EI of the total meal by 34%. These results are consistent with the results of similar studies done in adults and support the viewpoint that large portions of high ED foods are contributing to weight problems in both adults and children. However, these results are not consistent in other studies on PS and ED effects in children intake.

A year later, Leahy et al. (25) also conducted a study on the effects of PS and ED on preschool children's food intake. This study also manipulated a pasta entree for ED and PS but used a different method to decrease ED than Fisher et al. The HED (1.6 kcal/g) entree had a

tomato sauce with cheese in it and the LED (1.2 kcal/g) sauce had pureed broccoli and cauliflower as well as decreased amounts of low-fat cheese in it to increase the vegetable and water content. The entree was served in two portion sizes, the larger one being 400g and the smaller 300g. The other test foods were fixed. The results of the study showed that neither ED nor PS had a significant effect on the grams of food consumed. Portion size also did not significantly affect energy intake, though ED did; in the LED condition energy intake of the entree was reduced by 25% and energy intake of the meal was reduced by 17%.

The fact that PS did not affect the amount of food eaten is contrary to the expectation that food intake increased in both children and adults with the amount of food served to them. There was also a slight difference between how much food was eaten by girls versus boys. The girls ate about 385.5 ± 11.7 grams while the boys ate about 439.5 ± 11 grams. Three reasons were given by the authors as to why the portion size anomaly was found in this study. First, the reduction in portion size was only 25% in this study while in other studies on PS in children, the reduction was 50%; they hypothesized that the degree of change between portion sizes makes a difference on intake. Second, the smaller portion size in the study was still a larger than age-appropriate portion size for children. Third, the test entree was different from the macaroni and cheese typically used in PS studies on children; it was suggested that children might respond to different portion sizes of only certain foods, and therefore there was a call to study a wide range of different portion sizes in different test foods.

Another study on the effects of PS and ED on EI in preschool children was conducted a few years ago by Looney and Raynor (26). In this study, two different types of snacks served at the daycare center were used as a HED and LED food while each was manipulated for PS (150g and 300g respectively). The LED food (0.43 kcal/g) was applesauce and the HED food (1.19 kcal/g) was chocolate pudding. Consistent with past research, the results showed that there was a significant portion size effect, with more food and energy consumed with the largest portion size.

However, it was also found that energy density had no effect on energy intake and therefore there was no combined effect of PS and ED. The researchers believed that the disparity in the ED results was due to the fact that both of the foods had a relatively low energy density; therefore, there might be a margin of energy density that needs to be met for ED to influence EI.

Current Study

There variability in studies done on the effects of PS and ED on energy intake in children. This inconsistency has led to a need for future research on these two aspects of energy intake in order to better understand the mechanisms behind children's intake patterns. Understanding the relationship between portion size and energy density may be key in promoting healthy weight and healthy eating behavior in children as a means of reversing the climbing trend of childhood overweight and obesity. The goal of this study was to test whether energy density and portion size interact to affect energy intake in children using an entire meal manipulated for energy density (HED and LED) and portion size (100%, 150%, and 200%). Because children and adults tend to eat based on how much food is given to them, it was hypothesized that the children would consume more food in the largest portion size condition as compared with the smallest portion size condition. It was also hypothesized that the children would consume more calories when given the high-ED highest portion size condition and that the effects of PS and ED would be independent and additive in promoting high energy intake. Because the results of a past study (25) has suggested that responses to varying portion sizes might be particular for certain foods, this study incorporated manipulation of all meal components by portion size and energy density.

Role in the Study

My role in this study included preparation of the meal components, weighing the meal components, helping in transportation of the test materials to the daycare, overseeing the set-up of the classrooms (doing quality control), observing and taking notes on the children as they ate, proper collection of the meal components, cleaning up when the children were done, and data entry.

Subjects and Method

Experimental Design

This crossover study was designed to examine the relationship between ED and portion size in children ages 3 to 6 years. One day a week for 6 weeks, children were served lunch at their usual lunch time in their own classrooms. Using a within-subject, factorial design, the lunches were either high ED or low ED (100% or 142%) and served in three different portion sizes (100%, 150%, or 200%). Every lunch included macaroni and cheese, chicken, a green vegetable, applesauce, ketchup, milk, and water. All the meal components except for water were manipulated for portion size and energy density (Appendix A and B), and the children ate *ad libitum*. Within two weeks of the last meal served, the children's liking of the food used in the study was assessed, and their heights and weights were measured.

Participants

The children were recruited from the Child Care Center at Hort Woods and the Bennett Family Center on the University Park campus of The Pennsylvania State University. Letters were sent home to the parents of 3-to-6-year-olds in preschool and kindergarten classrooms (see Appendix N). Parents gave written consent to have their children participate in the study and agreed to complete study questionnaires on their demographics and their child's eating habits. Fifty-one subjects aged 3 to 6 years from both childcare centers were enrolled in the study. Three subjects were dropped from the study because they were not present for ≥ 4 of the experimental meals.

Experimental Menu

This study included 6 meal conditions varying in ED (100% or 142%) and portion size (100%, 150%, or 200%). The meals were comprised of macaroni and cheese, chicken, a green vegetable, applesauce, ketchup, water, and milk, with all components manipulated for energy density and portion size except the water (Appendix A and B). The conditions were counterbalanced across classrooms. (Appendix C). The brands and energy density of the high-ED and low-ED foods are listed in Table 1.

Table 1. High-ED and Low-ED Foods and Brands

High-ED			Low-ED		
<u>Brand Name</u>	<u>Serving weight (g)</u>	<u>ED (kcal/g)</u>	<u>Brand Name</u>	<u>Serving weight (g)</u>	<u>ED (kcal/g)</u>
Bell & Evans Breaded Chicken Breast Nuggets	113 g	1.68	Tyson's Grilled Ready Chicken Breast Strips	84 g	1.19
Stouffers Traditional Macaroni and Cheese (with Land O' Lakes Salted Whipped Butter and Molly McButter Natural Butter Flavor Sprinkles)	830 g	2.10	Stouffers Traditional Macaroni and Cheese	250 g	1.40
Wegmans' Just Picked Frozen Peas (with Land O' Lakes Salted Whipped Butter)	204 g	0.81	Hanover Premium Petite Broccoli Florets	85 g	0.29
Land O' Lakes Salted Whipped Butter	7 g	7.14	Land O' Lakes Salted Whipped Butter	7 g	7.14
Molly McButter Natural Butter Flavor Sprinkles	2 g	2.50	Molly McButter Natural Butter Flavor Sprinkles	2 g	2.50
Knouse applesauce	126 g	0.74	Knouse applesauce (70% unsweetened, 30% sweetened)	123.2	0.57
Heinz Ketchup	17 g	1.18	Heinz Ketchup (60% regular, 40% reduced sugar)	17 g	0.82
Whole milk	100 g	0.61	Lowfat milk	100g	0.42

The three lower ED meals and the three higher ED meals were varied by portion size. The 100% portion size conditions included 100 grams of chicken, macaroni and cheese, and applesauce; 75 grams of the green vegetable; 20 grams of ketchup; and 183 grams of milk. The 150% portion size conditions included 150 grams of chicken, macaroni and cheese, and applesauce; 112.5 grams of the vegetable; 30 grams of ketchup; and 274.5 grams of milk. The 200% portion size conditions included 200 grams of chicken, macaroni and cheese, and applesauce; 150 grams of the green vegetable; 40 grams of ketchup; and 366 grams of milk. 237 mL of water were also given at each meal. Portion sizes in grams of food are shown in Appendix V.

Lunch Procedure

Once a week for 6 weeks the children had lunch in their classroom at their regular lunch time. All the foods were pre-portioned. The orientation of the place setting for each subject was consistent across all conditions (Appendix J). Throughout the study, the children were reminded that only one portion of food was available to eat and not to share food with their classmates. Classroom teachers sat with the children. A research assistant unobtrusively recorded the subjects' comments related to the food, any food dropped or lost, and indications of a child not feeling well. The teachers were asked to help avoid and re-direct food-related conversation at their table in an attempt to control external influences on food intake. Once a subject was finished eating, a research assistant replaced any dropped food to the subject's plate or bowl and weighed the left-over food to determine the amount consumed. Weight was recorded to the nearest 0.1 gram using digital scales (Mettler-Toledo PR5001 and XS4001S; Mettler-Toledo, Columbus, OH).

Weight, Height, and Preference Assessments

A week after the last condition, the participating children had their heights and weights measured; a hedonic assessment of the children's taste preferences was also done on the foods served to them for lunch. Preference was assessed using The Tasting Game and a modernized "Super Yummy-Super Yucky" 5-point Likert scale (Appendix M) adapted from the original scale by Birch (27, 28, 29). The game was played using a pre-devised script (Appendix L) in which the researcher guided children through an interactive explanation of the super yummy face, yummy face, just okay face, yucky face, and super yucky face and then asked the children to point to a face after tasting samples of the study foods. Heights and weights were each measured twice and CDC growth charts were used in calculating BMI percentile.

Parental Questionnaire

A letter explaining the study was sent home with the children addressed to their parents (Appendix N). Parent who gave informed consent (Appendix O) their children's participation in the study were asked to fill out three questionnaires: the Child Feeding Questionnaire, the Child Eating Behaviour Questionnaire and a Demographics and Background Information (DBI) Questionnaire. The Child Feeding Questionnaire addresses parental responsibility in feeding the child at home, parents' weight throughout their lifetime, child's weight throughout their lifetime, parental concern over child's weight, and parental tracking of food groups and portion size (Appendix R). The Child Eating Behaviour Questionnaire assess the child's normal feeding practices with questions to address interest, emotional eating, length of time taken to eat, environmental influences, and amount typically eaten, among others (Appendix X). The

Demographics and Background Information form asked parents for information on income, family structure, level of education, employment, ethnicity, and race (See Appendix Q).

Statistical Analysis

Data were analyzed by using a mixed linear model (PROC MIXED) in the SAS system for WINDOWS (version 9.4; SAS Institute, Cary, NC). The main outcomes were weight of food consumed (g) and calories consumed from food (kcal). The model included two fixed-factor effects: energy density (100% and 142%) and portion size (100%, 150%, and 200%). The interaction between energy density and portion size was tested before analyzing the main effects of these factors. If no interaction was found, only the main effects were included in the linear mixed model. The subjects were treated as a random effect. Results were considered significant at $p < 0.05$. For significant effects, Tukey's test was used for post-hoc comparison of the means. Results are reported as mean \pm standard error.

Results

Subject Characteristics

Fifty-one subjects aged 3 to 6 years from both childcare centers were enrolled in the study. Three subjects were dropped from the study because they did not participate in ≥ 4 study meals. The final group of children 48 was comprised of 25 boys and 23 girls and had a mean (\pm standard error) age of 4.2 ± 0.1 years (range 3.1 to 5.4 years) and a mean sex-specific BMI-for-age percentile of 53.44 ± 4.27 ($n=46$; range, 1.17 to 98.16) (20). Parents provided demographic information for all 48 children; of these, 32 (67%) were white, 1 (2%) were African American, 9 (19%) were Asian, and 6 (12%) were more than one race or other (see Appendix W). Approximately 70 % of parents who provided income information ($n=34$) had an income above \$50,000 (see Appendix X).

Meal Food Intake

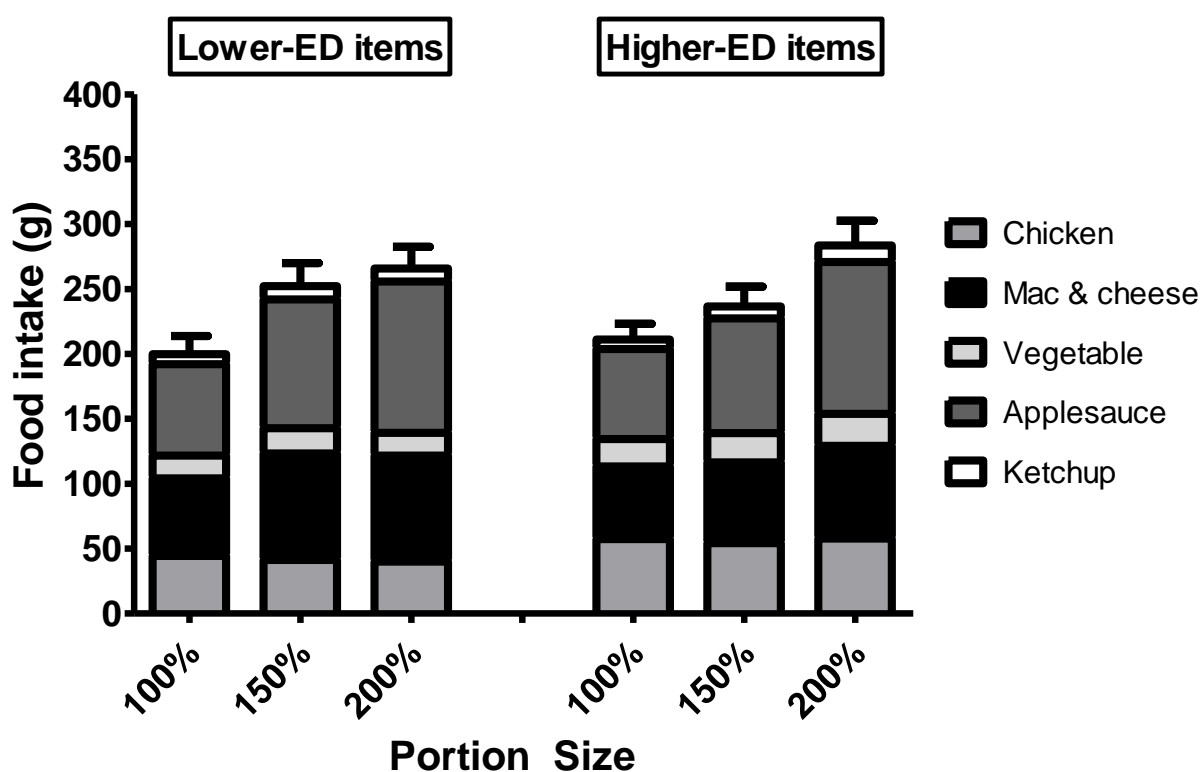
Meal food intake by weight was significantly influenced by portion size but not by energy density (Figure 1). Doubling the portion size of the food significantly increased intake from a mean of 205.5 ± 8.7 g at the 100% portion size conditions to 274 ± 12.3 grams at the 200% portion size conditions ($p < 0.0001$); this is a 68.5 gram or 33% increase in the mean weight of food consumed between the 100% and 200% portion size conditions. The mean weight of food consumed at the 150% portion size conditions was 243.6 ± 11.4 , and all three conditions were significantly different from each other (see Table 2). Weight of food consumed at the meal was not influenced by age or sex. Thus, the children consumed a greater amount of food when more food was served to them regardless of the energy density of the meal.

Table 2. Effects of ED and PS on grams consumed of food (excluding milk and water)

Outcome Variable	Predictor Variables (p values)		Means and Std Error of PS Conditions (g±SE)			Means and Std Error of ED Conditions (g±SE)	
	PS	ED	100%	150%	200%	LED	HED
Food Grams	<0.0001	0.6417	205.5±8.7 ^a	243.6±11.4 ^b	274.0±12.3 ^c	239.0±9.4	242.8±9.0

^{a-c} Means with a different letters are significantly different

Figure 1. Mean grams consumed across portion size and energy density conditions



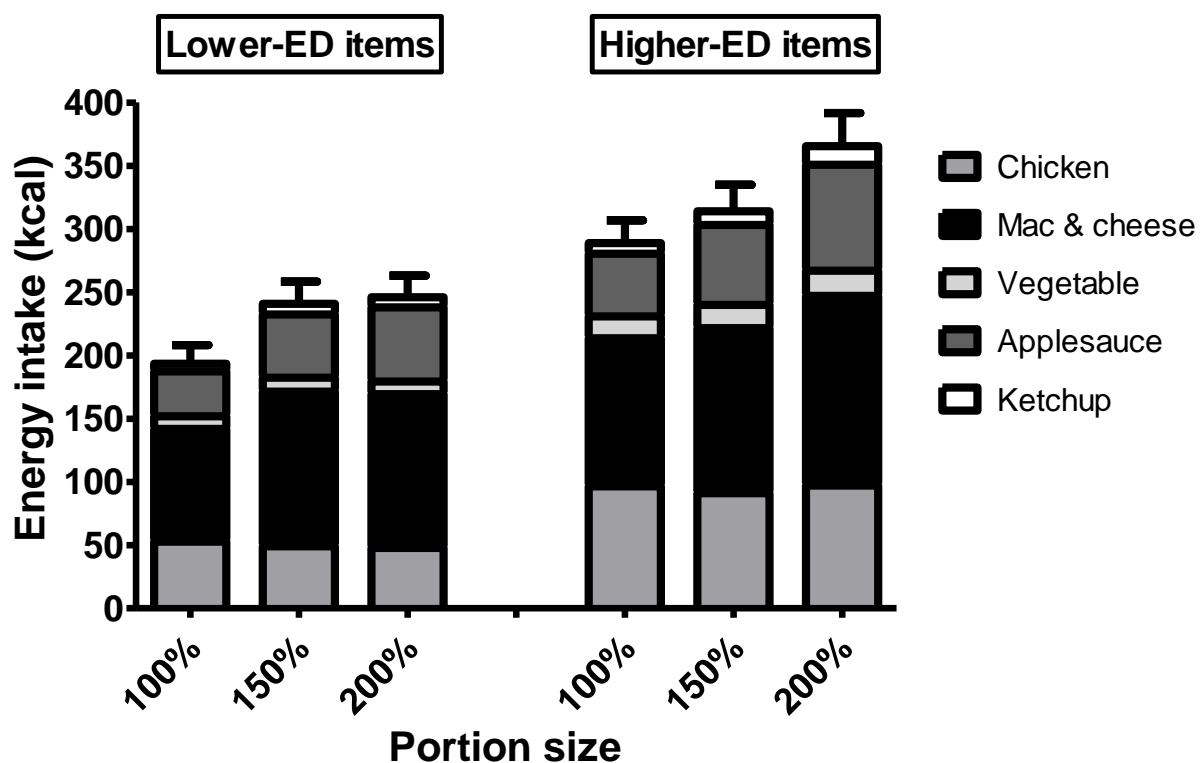
Meal Energy Intake

Portion size and energy density had significant and independent effects on meal energy intake. Doubling the portion size of food significantly increased energy intake from a mean of 242.1 ± 12.1 kcal at the 100% portion size conditions to 302.2 ± 16.3 kcal at the 200% portion size ($p < 0.0001$); this is a 60 kcal or 27% increase in calorie consumption between these conditions. The mean energy consumed in the 150% conditions was 278.2 ± 14.3 , and all three conditions were significantly different from each other (Table 3). Mean energy intake in the low-ED meals was 225.5 ± 9.5 kcal and 319.2 ± 12.5 kcal in the high-ED meals. Energy consumed in the high-ED meals was 94 kcal greater than those of the low-ED meals ($p < 0.0001$), which is a 42% increase in total calories consumed. Portion size and energy density effects combined to increase total intake by 174 ± 21 kcal or 89%.

Table 3. Effects of ED on energy consumed from foods (excluding milk and water)

Outcome Variable	Significance of effects (p values)		Portion size effect (mean \pm SEM)			Energy density effect (mean \pm SEM)	
	PS	ED	100%	150%	200%	LED	HED
Food energy (kcal)	<0.0001	<0.0001	242.1 ± 12.1^a	278.2 ± 14.3^b	302.2 ± 16.3^c	225.2 ± 9.5^a	319.2 ± 12.5^b

Figure 2. Mean calories consumed across portion size and energy density conditions



Preference Assessment

The preference assessment indicated that most of the children rated all the foods as acceptable (just okay or higher); this includes the HED and LED chicken, HED and LED macaroni and cheese, HED and LED applesauce, HED and LED ketchup, and HED vegetable. The majority of children rated the LED vegetable as acceptable, but some (n=9) rated it as super yucky. See Appendix X for taste preference details.

Discussion

The main finding of this study is that portion size and energy density act independently and are additive in influencing the number of calories consumed at a meal. This is consistent with results by Fisher et al. (23) that portion size is a significant predictor of food intake, but both PS and ED combine to increase energy intake. The present data show that children will consume a greater amount if more food is given to them regardless of energy density, as shown in Figure 1. When served the largest portion, children ate 33% more food compared to when served the smallest portion. Increasing the energy density of the largest portion size did not result in greater food intake but did result in more calories consumed. The combined effect of increasing the energy density and portion size of the available foods was an increase in caloric consumption of 174 ± 21 kcal or 89%.

The results of the present study suggest that portion size and energy density are independent and additive in increasing children's energy intake at a meal. The results of the study by Leahy et al. revealed that portion size did not have an effect on increased food intake. As suggested by the authors, this might have been the result of having two close portion sizes (400 g and 300g) of the pasta dish that were larger than age-appropriate used in the study. In the present study, the portion sizes of the pasta dish (macaroni and cheese) ranged from 100g to 200g across three portion size conditions. Thus, the smaller portions might have allowed a portion size effect to be seen. Leahy et al. also conjectured that there might be specific foods that do not have a portion size effect in children. Food-specific effects were tested in the present study by manipulating all test foods by portion size. The results of the present study did show increased food intake with increased portion size in all test foods except the chicken. This suggests that the difference between portion sizes might be the primary determinant on whether there is a portion size effect on children's food intake as opposed to the type of food being consumed.

As was found by Looney & Raynor, the results of this study showed a significant portion size effect that affected the amount of food consumed. However, the results of the present study differed from Looney & Raynor's in that an effect of ED on the energy intake of the meal and of ED and PS on energy intake of a meal was present. This could be due to the fact that many of the test foods used in the present study did not have a relatively low energy density to begin with as the snack foods in the study by Looney and Raynor did. This suggests that there might be a threshold of energy density that is necessary to see the effect of energy density on energy intake. Looney and Raynor's study also used a single food to represent energy density, with applesauce being LED and chocolate pudding being HED. Only serving a single food could have affected their results. In the present study, a variety of foods were served and an effect of energy density was found.

The findings of the present study could shed light on why both children and adults have problems with maintaining healthy weights in a western culture like the United States. The availability of large portion sizes in restaurants and in the home may be a determinant in the prevalence of childhood overweight and obesity, especially when large portion sizes are combined with high-energy density foods commonly eaten by children (30). The types of foods that children like to eat that are so abundantly available for consumption inside and outside the home are high in energy density, which is also contributing their weight gain. Data has shown that children who consume a large amount of high-ED foods increase their intake of fat and empty calories while decreasing their intake of micronutrients, fruits, and vegetables. This can have implications for a child's future of growth, weight gain, and chronic disease status (31, 32,2). While energy density does not affect the amount of food consumed in one sitting, it does affect the amount of energy consumed. Therefore, when the effects of portion size and energy density are added together the result is a significant increase in energy intake.

In addition to energy density, there are also many factors that influence a culture of larger portion sizes, such as plate size, restaurant and fast food value deals, as well as ignorance of what an appropriate portion size should be. Research has shown that children prefer larger portions of high-ED foods perhaps as a result of the abundant supply of food in children's eating environment as well as marketing of large portions of high-ED foods to children. These environmental influences also affect the children's caregivers who are providing the portions of food served to them. Because children's food intake is based on what is given to them, meals served both inside and outside the home are contributing to positive energy balance. Research has also suggested that children are able to serve themselves appropriate portion sizes of foods; therefore, one possible solution to decreasing prevalence of childhood obesity might be to give children more autonomy in choosing the amount of food they want to eat.

Giving special attention to the food being served to children will probably be a significant factor in reducing the amount of energy they consume at a meal. A couple of studies have explored ways in which to reduce the energy density or portion size of children's meals while also increasing vegetable intake. Pureed vegetables used in the preparation of a meal reduced the energy density and therefore the energy intake of meal and can be used as an effective strategy to promote healthy weight and vegetable intake (33). Other studies have looked at the effects of a vegetable pre-load in reducing the portion size effect in higher ED entrees with promising results (34, 35). It has also been shown that eating a satisfying amount of LED, high-water content food like fruits and vegetables decrease energy density and energy intake while promoting satiety (36, 37).

The results of the present study show that portion size and energy density have an additive effect on energy intake in preschool children. The nutrition transition of the past few decades has made highly palatable high-ED foods widely available in large portion sizes, which could be contributing to the increased energy intake, increased weight gain, and increased

prevalence of chronic disease in children. A healthier future shift in the qualitative and quantitative aspects of the nation's nutrition transition could contribute to a decrease not only in the chronic ramifications of positive energy balance in children but also in the prevalence of pediatric overweight and obesity.

Study Limitations

This study has a few limitations. The majority of the subject population was white (67%) and over half were living in a household with an income of over \$100,000 (52.9%). Previous data has suggested that income and/or ethnicity can affect the types and amounts of food eaten (9, 38). Future research should include populations more diverse in terms of ethnicity and household income. Many aspects of the children and their environment could not be controlled in this study. For instance, it was impossible to know the children's pattern of dietary intake in the day leading up to the test meal. The data could have also been affected by variations in the children's activity levels, the presence of sickness, parental influences on eating practices in the children's home, the classroom environment and special events in the daycare, and the effect of conditioning (39). Unless the subjects and the environment can be strictly controlled and monitored, the multi-faceted aspects of children's eating behaviors will be difficult to study and understand comprehensively. As has been done in adult intake studies, future PS and ED studies with children should collect data on intake across multiple consecutive days in an environment that can be more controlled; in doing this, the long-term effects of PS and ED interaction can be studied in a less variable environment.

Conclusion

Portion size and energy density are important factors in determining energy intake in children. The results of the present study suggest that decreasing portion size or the energy density of food will contribute to decreased energy consumption in children, while decreasing both portion size and energy density together will contribute to a greater decrease in energy intake and could help to improve energy balance in children. As the prevalence of childhood overweight and obesity has risen, so too has the importance of understanding the mechanisms contributing to weight gain. The independent and additive effects of PS and ED on dietary intake has implications for promoting healthy weights and weight management practices in children; this research can be used to help achieve goals for childhood health initiatives like the Healthy People 2010 Objectives for the Prevention and Control of Childhood Obesity.

Appendix A

Low ED Portion Size Amounts Across All Portion Size Conditions

Lower-ED meal							
Lower-ED food	# of kids and teachers	100% portion size (Cond 1)		150% portion size (Cond 2)		200% portion size (Cond 3)	
		Weight (g)	Needed Amt (g)	Weight (g)	Needed Amt (g)	Weight (g)	Needed Amt (g)
Grilled chicken strips	21	100.0	2520	150.0	3780	200.0	5040
Broccoli with butter and butter flavoring	21	75.0	1890	112.5	2835	150.0	3780
Standard mac & cheese	21	100.0	2520	150.0	3780	200.0	5040
70% unsweetened and 30% sweetened apple sauce	21	100.0	2520	150.0	3780	200.0	5040
60% regular and 40% reduced-sugar ketchup	21	20.0	504	30.0	756	40.0	1008
1% Milk	21	183.0	4227	274.5	6341	366.0	8455

Appendix B

High ED Portion Size Amounts Across All Portion Size Conditions

Higher-ED meal							
Higher-ED food	# of kids and teachers	100% portion size (Cond 4)		150% portion size (Cond 5)		200% portion size (Cond 6)	
		Weight (g)	Needed Amt (g)	Weight (g)	Needed Amt (g)	Weight (g)	Needed Amt (g)
Breaded chicken nuggets	21	100.0	2520	150.0	3780	200.0	5040
Peas with butter flavoring	21	75.0	1890	112.5	2835	150.0	3780
Mac & cheese with added butter and oil	21	100.0	2520	150.0	3780	200.0	5040
Sweetened applesauce	21	100.0	2520	150.0	3780	200.0	5040
Regular ketchup	21	20.0	504	30.0	756	40.0	1008
Whole milk	21	183.0	4227	274.5	6341	366.0	8455

Appendix C

PSS--Preschool Randomization

PSS - Preschool Randomization

	Week 1 Condition	Week 2 Condition	Week 3 Condition	Week 4 Condition	Week 5 Condition	Week 6 Condition	Semester
Cohort 1	4	3	5	2	6	1	Spring/Summer 2013
Cohort 2	1	6	2	5	3	4	Spring/Summer 2013
Cohort 3	3	2	4	1	5	6	Fall 2013 - Nature's Edge
Cohort 4	5	4	6	3	1	2	
Cohort 5	2	1	3	6	4	5	
Cohort 6	6	5	1	4	2	3	

Appendix D

PSS High ED Mac and Cheese

HED Starch
PSS Hi ED Mac and Cheese 2.1 (2.10 kcal/g)

Recipe Report Yield: 1 (1,000 serving(s)) Category: Basic Food
 Source: Custom No. Ingredients: 3 Manufacturer: (None)

Preparation Preparation Method: Cooking Time:
 Preparation Time: Cooking Temp:

Ingredient	Kcal kcal	Protein g	Carb g	Fat g	Sodium mg	Vit A (IU) IU	Vit C mg	Calcium mg	Diet Fiber g	Sugar g
750,000 g PSS Stouffers Mac and Cheese with 6% water loss	1117.021	47.872	105.319	54.255	2617.021				6.383	
35,000 g CRISCO Pure Canola Oil	300.000	0.000	0.000	35.000	0.000	0.000	0.000	0.000	0.000	0.000
45,000 g Butter	322.650	0.383	0.027	36.500	259.200	1124.550	0.000	10.800	-0.000	0.027

Instructions

830 g 1739.67

Appendix E

PSS Peas (HED Vegetable) 500g

Kids PSS Peas 500g

Recipe Report Yield: 2.5 (1,000 serving(s)) Category: Basic Food
Source: Custom No. Ingredients: 2 Manufacturer: (None)

Preparation
 Preparation Method:
 Preparation Time:
 Cooking Time:
 Cooking Temp:

Ingredient	Kcal kcal	Protein g	Carb g	Fat g	Sodium mg	Vit A (IU) IU	Vit C mg	Calcium mg	Diet Fiber g	Sugar g
490.196 g Green Peas, Frozen, Boiled, Drained	382.353	25.245	69.902	1.324	352.941	10294.120	48.529	117.647	26.961	22.794
9.804 g MOLLY MC BUTTER Natural Butter Flavor Sprinkles	24.510	0.000	4.902	0.000	882.353	0.000	0.000	0.000	0.000	0.000

Instructions

Appendix F

PSS Peas (HED Vegetable) 1000g

Kids PSS Peas 1000g

Recipe Report Yield: 5 (1,000 serving(s)) Category: Basic Food
Source: Custom **No. Ingredients:** 2 **Manufacturer:** (None)


Preparation
Preparation Method: Cooking Time:
Preparation Time: Cooking Temp:

Ingredient	Kcal kcal	Protein g	Carb g	Fat g	Sodium mg	Vit A (IU) IU	Vit C mg	Calcium mg	Diet Fiber g	Sugar g
980.392 g Green Peas, Frozen, Boiled, Drained	764.706	50.490	139.804	2.647	705.882	20588.230	97.059	235.294	53.922	45.588
19.608 g MOLLY MC BUTTER Natural Butter Flavor Sprinkles	49.020	0.000	9.804	0.000	1764.706	0.000	0.000	0.000	0.000	0.000

Instructions


Appendix G

PSS Macaroni and Cheese (HED)

										
Recipe Report		Yield: 1 (1,000 serving(s))		Category: Basic Food						
Source: Custom		No. Ingredients: 1		Manufacturer: (None)						
Preparation		Preparation Method:		Cooking Time:						
Preparation Time:		Preparation Time:		Cooking Temp:						
Ingredient	Kcal kcal	Protein g	Carb g	Fat g	Sodium mg	Vit A (IU) IU	Vit C mg	Calcium mg	Diet Fiber g	Sugar g
750.000 g PSS Stouffers Mac and Cheese with 6% water loss	1117.021	47.872	105.319	54.255	2617.021				6.383	
Instructions										

Appendix H

PSS Broccoli (LED Vegetable) 500g

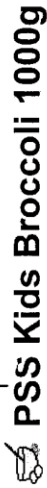
 PSS Kids Broccoli 500g

Recipe Report	Yield: 3.546 (1,000 serving(s))	Category: Basic Food								
Source: Custom	No. Ingredients: 3	Manufacturer: (None)								
Preparation										
Preparation Method:										
Preparation Time:										
	Cooking Time:									
	Cooking Temp:									
Ingredient	Kcal	Protein	Carb	Fat	Sodium	Vit A (IU)	Vit C	Calcium	Diet Fiber	Sugar
	kcal	g	g	g	mg	mg	mg	mg	g	g
472.813 g AR Study - Broccoli, frozen - USDA	122.931	13.286	22.600	1.371	113.475	502.163	0.000	4.823	14.184	6.383
20.095 g Butter	144.078	0.171	0.012	16.299	115.745	0.000	0.000	0.000	0.000	0.012
7.092 g MOLLY MC BUTTER Natural Butter Flavor Sprinkles	17.731	0.000	3.546	0.000	638.298	0.000	0.000	0.000	0.000	0.000

Instructions

Appendix I

PSS Broccoli (LED Vegetable) 1000g

 PSS Kids Broccoli 1000g

Recipe Report Yield: 7.092 (1,000 serving(s)) Category: Basic Food
 Source: Custom No. Ingredients: 3 Manufacturer: (None)

Preparation
 Preparation Method:
 Preparation Time:
 Cooking Time:
 Cooking Temp:

Ingredient	Kcal kcal	Protein g	Carb g	Fat g	Sodium mg	Vit A (IU)	Vit C mg	Calcium mg	Diet Fiber g	Sugar g
945.627 g AR Study - Broccoli, frozen - USDA	245.863	26.572	45.201	2.742	226.950				28.369	12.766
40.189 g Butter	288.156	0.342	0.024	32.597	231.489	1004.326	0.000	9.645	0.000	0.024
14.184 g MOLLY MC BUTTER Natural Butter Flavor Sprinkles	35.461	0.000	7.092	0.000	1276.596	0.000	0.000	0.000	0.000	0.000

Instructions

Appendix J

Pre-School PSS Study Supplies List and Schedule

Updated 9/25/2013

Pre-school PSS Study Supplies List and Schedule

Foods

- LED:
 - o Tyson's Grilled Ready Chicken Breast Strips
 - o Frozen broccoli
 - o Stouffer's Mac n Cheese
 - o Knouse food applesauce
 - o Knouse food unsweetened applesauce
 - o Heinz regular ketchup
 - o Heinz reduced-sugar ketchup
 - o 1% Milk
 - o 1pt water bottle
- HED:
 - o Bell & Evans Breaded chicken breast nuggets
 - o Frozen peas
 - o Stouffer's Mac n Cheese
 - o Knouse food applesauce
 - o Heinz regular ketchup
 - o Whole milk
 - o 1pt water bottles

Nonfoods:

- To bring:
 - o Kitchen scale
 - o Serving spoons, tongs
 - o Cambro insulator
 - o Extra sets of milk bottles, bottled water, ketchup cups
 - o Foil wraps - 1 large foil and 2 small foil per child
 - o Pens, markers
 - o Enrollment sheets
 - o Intake sheets
 - o Name cards
 - o Plastic cups for ketchup
- Obtain at Bennett Center
 - o Napkins, forks and spoons
 - o Cart
 - o Our plates and small bowls

Updated 9/25/2013

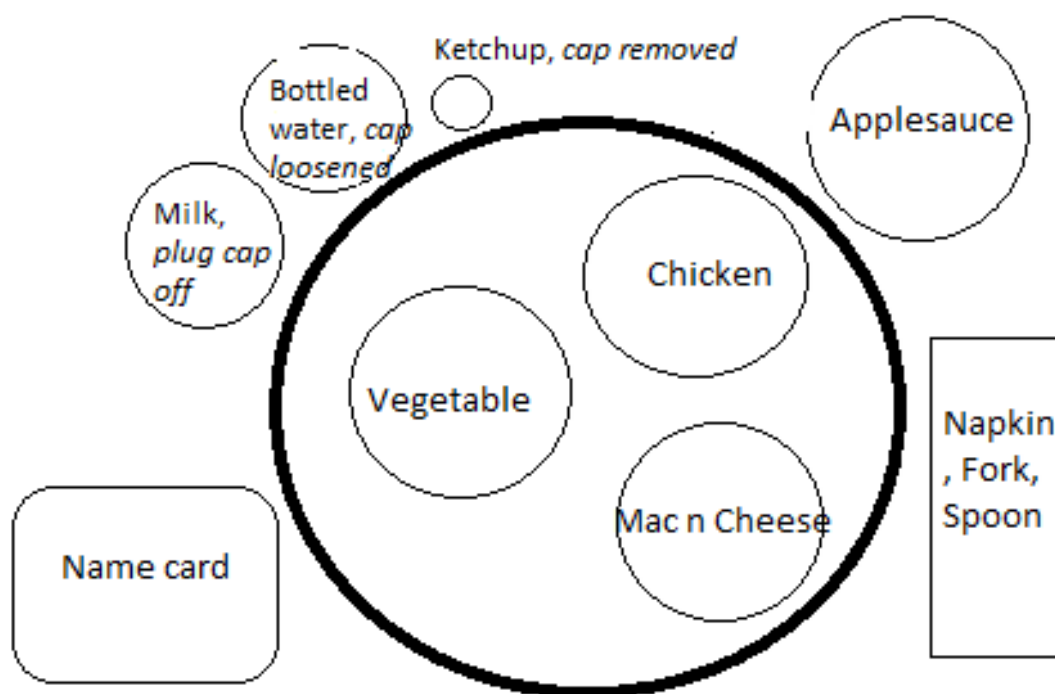
Operation schedule:

Days prior:

- Label intake sheets - label cohort, subject ID, classroom, date of study
 - Separate the name cards and intake sheets by classroom (class p eats the earliest so prepare this class' meals first)
- Make LED ketchup and applesauce mixtures in separate buckets (if needed) and refrigerate
- If HED conditions, place regular, sweetened applesauce in to bucket and refrigerate
 - Make sure to label the food item and date of creation
- Label with subject ID's the following:
 - Milk bottles (circle sticker placed on side of bottle)
 - Plastic ketchup cups (sticker on bottom of container and on top of cap)
 - Water bottles (stickers on the sides)
- Measure out serving portions for ketchup, milk, and record weight on subject intake sheet
 - Ketchup: measure without the plastic cap
 - w/o cup weight: place cap on the scale, press "0," then measure out portion of ketchup, record weight on intake sheet
 - w/ cup weight: once weighed and recorded w/o cup weight, lift the cup, press "0," then replace the ketchup + cup (still no plastic top) on the scale and record weight
 - Milk: Label bottles with subject ID. Measure and record w/o cup and w/cup weights, *without red plastic top*
- Measure and record bottled water weight for each subject - measure as is, unopened.

Day of experiment:

- 9:30am - Start cooking mac n cheese in the oven; turn on the warmer to setting 6
 - Check after cook time, stir, and place back in oven if necessary
 - Once done, line the large metal tray with plastic bag (on top of the warmer), place mac in the tray, cover with 2 layers of foil, place in warmer
- Label foil wraps with children's IDs
 - Each child gets 1 large foil wrap and 2 small foil wraps
- 10am - Cook chicken
 - If LED: Spray the pan with PAM, sautee chicken until warm, and cut into ~2 in pieces while frying in the pan
 - If HED: Bake in over ~20 min or until golden brown. Cut into ~2 in pieces once out of the kitchen
 - Place chicken in smaller medium tray, cover in foil, place in warmer
- 10:40 am - Cook vegetables
 - Prepare butter & seasoning mixture in bowl, label and cover
 - Broccoli - microwave in bag for ~5 min



Appendix K

Preschool PSS Data List of Anomalies

Updated 1/09/2014

Preschool PSS Data List of Anomalies

Sample Size: 48

Cohort 1

- ID 106, Subject J, condition 2 150% LED
 - Chicken weighed 16.3 g more post-meal compared to pre-meal
 - Coded as missing data
- ID 104, Class g, subject D, 5/9/13, condition 4 100% HED
 - Chicken weighed more after meal because water spilled on chicken
 - 9 pieces HED chicken left
 - Weighed 9 pieces dry chicken
 - Subtract from weighed chicken post-meal
 - Remove water weight from chicken weight
 - Added to water not consumed
- ID 102, class g, subject B, 5/23/13, condition 5 150% HED
 - Scale off? Not balanced correctly
 - Water weighs more after meal
 - Difference is 1.4 g more □ coded as 0
- ID 104, class g, subject D, 5/23/13 , condition 5 150% HED
 - Chicken nuggets weighed 20g more after the meal
 - Coded as missing
- ID 120, class p, subject Z, 5/24/13, condition 6 200% HED
 - A bit of milk spilled
 - Don't know how much. Only a small amount spilled
 - Coded as weighed amount

Cohort 2

- General: All intakes ± 1.5 g were coded as 0
- ID 134, Class NE, Cond 5
 - -5.4 g for mac intake
 - Averaged other 5 conditions and used 5.6 g for mac intake
- ID 135, Class NE, Cond 4
 - Milk missing, coded as missing
 - Undergrad emptied before weighed
- ID 127, Class NE, Cond 1
 - Original milk intake -36.0
 - Discovered that pre-weight with bottle did not include bottle
 - Added bottle weight and recalculated intake

Updated 1/09/2014

Excluded subjects

- Inclusion Criteria
 - Complete (no missing data or anomalies) data for 4 or more conditions
- ID 104
 - Absent for conditions 1 and 2
 - Chicken and applesauce missing for condition 5
- ID 108
 - Absent for conditions 2 and 3
 - Served no chicken for condition 5
- ID 126
 - Absent conditions 3, 5, and 6 (child moved)

Proc Mixed Models

Model Set #1

- Fixed Factors: PS ED WEEK
- Repeated Factors: WEEK
- Group: NONE
- Random Factor: NONE
- CS
- Outcome Variables:
 - LtotE and exfoodg (same thing)
 - Lfoodg
 - Mac (when ps*ed included in fixed effects, it is trending) and mackcal
 - App and appkcal
 - Ket and ketkcal
 - Milk and mlkkcal

Model Set #2

- Fixed Factors: PS ED WEEK
- Repeated Factors: WEEK
- Group: NONE
- Random Factor: NONE
- ARMA (1,1)
- Outcome Variables:
 - Ltotg and exfoodg (same thing)
 - Chk and chkkcal

Model Set #3

- Fixed Factors: PS ED WEEK

Updated 1/09/2014

- Repeated Factors: WEEK
- Group: NONE
- Random Factor: NONE
- TOEP
- Outcome Variables:
 - Veg and vegkcal

Appendix L

Preference Assessment (Tasting Game)

Preference Assessment Script – 5 Faces
Children’s Food Preference Assessment

2 December 2013

1. Preference Assessment

Explain to the child how to play the Tasting Game:

“I’d like to play the tasting game with you today. I’d like to know what you think about the foods that I have. I have five faces here. Do you see a face that looks like the face you make when you eat something that tastes super yummy? Point to the face that you would make if you ate something that tasted super yummy.”

The interviewer should either point to the super yummy face or reinforce the child for picking the correct face.

“This is the super yummy face, see how he’s smiling and licking his lips with his tongue like he’s thinking super yummy! OK, now, do you see a face up here that looks like the face that you make when you eat something that tastes yummy?”

Again, either point to the yummy face or reinforce the child for picking the correct one.

“This is our yummy face. See how he’s smiling like he’s saying yummy? OK, now, do you see a face up here that looks like the face that you make when you eat something that tastes super yucky?”

The interviewer should either point to the super yucky face or reinforce the child for picking the correct face.

“This is the super yucky face. See how he’s frowning and has his tongue sticking out like he’s thinking super yucky? OK, now do you see a face up here that looks like the face that you would make when you eat something that tastes yucky?”

Again, either point to the yucky face or reinforce the child for picking the correct one.

“This is the yucky face. See how he’s frowning like he’s thinking yucky? OK, now this other face is our just OK face. This is the face that you make when you taste something and it doesn’t taste yummy, but it doesn’t taste yucky, it tastes just kind of OK”

Again, either point to the “just OK” face or reinforce the child for picking the correct one.

“This is the just OK face. See how he’s is not frowning or smiling?”

What is your favorite food? So, if I gave you some (favorite food) to taste, which face would you point to?

Allow child to point to the face to make sure they understand. Either reinforce the child for the correct choice or show them the correct face. If the child points at “yummy” or “super yummy,” the child’s response is correct so assume they understand.

What is your least favorite food, or a food you think is yucky? So, if I gave you some (least favorite food) to taste, which face would you point to?

Allow child to point to the face to make sure they understand. Either reinforce the child for the correct choice or show them the correct face. If the child points at “yucky” or “super yucky,” the child’s response is correct so assume they understand.

Preference Assessment Script – 5 Faces

2 December 2013

Great work, now one more question and we will start our tasting game.

What if I gave you something to taste and you couldn't decide if it was yummy or yucky? What face would you point to?

Allow child to point to the face to make sure they understand. Either reinforce the child for the correct choice or show them the correct face. If the child points at "just OK" the child's response is correct and assume they understand.

"OK, now I'd like to play the game with real food. I have some foods here and I'd like to know whether you think they taste super yummy, yummy, super yucky, yucky, or if they taste just OK. I'd like you to taste each one and then put the cup in front of the face that you make when you eat it. OK? Here is your first food to taste."

Allow the child to take a taste. When the child is finished, point to each face and ask:

"What do you think? Did that taste super yummy, yummy, super yucky, yucky, or did it taste just OK? Put the cup in front of the face that you made when you tasted the _____."

Wait for the child to place the cup in front of one of the faces. When the child is finished, mark the response on the preference sheet. Respond to the child and give the child the next food to taste (the order of the foods will be predetermined).

"You thought that one was (appropriate face)! Here is another food to taste."

Allow the child to take a taste of the second food. Again, pointing to the appropriate faces, ask the child:

"What do you think? Did that taste super yummy, yummy, super yucky, yucky, or did it taste just OK? Put the cup in front of the face that you made when you tasted the _____."

Again, wait for the child to place the cup in front of one of the faces. When the child is finished, mark the response on the data sheet. And repeat this step for the remaining foods. Periodically reinforce the child. Be careful to reinforce child for playing the game, not for the actual choices that he/she makes. Avoid reinforcement directly after the child places a food into a category and use phrases such as:

"You are really good at this game!"

"I'm having so much fun playing this game with you!"

Appendix M

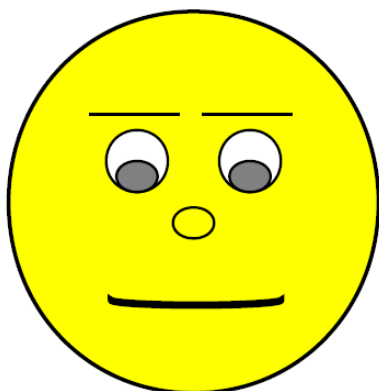
Likert Scale



Super Yummy



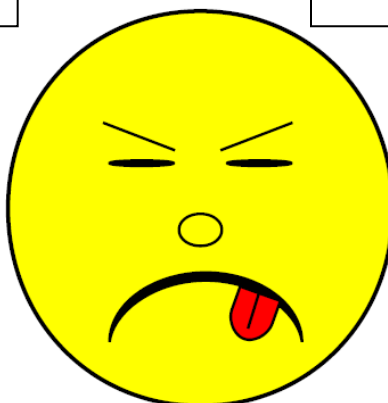
Yummy



Just Okay



Yucky



Super Yucky

Appendix N

Recruitment Letter to Parents

Dear Parents:

The Bennett Family Center and the Researchers with the Laboratory for the Study of Human Ingestive Behavior at Penn State are collaborating on a new project. The title of our new project is “Perceptions of Different Tastes at a Single Meal – Preschool Study.” We are seeking a group of children ages 3 – 5 and their parent to participate in a research study. If you are a parent of a child in this age group and are interested in having you and your child participate, please continue reading this letter and the attached Parent Informed Consent form. Parental consent is required for all children under the age of 18. All children at the center are eligible for inclusion in this research study.

The objective of this study is to understand the effects of changes in portion sizes of commonly consumed foods in kids.

At 6 different lunch times (beginning roughly the week of May 7, 2013), we will provide lunch. Your child will have lunch in one of the classrooms with other kids enrolled in the study. Children will participate in the following activities:

Lunch

- Lunch will be served to children by the Laboratory of Human Ingestive Behavior. It will consist of foods typically served at the daycare center: Grilled chicken breast, chicken nuggets, steamed broccoli, green peas, applesauce, macaroni and cheese, milk, and water. Not all foods will be served on the same day. This will vary slightly from their usual lunch as a bottle of spring water will be offered as the beverage.

The Tasting Game

- “The Tasting Game” is used to assess children’s food preferences for menu items and involves interviewing children individually. At the end of the study, children taste a food that is served during the study and tell us about their preferences for the food.

Height and weight

- These measurements will be taken once by a trained staff member of our laboratory.

Parent Activity

- Parents will be asked to complete three questionnaires. We will distribute the questionnaires toward the later weeks of the study. Upon completion of the Parent Activity, the participating parent will receive \$20. Arrangements will be made to meet parents during pick-up time to exchange the questionnaires and payment.

Your participation in this research gives your child the opportunity to take part in these “special” activities while also allowing them to decline participation at any time in the study.

If you are interested in participating, please read and sign the consent form attached to this letter. Please return the forms to the ‘Perceptions of Different Tastes at a Single Meal – Preschool Study’ envelope at

the front desk. We would be happy to provide you with any additional information if you have questions regarding this research or other aspects of our work. If you have any questions, please contact Jennifer Meengs, MS, RD at 863-8482.

Sincerely,

Barbara J. Rolls, Ph.D.
Principal Investigator

Appendix O

Informed Consent Form for Parents

Informed Consent Form for Biomedical Research
The Pennsylvania State University – Preschool Study

ORP OFFICE USE ONLY
DO NOT REMOVE OR MODIFY
IRB# 41852 Doc. #1005
The Pennsylvania State University
Institutional Review Board
Office for Research Protections
Approval Date: 04/30/2013 – J. Mathieu
Expiration Date: 02/28/2014 – J. Mathieu

Title of Project: Perceptions of Different Tastes at a Single Meal

Principal Investigators: Barbara J. Rolls, Ph.D.
226 Henderson Building, University Park, PA 16802
Email: bjr4@psu.edu; Telephone: 814-863-8481

Other Investigator(s): Jacinda Li, Graduate Student
Jennifer Meengs, MS, RD
Telephone: 814-863-2877

- Purpose of the study:** The purpose of this research is to test how children respond to changes of portion sizes of foods at a meal.
- Procedures to be followed:** If you agree to allow your child to take part in this research, your child will have lunch for 6 different testing sessions that are provided by the Laboratory for the Study of Human Ingestive Behavior. Lunch will take place during the child's regularly scheduled lunch period in a pre-school classroom at the Bennett Family Center. At the end of the study, children will meet with a research assistant for a brief interview that includes The Tasting Game, which will involve assessing the child's preference of the foods used in the study. Your child's height and weight will also be measured once during the study by a trained lab staff member. We may take a photograph of the children during a test session to be used in poster or slide presentations of this study at scientific meetings. If you do not wish your child to be included in a photograph, there is a place for you to indicate such at the end of this consent form.

Parents will be asked to complete a set of questionnaires, which will be distributed toward the end of the study. We will schedule appointments around a parent's pick up of their child from the center for the parents to return the questionnaires and receive payment.
- Discomforts and risks:** There are no risks involved in eating the meals. The foods served will be commonly served items at the day care center. It is possible that investigators will discover a participant's previously unknown food allergy during the course of the study. If this occurs, the parent(s) of the child will be notified immediately so that a quick decision about medical care can be made and action can be taken.
- Benefits:** You and your child will be aiding in our understanding of human eating behavior.
- Duration/time of the procedures and study:** The total time your child will spend participating in this project, including meals, the game, and height and weight measurements, will be roughly 3 hours and 15 minutes (30 minutes for each meal and 15 minutes for obtaining height and weight and the games). The total time for parents will be roughly 20 – 30 minutes to complete the questionnaires.
- Compensation:** The parent who completes the questionnaires will be paid \$20.00 upon completion of these assessments. There is no separate payment for the child's participation.
- Statement of confidentiality:** You and your child's participation in food portion of the research will remain confidential. The investigators and their assistants will have access to you and your child's identity and to information that can be associated with these identities, but this information will not be shared. Children

participating in the study will be assigned a number, color, and letter of the alphabet to protect their identity. If parents agree to the use of photographs in poster or oral presentations, facial images may be recognizable, but no names or other identifiable information will be included. The following may review and copy records related to this research: Penn State's Office for Research Protections, the Institutional Review Board, and the US Department of Health and Human Services Office for Human Research Protections.

8. **Right to ask questions:** Please contact Jennifer Meengs at 863-8481 with questions, complaints or concerns about the research. You can also call this number if you feel this study has harmed you or your child. If you have questions, concerns, or problems about your rights as a research participant or would like to offer input, please contact Penn State's Office for Research Protections (ORP) at (814)865-1775. The ORP cannot answer questions about research procedures. Questions about research procedures can be answered by the research team.
9. **Voluntary participation:** Your participation and your child's participation are voluntary. You and your child can stop at any time. You and your child can choose not to answer any questions you don't want to answer. Your child does not have to eat any foods that he/she does not want to eat. Refusal to take part in or withdrawing from this study will involve no penalty or loss of benefits you would receive otherwise.
10. **Injury Clause:** In the unlikely event you or your child 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 or your child have against The Pennsylvania State University for injury resulting from negligence of the University or its investigators.

If you agree to the information outlined above, please sign the form below and mark today's date. You will receive a copy of this form. You must be at least 18 years of age or older to enroll yourself in this study.

Child's Name: _____ Date of Birth: _____

Child's Ethnicity:

- HISPANIC OR LATINO
 NOT HISPANIC OR LATINO
 PREFER TO NOT ANSWER

Child's Race:

- AMERICAN INDIAN/ALASKAN NATIVE WHITE
 ASIAN HAWAIIAN/PACIFIC ISLANDER
 BLACK OR AFRICAN AMERICAN PREFER TO NOT ANSWER

- My child's photograph **MAY** be used in presenting the results from this research in a poster or oral presentation.
- My child's photograph **MAY NOT** be used in presenting the results from this research in a poster or oral presentation. NOTE: Images will be destroyed within 2 years of completing this research.

Parent Signature

Date

Parent Email

Person Obtaining Consent

Date

Appendix P
Questionnaire Directions

June 4, 2013

Dear Parents:

Thank you for having your child participate in our “Perceptions of Different Tastes at a Single Meal – Preschool Study.” Please complete the three accompanying brief questionnaires (they should take no more than 5 – 10 minutes to complete) to the best of your knowledge. All answers will be kept confidential. The questionnaires include the following:

1. Family Demographics Questionnaires
2. Child Eating Behaviour Questionnaire
3. Child Feeding Questionnaire

Our research staff will be meeting parents at the front desk of Bennett Center during pick-up time (5 – 5:45pm) on **Monday, June 17th** and **Wednesday, June 19th**. Please bring your completed forms then to receive your \$20 compensation. If you are not available on those dates, please email Jacinda Li at jcl270@psu.edu to arrange an alternate meeting time for you.

If you have any questions, please contact Jennifer Meengs, MS, RD at 863-8482 or Jacinda Li at 863-8573 or jcl270@psu.edu.

Thank you again for your participation.

Sincerely,
Jacinda Li

Laboratory for the Study of Human Ingestive Behavior
The Pennsylvania State University

Appendix Q

Demographic/Background Information

DBI Questionnaire

Child ID: _____

Date: _____

Demographic/Background Information

What is your child's date of birth?

Please indicate who lives in your household, and if applicable how many (i.e. siblings 2)?

Mother	_____	Grandmothers	_____
Father	_____	Grandfathers	_____
Siblings	_____	Aunts	_____
Uncles	_____	Cousins	_____
Other	_____		

Who in your household has the primary role in food preparation?

What is your marital status:

<input type="checkbox"/> Married	<input type="checkbox"/> Single	<input type="checkbox"/> Widowed	<input type="checkbox"/> Divorced
<input type="checkbox"/> Separated	<input type="checkbox"/> Remarried	<input type="checkbox"/> Living together (not married)	

What is your total or combined family income, before taxes?

Less than \$20,000
 \$21,000 - \$35,000
 \$36,000 - \$50,000
 \$51,000-\$75,000
 \$76,000-\$100,000
 \$100,000+

What is the highest level of formal education for:

MOM

High school (12 yrs)
 Associates (14 yrs)
 Technical/Vocational School(14 yrs)
 Bachelors (16 yrs)
 Masters (18 yrs)
 PhD (20 yrs)
 MD (20 yrs)
 JD (20 yrs)
 Other, describe _____

DAD

High school (12 yrs)
 Associates (14 yrs)
 Technical /Vocational School (14 yrs)
 Bachelors (16 yrs)
 Masters (18 yrs)
 PhD (20 yrs)
 MD (20 yrs)
 JD (20 yrs)
 Other, describe _____

Appendix R

Child Feeding Questionnaire

CHILD FEEDING QUESTIONNAIRE

INSTRUCTIONS: Using the scale below, please circle one number for each question which best corresponds to your answer. Please answer about your child who is in our study.

ID #: Date:	never	seldom	half of time	most of time	always
1. When your child is home, how often are you responsible for feeding him/her?	1	2	3	4	5
2. How often are you responsible for deciding what your child's portion sizes are?	1	2	3	4	5
3. How often are you responsible for deciding if your child has eaten the right kind of foods?	1	2	3	4	5

Using the scale below, please indicate how you would classify your own weight at each of these 4 time periods listed below (Please circle ONLY ONE number for each time period)

	underweight markedly	underweight	average	overweight	overweight markedly
4. Your childhood (5 to 10 years old)	1	2	3	4	5
5. Your adolescence	1	2	3	4	5

6. Your 20's	1	2	3	4	5
7. Currently	1	2	3	4	5

Using the scale below, please indicate how you would classify your child's weight at each of these 6 time periods listed below.
(Please circle only one number for each time period)

	underweightmarkedly	underweight	average	overweight	overweightmarkedly
8. Your child during the first year of life	1	2	3	4	5
9. Your child as a toddler	1	2	3	4	5
10. Your child as a preschooler	1	2	3	4	5
11. Your child as kindergartener	1	2	3	4	5

Using the scale below, please circle one number for each question which best corresponds to your answer. Please answer about your child who is in our study.

	unconcerned	unconcernedslightly	neutral	concernedslightly	concernedvery

12. How concerned are you about your child <i>eating too much</i> when you are not around him/her?	1	2	3	4	5
13. How concerned are you about your child having to diet to maintain a desirable weight?	1	2	3	4	5
14. How concerned are you about your child becoming over weight?	1	2	3	4	5

INSTRUCTIONS:

Using the scale below, please circle one number for each question which best corresponds to your answer. Please answer about your child who is in our study.

	disagree	disagreeslightly	neutral	agreeslightly	agree
15. I have to be sure my child does not eat too many <i>sweets (candy, ice cream, cake or pastries)</i> .	1	2	3	4	5
16. I have to be sure my child does not eat too many <i>high fat foods</i> .	1	2	3	4	5
17. I have to be sure my child does not eat too many of his/her <i>favorite foods</i> .	1	2	3	4	5
18. I intentionally keep some foods out of my child's reach.	1	2	3	4	5
19. I offer <i>sweets (candy, ice cream, cake or pastries)</i> to my child as a reward for good behavior.	1	2	3	4	5
20. I offer my child his/her <i>favorite foods</i> in exchange for good behavior.	1	2	3	4	5

21. If I did not regulate or guide my child's eating, he/she would eat too many <i>junk foods</i> .	1	2	3	4	5
22. If I did not regulate or guide my child's eating, he/she would eat too many of his/her <i>favorite foods</i> .	1	2	3	4	5
23. My child should always eat all of the food on his/her plate.	1	2	3	4	5
24. I have to be especially careful to ensure my child eats enough.	1	2	3	4	5
25. If my child says "I'm not hungry" I try to get him/her to eat anyway.	1	2	3	4	5
26. If I did not guide or regulate my child's eating, he/she would eat much less than he/she should.	1	2	3	4	5

INSTRUCTIONS:

Using the scale below, please circle one number for each question which best corresponds to your answer. Please answer about your child who is in our study.

	never	rarely	sometimes	mostly	always
27. How much do you keep track of the <i>sweets (candy, ice cream, cake or pastries)</i> that your child eats?	1	2	3	4	5
28. How much do you keep track of the <i>snack food (potato chips, Doritos, cheese puffs)</i> that your child eats?	1	2	3	4	5
29. How much do you keep track of the <i>high fat</i> foods that your child eats?	1	2	3	4	5

30. How often do you allow your child to have as <u>much</u> as he/she wants of a healthy food?	1	2	3	4	5
31. How often do you allow your child to have as <u>little</u> as he/she wants of a healthy food?	1	2	3	4	5
32. How often do you allow your child to have as <u>much</u> as he/she wants of an unhealthy food?	1	2	3	4	5
33. How often do you allow your child to have as <u>little</u> as he/she wants of an unhealthy food?	1	2	3	4	5

Appendix S
PSS Example Intake Sheet

Subject ID: _____

Classroom: _____

Cohort: _____

Intake Sheets: PSS – Preschool Study
Condition 1: 100% LED

Check 1: _____

Check 2: _____

Date: _____

Week: _____

Lunch Food	Pre-Weight		Post-Weight	Amount Consumed
Grilled chicken (100 g)	(w/o plate)		(w/o plate)	
LED Mac n Cheese (100g)	(w/o plate)		(w/o plate)	
Broccoli (75g)	(w/o bowl)	(w/bowl)	(w/bowl)	
LED applesauce (100g)	(w/o bowl)	(w/bowl)		
Low-sugar ketchup (20g) <i>Weighed without clear plastic cap</i>	(w/o cup)	(w/cup)		
1% Milk (183g) <i>Weighed without red cap</i>	(w/o bottle)	(w/bottle)		
Water in bottle (237ml) <i>Weighed with cap</i>				

Time Meal: _____

Serving instructions:

- Children sit with their classmates
- Chicken from 12 – 3 o'clock; Mac n cheese 3-6 o'clock; Veg on left side
- Milk served with red cap screwed on but top cap off
- Ketchup served with plastic cap off
- Water served with cap off

Weighing

- Scrape chicken and mac n cheese onto separate plate to weigh

Appendix T

PSS Study Preparation--Week 1, Condition 3

PSS - Preschool - Study Preparation

Date: 10/15/2013

Classroom: Nature's Edge

Week: 1

Condition: 3 (Low-ED, 200% Portion Size)

Day Before

- Macaroni and cheese
 - Put frozen macaroni and cheese into the refrigerator in front of the oven
- Vegetables
 - Prepare butter & seasoning mixture in bowl (refer to **broccoli** recipe)
 - Label and cover
 - **For broccoli seasoning, place in refrigerator near the oven**
- Ketchup
 - Prepare total of **912 g of LED ketchup**
 - Mix
 - **547g** regular ketchup
 - **365 g** sugar-free ketchup
 - Portion out **40 g** into plastic cups labeled with child's letter
 - Weigh and record on intake sheets. *Weigh with and without container, no plastic top*
- Applesauce
 - Prepare total of **4560 g of LED applesauce**
 - Mix
 - **3192 g** unsweetened applesauce
 - **1368 g** sweetened applesauce
 - Label the container with "LED applesauce", today's date, and study date
 - Store in pantry refrigerator
- Milk: **1% Low-fat**
 - Label milk bottles labeled with child's letter
 - Pour **366 g** into each bottle
 - Weigh and record on intake sheets. *Weigh with and without container, no red top*
- Water
 - Label with child's letter
 - Weigh and record on intake sheets

- Aluminum Foil
 - Label foil wraps with children's letter
 - Each child gets 1 large foil wrap and 2 small foil wraps

Supplies:

- Milk crate with
 - name cards
 - serving spoons
 - aluminum foils
 - pens
- Milk bottles
- Ketchup mixture
- Applesauce mixture

Study Day

9:30 am

- Turn on warmer to 6
- Turn on oven to high fan and 325°F
- Place macaroni and cheese (on a baking sheet with Al foil, lid on) in oven
- Pull out bags of grilled chicken strips from the freezer

10:00 am

- Check macaroni and cheese, stir, and put back into oven
- Cook chicken:
 - Spray the pan with cooking spray
 - Sautee chicken until warm
 - Cut into ~2 in pieces while frying in the pan
 - Place chicken in smaller medium tray
 - Cover in foil
 - Place in warmer

10:40 am

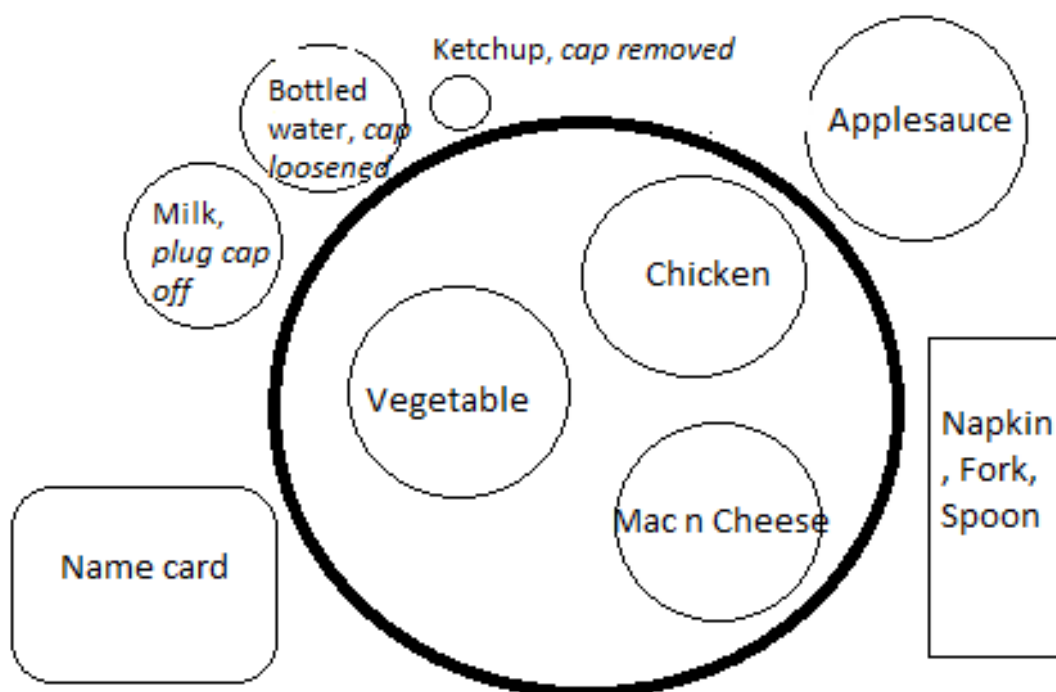
- Check macaroni and cheese
 - Once done, line the large metal tray with plastic bag (box of bags is on top of the warmer)
 - Pour macaroni and cheese in the tray
 - Cover with 2 layers of foil
 - Place in warmer
- Cook vegetables
 - Use **broccoli** recipe
 - **Broccoli - microwave in bag for ~4 min**
 - Place vegetables in smaller medium tray
 - Cover in foil
 - Place in warmer

- 11:00 am
- o Pack up food and supplies
 - o Turn off the oven, stove, and warmer
 - o Staff walks to Hort Woods (remember the cart!)
- 11:15 am
- o Staff at Hort Woods starts labeling plates and bowls
 - o Leave the lab
- 11:20 am
- o Unload car with cart
 - o One person checks attendance - check for the sign-ins of enrolled children on each classroom's sign-in sheet
 - o Eliminate the intake sheets of children who are absent
- 11:25 am to 12:00 pm
- o Classroom set-up
 - Check attendance: check for the sign-ins of enrolled children on each classroom's sign-in sheet
 - Eliminate the intake sheets of children who are absent
 - Set up tables with children's name cards
 - Borrow from the daycare kitchen napkins, forks, spoons
 -
 - o Food preparation
 - Set up weighing stations (2 scales)
 - Use stickers to label children's letter ID on plates and bowls
 - Each child gets:
 - 1 large plate
 - 1 small bowl with green rings
 - 1 small bowl without rings
 - Portion foods.
 - Cover and label the meals with aluminum foil
- 12:00 pm
- o Set children's places at their tables
 - Applesauce in small bowl without ring - cover with small foil
 - Vegetables in small bowl with green rings - cover with small foil
 - Chicken and mac plated on large plate - cover with large foil
 - Remove the red plug top from the red cap on the milk bottle (but keep the red sipping top)
 - o Have children wash their hands and sit at their assigned seat.
 - o Unwrap the foods as they are washing their hands.
 - o Tell the children, "You can eat as much or as little as you would like."
 - o One experimenter per table observes the meal from a distance. Record dropped food or anything odd.

After children finish eating

- o Children should leave all of their uneaten foods and dishes on the table
- o Have children wash their hands and follow instructions given by teacher
- o Collect children's leftover food, utensils, and dishes and weigh in the Library
- o Compost the foods and recycle water bottles
- o Wash plates and milk bottles, etc at the center?
- After returning to lab, wash the large serving trays, check supplies, restock if necessary

Serving Set-up:



Appendix U

PSS Study Preparation--Week 1, Condition 5

PSS - Preschool - Study Preparation

Date: 10/24/2013

Classroom: Room to Grow

Week: 1

Condition: 5 (High-ED, 150% Portion Size)

Day Before

- Macaroni and cheese
 - Put frozen macaroni and cheese into the refrigerator in front of the oven
 - Prep butter and oil (refer to recipe)
- Vegetables
 - Prepare butter & seasoning mixture in bowl (refer to peas recipe)
 - Label and cover
 - For peas seasoning, place on counter
- Ketchup
 - Prepare total of 756 g of regular ketchup
 - Portion out 30 g into plastic cups labeled with child's letter
 - Weigh and record on intake sheets. *Weigh with and without container, no plastic top*
- Applesauce
 - Prepare total of 3780 g of regular (sweetened) applesauce
 - Label the container with "HED (regular) applesauce", today's date, and study date
 - Store in pantry refrigerator
- Milk: 1% Whole
 - Label milk bottles labeled with child's letter
 - Pour 274.5g into each bottle
 - Weigh and record on intake sheets. *Weigh with and without container, no red top*
- Water
 - Label with child's letter
 - Weigh and record on intake sheets
- Aluminum Foil
 - Label foil wraps with children's letter
 - Each child gets 1 large foil wrap and 2 small foil wraps

Supplies:

- Milk crate with
 - o name cards
 - o serving spoons
 - o aluminum foils
 - o pens
- Milk bottles
- Ketchup mixture
- Applesauce mixture

Study Day

9:00 am

- o Turn on warmer to 6
- o Turn on oven to high fan and 325°F
- o Pull out bags of chicken nuggets from the freezer

9:15 am

- o Place macaroni and cheese (on a baking sheet with Al foil, lid on) in oven

9:45 am

- o Check macaroni and cheese, stir, and put back into oven
- o Cook chicken:
 - Cover pan with aluminum foil
 - Place in oven
 - Cut nuggets in half when out of the oven

10:00 am

- o Check macaroni and cheese
 - Once done, line the large metal tray with plastic bag (box of bags is on top of the warmer)
 - Pour macaroni and cheese in the tray
 - Cover with 2 layers of foil
 - Place in warmer
- o Cook vegetables
 - Use **peas** recipe
 - **Peas - microwave in casserole dish for ~4 min**
 - Place vegetables in smaller medium tray
 - Cover in foil
 - Place in warmer

10:15 am

- o Chicken
 - Weigh 150g chicken and place into plastic bag
 - Place in the warmer

10:45 am

- o Pack up food and supplies

- o Turn off the oven, stove, and warmer
- o Staff walks to **Hort Woods** (remember the cart!)

11:00 am

- o Staff at Hort Woods starts labeling plates and bowls
- o Leave the lab

11:10 am

- o Unload car with cart
- o One person checks attendance – check for the sign-ins of enrolled children on each classroom’s sign-in sheet
- o Eliminate the intake sheets of children who are absent

11:15 am to 12:00 pm

- o Classroom set-up
 - Check attendance: check for the sign-ins of enrolled children on each classroom’s sign-in sheet
 - Eliminate the intake sheets of children who are absent
 - Set up tables with children’s name cards
 - Borrow from the daycare kitchen napkins, forks, spoons
 -
- o Food preparation
 - Set up weighing stations (2 scales)
 - Use stickers to label children’s letter ID on plates and bowls
 - Each child gets:
 - 1 large plate
 - 1 small bowl with green rings
 - 1 small bowl without rings
 - Portion foods.
 - Cover and label the meals with aluminum foil

12:00 pm

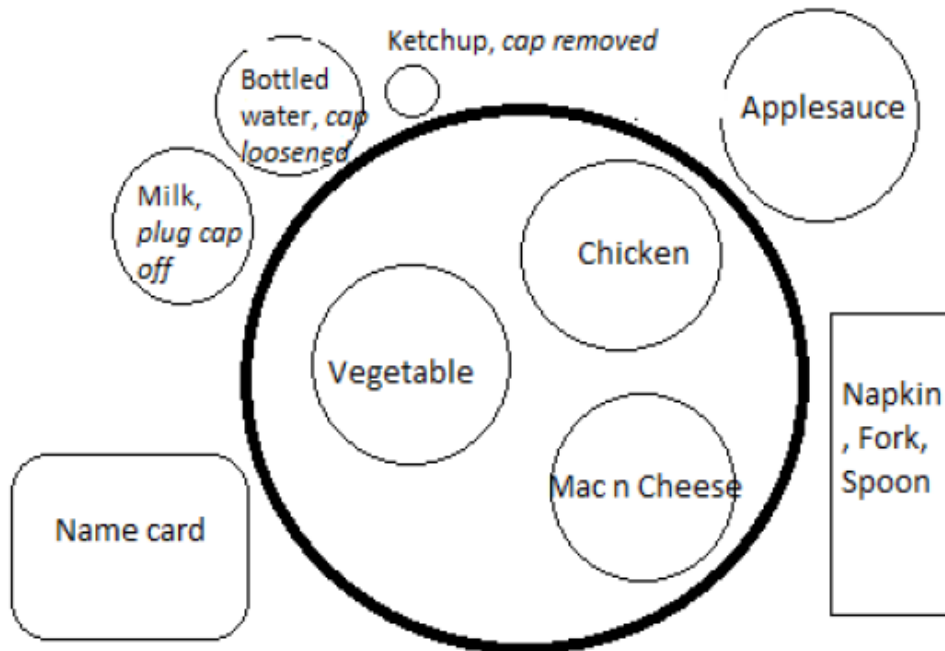
- o Set children’s places at their tables
 - Applesauce in small bowl without ring – cover with small foil
 - Vegetables in small bowl with green rings – cover with small foil
 - Chicken and mac plated on large plate – cover with large foil
 - Remove the red plug top from the red cap on the milk bottle (but keep the red sipping top)
- o Have children wash their hands and sit at their assigned seat.
- o Unwrap the foods as they are washing their hands.
- o Tell the children, “You can eat as much or as little as you would like.”
- o One experimenter per table observes the meal from a distance. Record dropped food or anything odd.

After children finish eating

- o Children should leave all of their uneaten foods and dishes on the table
- o Have children wash their hands and follow instructions given by teacher

- o Collect children's leftover food, utensils, and dishes and weigh in the Library
 - o Compost the foods and recycle water bottles
 - o Wash plates and milk bottles, etc at the center?
- After returning to lab, wash the large serving trays, check supplies, restock if necessary

Serving Set-up:



Appendix V**Portion Size Conditions in Gram Amounts of Food**

	100%	150 %	200%
Chicken	100 grams	150 grams	200 grams
Macaroni and Cheese	100 grams	150 grams	200 grams
Vegetable	75 grams	112.5 grams	150 grams
Applesauce	100 grams	150 grams	200 grams
Ketchup	20 grams	30 grams	40 grams
Milk	180 grams	274.5 grams	366 grams

Appendix W

Distribution of Children by Race and Ethnicity

Race	Number of Children	Percent of sample
American Indian/Alaskan Native	0	0%
Asian	9	19%
Black or African American	1	2%
White	32	67%
Hawaiian/Pacific Islander	0	0%
More than one race or other	6	12%

Ethnicity	Number of Children	Percent of sample
Not Hispanic or Latino	44	92%
Hispanic or Latino	3	6%
Missing	1	2%

Appendix X**Distribution of Family Income in Subjects**

Family Income	Frequency	Percentage
Less than \$20,000	0	0%
\$21,000 - \$35,000	2	5.9%
\$36,000 - \$50,000	1	2.9%
\$51,000 - \$75,000	8	23.5%
\$76,000 - \$100,000	5	14.7%
\$100,000 +	18	52.9%

Appendix W

Mean Intake of Grams and Energy of Foods Across Conditions

Outcome Variable	Means of PS Conditions			Means of ED Conditions	
	100%	150%	200%	LED	HED
Total energy kcal	283.9	332. ^b	351.7	268.3	374.1
Total lunch intake g	326.6	388.8	408.8	380.7	369.9
Total food intake g	205.6	244.2	274.5	240.1	243.2
Mac & cheese g	57.7	71.8	76.6	74.8	63.1
Mac & cheese kcal	103.9	126.6	135.5	111.4	132.3
Chicken g	51.2	48.1	48.8	41.9	56.4
Chicken kcal	75.9	71.3	72.2	49.8	94.9
Vegetable g	19.5	21.0	21.1	18.1	22.8
Vegetable kcal	13.8	14.8	15.0	10.3	18.5
Applesauce g	69.8	93.5	116.7	96.0	91.3
Applesauce kcal	42.9	56.9	71.0	48.3	65.2
Ketchup g	7.4	9.7	11.3	9.3	9.6
Ketchup kcal	7.4	9.7	11.5	7.7	11.3

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EXPERIENCE

Research lab assistant University Park, PA; 2012-2014

- Facilitated research study on children's tomato consumption across portion size and eating style variables
- Facilitated a research study in the Bennet Center and in the lab facility on portion size effect and energy density interaction in children and mother-children groupings.

HONORS AND AWARDS

Boscov Academic Excellence Award

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ASSOCIATION MEMBERSHIP/ACTIVITIES

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