THE IMPACT OF A SMARTER LUNCHROOMS MAKEOVER ON CHILDREN'S
FOOD CHOICE AND CONSUMPTION

A Thesis

presented to

the Faculty of California Polytechnic State University,

San Luis Obispo

In Partial Fulfillment

of the Requirements for the Degree

Master of Science in Agriculture

with Specialization in Food Science and Nutrition

by

Polina Zhuzhina

June 2016

© 2016
Polina Zhuzhina
ALL RIGHTS RESERVED

COMMITTEE MEMBERSHIP

TITLE: The Impact Of A Smarter Lunchrooms Makeover
On Children's Food Choice And Consumption

AUTHOR: Polina Zhuzhina

DATE SUBMITTED: June 2016

COMMITTEE CHAIR: Aydin Nazmi, Ph.D.
Associate Professor of Food Science & Nutrition

COMMITTEE MEMBER: Arlene Grant-Holcomb, Ed.D.
Director, Didactic Program in Dietetics/Lecturer

COMMITTEE MEMBER: Charmaine Martinez, M.F.A.
Associate Professor of Graphic Design

ABSTRACT

The Impact Of A Smarter Lunchrooms Makeover On Children's Food Choice And Consumption

Polina Zhuzhina

Childhood obesity has tripled over the past three decades and poses a serious public health problem. The Smarter Lunchrooms Movement aims to increase healthy eating by incorporating low-cost to no-cost alterations to the school lunchroom in an effort to increase consumption of healthier foods, such as fruits and vegetables, by making them more attractive and convenient.

Our study implemented Smarter Lunchrooms interventions at two primarily Hispanic elementary schools in Paso Robles, CA. The interventions focused on increasing the appeal of the salad bars, including installation of age-appropriate signage highlighting fruits and vegetables, as well as branding of fruits and vegetables with fun age-appropriate characters. Fruits were also placed into decorative bowls to increase their attractiveness. To determine whether these changes had an influence on fruit and vegetable choice and consumption, we tracked student's choice and intake prior to and following the intervention. Consumption was analyzed using a visual tray waste measurement to determine how much fruit, vegetable, and entrée the students ate during lunch.

Following the intervention, the proportion of children who selected fruits and vegetables increased at one school, but not at the other. Of the children that selected fruits and/or vegetables, the proportion eating the entire fruit or vegetable increased at both schools, while the proportion of students who did not eat any of their vegetables

decreased at one school. There were few significant differences by grade level (1-3 and 4-5).

If easy-to-implement strategies such as Smarter Lunchrooms interventions are effective mitigators of obesity risk, larger scale efforts across populations may help stem the ever-increasing impact of obesity. Therefore, future research should identify targeted methods by which to approach younger vs. older children among diverse socio-demographic and geographic groups.

ACKNOWLEDGMENTS

I would like to thank my advisor, Dr. Nazmi, for assisting me through this project, and for all the support and advice he provided. I would also like to thank my parents who have always helped me pursue my educational goals.

TABLE OF CONTENTS

	Page
LIST OF TABLES	ix
LIST OF FIGURES	x
Chapter 1: Introduction	1
Chapter 2: Literature Review	2
Childhood Obesity	2
Statistics and Stratifications	2
Consequences	2
Determinants	5
Prevention	10
National School Lunch Program	10
School Based Intervention	11
Smarter Lunchrooms	13
Manage Portion Size	15
Increase Convenience	16
Increase Visibility	19
Enhancing Taste Expectations	20
Suggestive Selling	22
Pricing Strategies	23
Smarter Lunchrooms Makeover	24
Summary	25
Research questions and hypotheses	26

Chapter 3: Methods.....	28
Baseline data	30
Intervention	31
Statistical Analysis.....	32
Chapter 4: Results	33
Fruit and vegetables taken	33
Consumption of fruits, vegetables, and main entrée.....	35
School level.....	35
School and grade level	38
Chapter 5: Discussion	41
REFERENCES	51
APPENDIX.....	59

LIST OF TABLES

Table	Page
Table 1 Main Principles of the Smarter Lunchrooms Movement.....	15
Table 2 Dates of assessments before and after Smarter Lunchrooms Intervention.....	33
Table 3 Socio Demographics by School.....	33
Table 4 Proportion of Fruits and Vegetables Taken by Students, by School and Period, Before and After Smarter Lunchrooms Intervention.....	34
Table 5 Consumption of Fruits, Vegetables, and Main Entrée, by School and Period, Before and After Smarter Lunchrooms Interventions	40
Table 6 Proportion of students captured for pre and post lunch analysis during the study.....	48

LIST OF FIGURES

Figure	Page
Figure 1 Descriptive names and effect on vegetable consumption in middle schools. (Adapted from Wansink et al., 2012).	22
Figure 2 Mean Percentage of Children Taking and Eating Fruit Servings (Taken from Springer, Kelder, & Hoelscher, 2006).	23
Figure 3 Proportion of Fruit and Vegetables Taken by Students During 2 Lunch Periods by School, Before and After Smarter Lunchrooms Intervention	35
Figure 4 Proportion of Students Consuming Entire Fruit, Vegetable, and Main Entrée, by School, Before and After Smarter Lunchrooms Intervention	37
Figure 5 Proportion of Students Consuming None of their Fruits, Vegetables, and Main Entrée, by School, Before and After Smarter Lunchrooms Intervention	37

CHAPTER 1

INTRODUCTION

Childhood obesity has been increasing rapidly for the past 30 years and remains a serious public health problem. Successful prevention strategies designed to reduce incidence of childhood obesity are vital. Schools are suitable venues for childhood obesity intervention programs because children spend half of their day at school, maximizing reach. The Smarter Lunchrooms Movement was developed on the principle of behavioral economics to change the lunchroom environment to influence students to make healthier choices during lunch. This literature review will, in the context of childhood obesity, focus on Smarter Lunchrooms, its impact, and potential future research directions.

CHAPTER 2

LITERATURE REVIEW

Childhood Obesity

Statistics and Stratifications

Childhood obesity is a major public health concern in America, with 33.6% of children 2-19 years of age estimated to be overweight, and 17.1% obese in 2003-2004 (Ogden et al., 2006). Trends over the past 30 years indicate that childhood obesity rates have increased from 5% in 1970 to 17% in 2004 (Ogden, Yanovski, Carroll, & Flegal, 2007). Obesity prevalence is highest among school-aged children (6-11 years) at 17.7% and adolescents (12-19 years) at 20.5%, compared to preschool-age children (2-5 years) at 8.4% in 2011-2012 (“Childhood Obesity Facts,” 2014). In addition, disparities in obesity rates between racial/ethnic groups highlight the differential impact of a wide range of social and economic factors on health outcomes. According to the CDC; obesity prevalence in 2012 among children and adolescents was higher among Hispanics (22.4%) and non-Hispanic blacks (20.2%) than among non-Hispanic whites (14.1%) (“Childhood Obesity Facts,” 2014).

Consequences

Being overweight as a child has medical and quality of life consequences, including metabolic syndrome, hyperlipidemia, hypertension, abnormal glucose tolerance, sleep apnea, and orthopedic complications. Metabolic syndrome has no accepted definition when it comes to children, but in adults it is a cluster of conditions including elevated blood pressure, high blood sugar, excess body fat around the waist, and abnormal cholesterol levels, which all contribute to increased risk of developing

cardiovascular disease (CVD) and other chronic diseases. A systematic review by Friend et al revealed that prevalence of metabolic syndrome is 29.2% in obese children (Friend, Craig, & Turner, 2013). The Bogalusa Heart study revealed that 58% of children with a BMI in the 85th percentile or higher had at least one CVD risk factor (Harsohena, Hyder L., & Poston, 2003). Another study by Csabi et al, found that 14.4% of overweight children had no CVD risk factors while lean children had 79.1% of no risk factors (Csabi, Torok, Jeges, & Molnar, 2000). The NHANES study reported that prevalence of dyslipidemia in children was 20.3% and increased to 42.9% in obese children (Gurnani, Birken, & Hamilton, 2015). In the US, 10% of children have pre-hypertension and 3.7% have hypertension, which can result from elevated BMI and waist circumference (Gurnani et al., 2015). Impaired glucose tolerance is observed in about 25% of obese children (Sinha et al., 2002). Sleep apnea is 4 to 6 times higher in obese children compared to their non-obese counterpart (Speiser et al., 2005). Excessive weight gain in obese children during periods of accelerated growth also contributes to damaged growth plates, blount disease, flatfoot, scoliosis, and osteoarthritis, leading to limited mobility (Speiser et al., 2005). In addition to the medical complications accompanying childhood overweight and obesity, the likelihood for psychosocial problems is also increased.

Weight bias stigma occurs when characterizations about skills and ability are based on weight. Negative views about overweight individuals include perceptions of lack of will power and poor self-discipline. Negative attitudes toward overweight peers have been demonstrated in preschool children as young as age 3 years. Their peers perceive obese children as being lazy, ugly, sad, mean, and sloppy (Puhl & Latner, 2007). Obese children are 63% more likely to be bullied than their normal weight counterparts,

and as BMI increases, the risk of bullying and teasing also increases (Puhl, 2011). Internalized stigma and shame for being overweight contributes to lower self-esteem among youth. This may contribute to the reports of increased depressive symptoms, behavioral problems, and poor school performance among overweight children, compared to their leaner counterparts (Beck, 2016). The severe physical and psychological consequences of obesity at the individual level are typically paired with serious economic implications.

The economic burden of childhood obesity to the individual can range between \$16,310 and \$19,350 over a lifetime compared to a normal weight child (Finkelstein, Graham, & Malhotra, 2014). At the population level, childhood obesity has associated annual direct costs, which include prescription drugs, emergency room, and outpatient costs of \$14.1 billion (Cawley, 2010). For obese adults who gain weight in their adult life, the healthcare cost to the nation is estimated to be \$147 billion dollars a year (Finkelstein et al., 2014). Obesity rates accounted for 21% of healthcare spending in 2005 (Cawley & Meyerhoefer, 2012). Overall, the combined child and adult obesity problem in the US is associated with an economic burden of more than \$200 billion (Cawley, 2010). The cost of childhood obesity is a burden to the nation, and will continue to rise, if successful intervention strategies aren't put into place.

Overweight children tend to become overweight adults, contributing to the negative consequences of the adult obesity epidemic (Guo, Wu, Chumlea, & Roche, 2002). It has been estimated that 80% of overweight adolescents will eventually become obese adults (Harshbarger et al., 2003). Overweight adolescents also have increased risk of mortality as adults, independent of the effect of adolescent weight on adult weight.

Lifespan is also shortened due to health complications associated with obesity. Staying overweight or obese into adulthood also contributes to increased rates of psychological problems, including poor quality of life, low self-esteem, and social problems (Davis, Bennet, Befort, & Nollen, 2014).

Determinants

An imbalance between energy intake and expenditure causes weight gain, which can eventually lead to obesity. Multiple factors contribute to this imbalance. Genetic predisposition and biology influence obesity and overweight, and their role in obesity development has been extensively studied. There are genetic factors that contribute to weight gain, with BMI being 25-40% heritable (WHO, 2000), but while genetics plays a role, the genetic factor accounts for less than 5% of childhood obesity cases (Bhadoria et al., 2015). This suggests that genetic predisposition is not a major contributor to childhood obesity, instead, the main factors are environmental and behavioral.

The environment influences childhood obesity at multiple levels, primarily through changes in behavior. Not having access to affordable healthy foods and safe recreational areas can affect obesity rates. The availability in the amount of food for consumption in various forms including fast food and junk food has increased over recent decades (Dietz & Gortmaker, 2001). Increase in access to fast food restaurants may lead to increases in eating more meals outside of the home, and eating out has been correlated with increase in total energy intake, fat intake, and percentage body fat (Harsohena et al., 2003). In adolescents there is an association between eating at fast food restaurants and increases in their consumption of soda, cheeseburgers, french fries, and pizza, while decreasing their consumption of fruits, vegetables, and milk (Harsohena et al., 2003).

Along with the increase of unhealthy foods that children are exposed to, their participation in mass media viewing, including television and Internet, has increased (Dietz & Gortmaker, 2001). This in turn has increased their exposure to advertisements pertaining to unhealthy food, and encourages consumption of products with high-fat and high-sugar content. (Trasande et al., 2009).

The environment in which children eat at home and outside of the home largely shapes their eating behavior. For example, time allotted to eat meals can play a role in what children are choosing to eat. When it comes to the lunchroom environment, the order of recess and lunchtime can influence children's food choice and intake. When children eat lunch before being able to play, they often rush to finish their lunch, and skip eating most of their food. A study performed by Price et al (2015) observed the effect that moving recess before lunch would have on 1st-6th grade students' fruit and vegetable consumption. The results indicated that moving recess before lunch increased consumption of fruits and vegetables by 54% ($p=0.001$), as well as increasing the proportion of students eating at least one serving of fruits or vegetables by 45% ($p=0.005$). While the control school experienced a decrease in fruit and vegetable consumption during the study (Price & Just, 2015). Another study observed the impact that moving recess before lunch would have on plate waste at two racially/ethnically diverse elementary schools in Illinois. When recess was scheduled before lunch, food waste of milk, meat, and vegetables was all lower, and overall food waste decreased from 34.9% to 24.3% ($p\text{-value}<0.05$) (Getlinger, Laughlin, Bell, Akre, & Arjmandi, 1996). These findings suggest that when children do not feel pressured to hurry and finish

eating, they have more time to enjoy their meals, which can lead to improved dietary intake.

Along with dietary concerns, physical activity is also declining in children and adolescents, which may decrease energy output (Harsoshena et al., 2003). One study in elementary school children observed that 20.5% of boys and 24.4 % of girls were inactive, and that activity levels declined with age in both genders (O'Loughlin, Paradis, Kishchuk, Barnett, & Renaud, 1999). Limited access to recreational space, due to neighborhood safety also influences physical activity (Trasande et al., 2009). Both of these limitations can contribute to increased energy intake and decreased energy expenditure, elevating risk for obesity. Neighborhood differences also contribute to the obesity disparities due to socioeconomic status (SES) and race/ethnicity (Rossen & Talih, 2014).

Socioeconomic status contributes to obesity disparities. In adults, an inverse relationship exists for SES and overweight/obesity. Which is especially apparent in adult women, with women from lower SES having six times higher prevalence of obesity compared to those from higher SES (Sobal & Stunkard, 1989). However, the correlation is not consistent among children. The inconsistency between studies examining SES and weight status in children could be related to the definition of SES in various studies. For example, an association between parental education level and childhood obesity has been observed. Obesity prevalence among children whose parents completed college (9% in girls and 11% in boys) was about half that of those whose parents did not complete high school (19% in girls and 21% in boys) between 1999-2010 ("Childhood Obesity Facts," 2015). While there is inconsistent evidence on the association between SES and

overweight/obesity rates in children, since parental SES is a strong predictor of the lifelong SES for children, we can predict that children growing up in lower SES households will have an increased risk for obesity throughout life. Many studies have also come to the conclusion that SES and obesity vary by ethnicity, and that ethnic/racial differences in BMI are not fully explained by individual SES (Sobal & Stunkard, 1989).

Ethnic/racial disparities exist when it comes to childhood obesity rates. The prevalence of obesity is higher among Hispanics (22.4%) and non-Hispanic blacks (20.2%), compared to non-Hispanic whites (14.1%) in 2011-2012 (“Childhood Obesity Facts,” 2015). Obesity prevalence is lowest in non-Hispanic Asians (8.6%) in 2011-2012 (“Childhood Obesity Facts,” 2015). Some of these disparities may be accounted for because of behavioral risk factors associated with obesity related to race/ethnicity. Blacks and Hispanics have higher rates of the following when compared to their non-Hispanic white counterparts; maternal depression during pregnancy, rapid weight gain during infancy, introduction of solid food earlier, and after 2 years of age, higher intake of sugar-sweetened beverages, and higher intake of fast food. Blacks consume sugar sweetened beverages 4 times as much as their non-Hispanic white counterparts, and Hispanics eat fast food 3 times as much as their white counterparts (Taveras et al., 2010). Black and Hispanic children also have lower rates of exclusive breast-feeding, and studies have demonstrated that breast-feeding is associated with a lower risk of obesity in childhood and adolescence (Daniels et al., 2005). Racial/ethnic disparities can contribute to behavior that may increase the risk of becoming overweight/obese in childhood.

Children’s eating behaviors, that start to develop at birth, are established by early childhood, and parents’ behaviors largely influence this (Budd & Hayman, 2010). During

infancy there is an innate preference for sweet and salty tastes, and a rejection of sour and bitter, coupled with neophobic tendencies of infants this causes them to reject new foods that aren't salty or sweet. Accepting new foods, especially those that are bitter, primarily vegetables, takes repeated exposures and liking of these foods generally increases after 5-10 exposures (L. L. Birch & Fisher, 2015). Parents shape their children's food environment, which in turn shapes children's preferences and food acceptance patterns later in life (Evers, 1997). Children's food preference is also impacted by social factors, including interactions with parents and peers. Adults and peers in a child's life can induce consumption of foods that were initially disliked by the child through modeling. This was seen with an increase in consumption of vegetables after the children observed their peers eating them (L. L. Birch & Fisher, 2015). Mealtime structure set up by parents and caregivers also influences children's eating behavior, for instance families that eat together consume more healthy foods. Parental feeding style also influence food behavior, controlling parents tend to have children with higher levels of body fat, which may in part be due to children losing internal ability to regulate food consumption. Using food as rewards for certain behaviors can also increase preference of a specific food, while offering a reward for eating certain foods, such as vegetables, can decrease liking of that food. These types of parental behaviors have been associated with negative effects on the quality of children's diets by reducing preference for those foods (Bhadoria et al., 2015). However, authoritative parental feeding style, which involves providing healthful food options, allowing the child to choose what to consume and how much is associated with positive outlook towards healthier foods and healthier food intake (Bhadoria et al., 2015). Studies have observed that children's food preference is currently of concern, for

instance 18% to 33% of infants and toddlers consumed no distinct servings of vegetables on a typical day and when vegetables were consumed, it was mostly in the form of french fries. There is also evidence that these dietary patterns tend to persist throughout childhood and into adolescence, and that diet quality declines from early childhood through adolescence (L. L. Birch & Fisher, 2015). This reiterates the importance of developing healthy eating habits at an early age that they can take with them into their adult life.

Prevention

One way childhood obesity may be reduced is by improving children's eating behavior and food choices. One of the places where obesity prevention efforts should be targeted is schools. Children spend most of their time at school, as well as consuming almost half of their calories while at school (Alpern, Stauffer, & Kesselheim, 2014). The national school lunch program can provide many children with about half of their daily calorie needs, and school lunch provides low-cost or free lunch to more than 31 million students at 92% of U.S. public and private schools (Alpern et al., 2014). Focusing on improving the school lunch environment, therefore, can be a great target for intervention (Perry et al., 2004).

National School Lunch Program

The National School Lunch Program (NSLP) was developed to meet federally defined nutrition standards. In 2010, the USDA put new regulations into place in order to align with the Healthy Hunger-free kids act. The regulations include offering fruits and vegetables as two separate meal components, offering fruits and vegetables daily at lunch, offering more vegetable subgroups like darky leafy greens and legumes, and fewer

starchy vegetables throughout the week, at least half whole grains, and require students to select a fruit or vegetable as part of their reimbursable meal. Additionally, participating schools must offer lunch at a reduced price to eligible children. Children from families with incomes below 130% of the federal poverty level are eligible for free meals. Children from families with incomes between 130 and 185% of the federal poverty level are eligible to receive reduced-price meals (USDA, 2012). A larger proportion of NSLP participants compared to nonparticipants are black or Hispanic. Participants are also more likely to be certified for free or reduced-price meals and to have low family incomes (47 percent of participants vs 32 percent of nonparticipants) and come from families with incomes below 185% of the poverty line (USDA, 2012).

Eating school lunch improves school-aged children's diets, by increasing micronutrient intake during lunch and for the entire day, compared to children who do not eat school lunch. Participants in NSLP have significantly higher intakes of vitamin b6, vitamin b12, thiamin, riboflavin, calcium, magnesium, phosphorous, and zinc over a 24-hour period, participants also have higher intakes of vitamin a, folate, iron, and fiber, but this isn't sustained over a 24-hour period. Participation in the school lunch program declines with age and as competitive options to school meals become available (Story, Kaphingst, & French, 2006).

School Based Intervention

Schools are a good target for intervention since school-based interventions reach a large amount of students at once. Interventions that target school lunch can be beneficial in improving children's diets by increasing fruit, vegetable, and whole grain consumption, and decreasing fat and sodium intake. School-based interventions can

target multiple areas such as incorporating a healthy eating curriculum in the classroom and environmental changes to the cafeteria.

Incorporating nutrition education into the already existing curriculum is an accessible way to incorporate nutrition at all grade levels. The Child and Adolescent Trial for Cardiovascular Health (CATCH) was a health behavior intervention implemented in elementary schools that focused on classroom curriculum. The intervention outcomes were measured using 24 hour recalls in 3rd grade, and following intervention, in the 5th grade, the intervention school had significant decreases in the consumption of total fat from 32.7% of energy to 30.3%, total energy, and decreases of saturated fat from 12.8% of energy to 11.4% of total energy (Lytle et al., 1996). As well as incorporating nutrition education, developing skills around food and eating are an important educational component as well. Teaching students about gardening, cooking, and mindful eating are all conducive to healthier food choices. A study in Minneapolis in three multicultural schools with children aged 8-15 participated in a gardening program that emphasized growing and harvesting food coupled with a nutrition curriculum that lasted 10 weeks. The children's fruit and vegetable consumption was measured before and after the intervention. The intervention significantly increased fruit consumption from 2 (mean) servings/day to 3 servings/day in boys ($p=0.029$) and vegetable consumption from 2 servings/day to 3.4 servings/day in boys ($p=0.007$) (Lautenshlager & Smith, 2007). Another study performed in English primary schools observed the influence that a culinary cooking class had on consumption of vegetables. The study had a professional chef come and teach two lessons on preparing a pasta salad with peas, cucumbers, tomatoes, celery, and red pepper. Vegetable consumption was measured using a scale of

1 (ate it more than once) -4 (did not eat it and did not want to eat it), and the vegetables in the pasta salad were used as a proxy for overall vegetable consumption. Vegetable consumption increased after the intervention by a mean of 0.09 ($p=0.002$) (Caraher, Seeley, Wu, & Lloyd, 2013). Recently, more school-based interventions have been targeting the school lunch environment to improve healthy food intake by the students who eat a school lunch (Jaime & Lock, 2009).

The goal of most school-based nutrition programs is to increase the consumption of healthy foods at school, including fruits and vegetables. Factors that have been reported to influence children's food choice and consumption were availability of ready to eat food and appealing packages (Pérez-Rodrigo & Aranceta, 2001). Other environmental changes to the school lunchroom include changes in food supply, point of purchase nutrition information and collaborations with private sector food distributors. Children have also been shown to make healthier food choices in a cafeteria setting when there is a comfortable environment to sit and enjoy the food, and when there is plenty of time for students to eat their meals. Marketing healthy foods in the lunchroom have also shown to be beneficial. Marketing methods include promotional materials, taste-testing activities, point of purchase signs, posters and student contests (Pérez-Rodrigo & Aranceta, 2001). The Smarter Lunchrooms Movement is an intervention strategy that incorporates these aspects into school cafeterias to nudge students to make healthier choices.

Smarter Lunchrooms

Smarter Lunchrooms (SL) was developed in 2009 by Brian Wansink and David Just from the Cornell Center for Behavioral Economics in Child Nutrition Programs (the

B.E.N. Center). SL incorporates behavioral economics into interventions to promote healthier food choices in schools. Behavioral economics was developed by economists and psychologists and uses principles based on biases in perception and thought processes and how those influence purchasing decisions (Mullainathan & Thaler, 2000). Behavioral economics in this context identifies behavioral triggers that lead individuals to select and purchase certain foods. SL uses these principles to influence selection and consumption of healthier foods in the lunchroom. The SL environment is designed to cue students to make healthier choices, and minimize the cues that influence students to make less healthy choices (Just & Wansink, 2009). Two principles that SL borrows from psychology are reactance and self-attribution (“Intro Into Behavioral Economics,” n.d.). Reactance occurs when an individual is forced or coerced into doing something, which tends to lead to rebellion. In the environment of school lunch, when certain desserts are completely banned by administration, children will rebel, and choose to purchase cookies and brownies on their own time outside of school. Self-attribution is the opposite of reactance; it takes place when an individual takes conscious ownership of their decision. In the lunchroom this occurs when a child makes a choice of a healthy item over an unhealthy item, instead of being forced to take something healthier. Having ownership of those choices allows for the child to feel empowered and make healthier choices in the future. These principles of behavioral economics are a part of libertarian paternalism, which are policies that are designed to influence choice but not infringe upon individual liberties. The aim of libertarian paternalism is to alter the environment to cue individuals towards certain choices, in the case of SL, the cues are designed to lead to selecting healthier foods. The aim of libertarian paternalism is to allow for the decision maker to

maintain self-attribution by making their own choices, but to also develop healthier habits that will carry out of the school environment (Hanks, Just, & Wansink, 2013).

The goal of SL is to equip schools with evidence-based strategies to influence students to make healthier food choices. The strategies incorporate low cost to no cost interventions, have a lunchroom focus, promote healthful eating behaviors, and are intended to be sustainable. The success of SL has led the USDA to award SL with a federal grant to increase students' healthy food consumption during school lunches across the nation (Redman, 2013). SL has developed best practices that can be implemented at schools by interested community members including food service directors, teachers, staff, and parents. Best practices include interventions to increase fruit, vegetable, main entrée, white milk consumption, and reimbursable meal participation. The six main pillars of SL are managing portion size, increasing convenience, improving visibility, enhancing taste expectations, suggestive selling, and pricing strategies (Table 1.1).

Table 1. Main Principles of the Smarter Lunchrooms Movement

Pillar	Principle
1	Manage portion size
2	Increase convenience
3	Improve visibility
4	Enhance taste expectation
5	Suggestive selling
6	Pricing strategy

Manage Portion Size

Portion sizes have increased dramatically over the past 20 years (Young & Nestle, 2002). With these larger portion sizes, the public has gotten worse at estimating the quantity of food they receive. Doubling the size of a fast food portion or product packages only makes it appear to be 50–70% bigger (Wansink & Chandon, 2014). Larger

portion sizes may be a contributor to how much children are eating, specifically in schools. While certain schools provide pre-portioned meals to their students, ones that allow for self-service can influence the amount their students are consuming of both healthy and unhealthy foods. While there haven't been any studies observing portion sizes in schools on student's consumption, there have been studies done with adult populations. Wansink et al performed a study on 85 nutrition experts that were gathered for ice cream, to determine how much ice cream they would consume based on the size of the serving utensils and bowls provided. Participants were randomly assigned either a small or large bowl, or small or large utensils to serve themselves ice cream. When participants used a larger bowl, they served themselves 31% more ice cream, and servings increased by 14.5% when participants used a larger spoon regardless of the size of the bowl (Wansink, van Ittersum, & Painter, 2006). This study implicates that simple environmental cues like the size of serving utensils can influence how much food individuals will unknowingly serve themselves. These simple changes can be incorporated into the lunchroom environment, by swapping out larger serving utensils for smaller ones for unhealthier food items, and increasing serving utensil size for healthier food items. Studies on serving utensil size has not been investigated in depth at the school level, this is an area of research that could be explored.

Increase Convenience

One of the strategies to improve children's healthy food choice at lunch is to increase fruit and vegetable choice and consumption. Increasing the accessibility of fruits and vegetables can do this. Accessibility differs in availability, with availability related to the presence of foods in the environment and accessibility concerning whether the foods

are available in a form and at a location and time that facilitates their consumption (Swanson, Branscum, & Nakayima, 2009). One study wanted to analyze whether slicing fruits would increase their accessibility. The researchers observed the selection and consumption of apples and oranges by students in kindergarten to fourth grade, in a rural Kentucky elementary school with a mostly non-Hispanic white population. Whole fruits were made available for students to place on their trays, and sliced apples and oranges were placed in individual bowls, which students placed on their trays. Sliced oranges were selected more often than whole oranges at 16.2% vs. 5.5%, but sliced apples were not chosen more than whole apples at 18.8% vs. 22.6%. The students who selected the sliced oranges also ate more, but there was no increase seen with the sliced apples. When analyzed by grade level, younger students were more likely to select both the sliced apples and oranges, and more likely to consume the sliced oranges compared to the older students. This indicates that slicing fruit, especially hard to eat fruit like oranges, can make them more accessible to younger children (Swanson et al., 2009).

A study done in six middle schools in Wayne County, New York, also wanted to observe the effect that slicing fruit would have on selection and intake. Three of the schools were randomly assigned sliced apples, and the other schools were assigned whole apples. The selection, consumption, and waste of apples were measured using a visual tray waste estimate and production records. The schools with sliced apples increased average daily apple sales by 71%, and students who ate more than half of their apple increased by 73% (Wansink, Just, Hanks, & Smith, 2013). This study contributes to the knowledge about making fruit more accessible, but pre-slicing it and making it easier for

consumption by students. Decreasing the barrier of accessibility increases the selection and consumption of fruit.

Another way to increase accessibility of fruit is to move them into decorative bowls throughout the lunchroom, to increase their visibility and reoccurrence. In a school in Minnesota, researchers moved a variety of fruit, including plums, peaches, apples, bananas, and oranges, to the cash register area, to replace snack foods like chips, granola bars, and desserts. This was a high traffic area in the school, so while students are waiting to purchase lunch they make impulse buys, the researchers replaced unhealthy impulse buys with healthier options. Fruit sales increased, snack food sales decreased, and total revenue did not drastically change (Wansink, 2015). In northern New York, researchers conducted a pre-post control design in which fruit was placed in colorful bowls in accessible places in the lunchroom. Three schools participated, with a total of 560 students in the study, which ran for a full semester. Following the intervention, all three schools saw increases in fruit sales. Three months after intervention, the average fruit sale among all three schools was 105% more before the intervention (Wansink & Hall, 2011).

Increasing convenience of healthy foods has been done in schools by incorporating convenience lines that feature only healthful food. These convenience lines have a healthy entrée choice, and fruits and vegetables as the only options for sides. They also serve salads in attractive see-through containers that can easily be picked up to eat on the go. A study done by Hanks et al introduced a convenience line at a high school in Corning, New York. The introduction of the convenience line increased the amount of items students took altogether, but the number of healthier foods students selected significantly increased by 18.8% (0.66–0.79 foods per student, $p=0.00$). The amount of

total milk taken also significantly increased, total milk selected increased by 12% (0.86–0.96 cartons per student, $p=0.00$). However, even though they took more healthy food items, they did not eat more of these foods. Consumption of healthy food items remained the same after the intervention (282.4–282.4 g per student, $p=1.00$), and more of the healthy food items ended up being wasted. Results also indicated that consumption of less healthy foods decreases by 27.9% ($p=0.00$). The study suggests that increasing convenience of healthier foods does cue students to take more of those items, but it is not enough to drive and increase in consumption. However, the increased exposure to healthier foods could eventually lead to a preference change for those healthier items (Hanks, Just, Smith, & Wansink, 2012).

Increase Visibility

Increasing visibility involves moving fruit and vegetables out of hidden and unattractive areas of the cafeteria into high traffic locations, and into decorative bowls. Some of the interventions discussed earlier that were increasing accessibility were also, increasing visibility of fruits and vegetables. Salad bars are one way to increase the accessibility and visibility of fruits and vegetables in the lunchroom. Incorporating salad bars in schools has gained popularity in the last few years (Adams, Bruening, Ohri-vachaspati, & Hurley, 2015). Salad bars are one way food service directors have tried to increase the appeal of fruits and vegetables and give students self-attribution through choice, in the lunch line.

Adams et al examined how placement of the salad bar in the cafeteria could influence choice and consumption of fruits and vegetables. In six middle schools with mostly non-white students, many of who were eligible for free and reduced lunch, three

schools had salad bars placed inside the serving line, and the other three had salad bars placed outside the serving line. The salad bars inside the serving line were more accessible since the students walked right past them, versus having to leave the service line to go to the salad bar. The results of the study indicated that middle school students consumed five times the amount of fruits and vegetables, when the salad bar was located within the service line. This means that placement of the salad bar in the lunchroom does have an impact on how much fruits and vegetables students will select and eat. Moving the salad bar to a higher traffic area within the cafeteria can have an increased effect on the amount of fruits and vegetables students select and consume. Students selecting any fruits or vegetables versus none was 4.36 times greater with salad bars located inside the serving line (Adams et al., 2015). Another study that was done in New York, involved moving a salad bar that already existed next to a wall, to the foreground of the cafeteria. This forced students to walk past the salad bar daily during lunch. Salad sales increased after the move of the salad bar, and continued to increase after the change was put in place (Just & Wansink, 2009).

Enhancing Taste Expectations

Taste expectation is what an individual perceives a food will taste like before tasting it. The belief about the way the food will taste comes from past experience with that specific food and the descriptive cues given about the food in the name or description of it. Restaurants employ this technique to increase the taste expectation of menu items by giving them attractive names. Similar techniques can be used at the school level, to increase consumption of healthy foods like fruits and vegetables. Wansink et al wanted to

examine whether giving carrots an attractive age appropriate name would increase their selection and consumption during lunch.

Elementary schools with ethnically and economically diverse populations had 113 students participate in a study where carrots were added to the lunch menu before and after intervention. Selection and consumption was recorded on three days prior to intervention, day of intervention, and day following intervention by recording what was taken, and weighing the leftovers to determine amount eaten. The intervention involved a treatment and control, the treatment school received carrots named “X-ray Vision Carrots” on the day of the intervention, while the control school received carrots simply named “The Food of the Day.” At both schools carrots were offered one day of the week where they were unnamed. The amount of carrots taken did not differ between the treatment and control group, but the amount of carrots eaten was higher in the “X-Ray Vision Carrot” group than the “Food of the Day” group. Carrots named “X-ray Vision Carrots” were eaten 66% of the time, only 32% of carrots named “Food of the Day” were eaten and 35% of unnamed carrots were eaten. The attractive naming of the carrots also had a carry over effect, the students that were exposed to the “X-ray Vision Carrots” were more likely to take carrots the day following intervention when they were unnamed (Wansink, Just, Payne, & Klinger, 2012).

Wansink et al performed another study observing the influence of attractive names for selection and consumption of multiple vegetables at two similar elementary schools with identical menus outside of New York City. Data on selection and consumption of carrots, green beans, and broccoli was collected at baseline, and following intervention. The intervention involved giving vegetables the attractive names

X-ray Vision Carrots, Power Punch Broccoli, Silly Dilly Green Beans, and Tiny Tasty Tree Tops, which were displayed on place cards next to the vegetables on the lunch line at one school, and not changing anything at the control school. After implementation of the creative names, the proportion of students taking vegetables increased by 99%, while the control school saw a decrease in proportion of students taking vegetables by 16.2%. The school with the attractive vegetable names saw selection of broccoli increase by 109.4%, green beans by 176.9%, and carrots by 30.2% (Wansink et al., 2012). Using creative age-appropriate names to describe healthy food items in the school lunchroom environment shows promising results in increasing vegetable, and probably fruit, consumption.

Figure 1 Descriptive names and effect on vegetable consumption in middle schools. (Adapted from Wansink et al., 2012).

Suggestive Selling

Suggestive selling incorporates the use of physical, as well as verbal cues to remind students to take a healthy food items. Using signs or verbal prompts by the lunchroom staff can do this. Signage can include posters that say do not forget to choose

a fruit, or save that apple for later. While lunchroom staff can remind students that they have the option of taking a fruit or vegetable with their meal. A study in New England elementary schools investigated if giving students the verbal prompt “would you like fruit or juice?” would increase their consumption of a serving of fruit. On the first data collection date, students at the intervention school were four times as likely to take fruit than the control school, and 70% and 69% of students ate their fruit at the intervention and control school respectively. On the second data collection date, three months later, students at the intervention school were twice as likely to take fruit compared to the control school, and 87% and 65% of students ate their fruit at the intervention and control schools, respectively (Springer, Kelder, & Hoelscher, 2006). Simply prompting students about fruits and vegetables can cue them to take that healthier option.

Figure 2 Mean Percentage of Children Taking and Eating Fruit Servings (Taken from Springer, Kelder, & Hoelscher, 2006).

Pricing Strategies

Food choice is largely influenced by taste, cost, and convenience (S A French, 2003). Healthier food items can be perceived as being more expensive than unhealthier

items such as fast food. However, the bundling strategy that fast food establishments use can be incorporated by lunchrooms. Instead of coupling cheap unhealthy foods like fries and burgers, schools can combine healthy main entrees that already come with a healthy side such as a vegetable, for a bundled price. The pricing strategy may be more effective with high school students, especially when they are paying for the lunch themselves. One study examined whether lowering the price of fruit, carrots, and salad by about 50% would increase sales of the items in two high schools. After lowering the price of these healthy food items sales of fruit increased from an average weekly total of 14.4 to 63.3 pieces ($p < 0.0006$), and baby carrot sales increased from an average weekly total of 35.6 to 77.6 packets ($p < 0.021$). Sales returned to baseline levels after the prices returned to normal (Simone A. French et al., 1997). Another strategy that was piloted was having students pay cash for things like desserts and soft drinks. Paying for these unhealthier foods with cash, can feel more of a burden for high school students, instead of using a credit or debit card to pay, where they may not necessarily see the cash exchange occurring right in front of them. In the experiments that employed using cash for competitive foods it was found that it did not hurt revenue or participation and it lead to greater sales of more nutritious items and lower sales of the less nutritious items (Just & Wansink, 2009).

Smarter Lunchrooms Makeover

Many of the studies that have implemented SL interventions have employed multiple principles. These studies looked at the effectiveness of SL when tailored to their specific lunchroom environment. One field study was conducted in Junior-Senior High Schools (grades 7-12) in western New York, which implemented multiple SL principles.

The principles adapted included incorporating a healthy convenience line, posting lunch menus with photos of fruits and vegetables being served, vegetables labeled with attractive names, fruit displayed in decorative bowls, and cueing the staff to give the students verbal prompts about taking fruits and vegetables. The intervention increased the selection and consumption of fruits and vegetables. Students were 13.4% more likely to select fruits and 23% more likely to select vegetables, and fruit consumption increased by 18% and vegetable consumption increased by 25% (Hanks et al., 2013).

Another study done in a high school in Ohio, implemented multiple interventions to increase the attractiveness of the cafeteria, in collaboration with the foodservice director and lunchroom staff. The changes made to the lunchroom included incorporating creative names for food items, adding signage, and incorporating marketing strategies. The intervention increased the number of students choosing fruits and vegetables as a side, number of students choosing fruit went from 22.6% to 40.7% and those choosing vegetables went from 48.65% to 63.31%. The amount of students choosing no fruit or vegetable decreased from 29% to 13% following intervention (McDowell, Gunther, & Kennel, n.d.). SL strategies that incorporate multiple principles have proven to be effective in assisting students' food choices given the results of these studies.

Summary

Childhood obesity is an increasing problem in the United States with about one in three children being overweight and one in six being obese (Ogden et al., 2006).

Childhood obesity has serious associated medical, psychosocial, and economic consequences. Being obese as a child is also a strong predictor of being obese as an adult, which has its own range of complications (Guo et al., 2002). Therefore, it is important to

prevent obesity at an early age. One target area for obesity prevention is through school interventions, since children spend a major proportion of their time and consume about half their calories at school. School interventions can consist of classroom nutrition lessons, gardening and cooking classes, and environmental changes to the lunchroom. SL is an evidence-based program that focuses on low-cost to no-cost changes to the lunchroom environment to alter students' food choice and consumption. SL has demonstrated promising results in improving students food choice and consumption of healthier food items. However, most of the research that has been done has been in older students, primarily middle and high school aged students. Less has been done with elementary school students, to determine if SL strategies are effective in this population. Most of the SL research that exists has also generally been done in the Eastern states of America, with a different racial/ethnic distribution compared to the rest of the United States. As such, significant gaps exist in the SL literature, indicating the need for studies among diverse age, racial/ethnic, and geographic populations. To address these needs, the current study aimed to implement SL principles at two primarily rural elementary schools in the Central Coast of California.

Research questions and hypotheses

- Null hypothesis #1: There is no difference in choice of fruits and vegetables in elementary school-aged children, pre and post implementation of a SL Makeover.
 - After the implementation of the SL Makeover, the children at the two schools will choose more fruits and vegetables compared to before the makeover.

- Null hypothesis #2: There is no difference in healthy food consumption, pre and post implementation of a SL Makeover.
 - After the implementation of the SL Makeover, the children at the two schools will consume more fruits, vegetables, and healthy main entrees compared to the before the makeover.

CHAPTER 3

METHODS

The US Department of Agriculture (USDA) promotes SL interventions, and provides grants to community organizations to put SL practices in place at local schools. The USDA funded a grant for the San Luis Obispo (SLO) Public Health Department to implement SL through the Supplemental Nutrition Assistance Program Nutrition Education (SNAP-Ed). SNAP-Ed is funded by the USDA, and is overseen by the California Department of Public Health Nutrition Education Obesity Prevention Branch (NEOPB).

The Center for Solutions Through Research in Diet and Exercise (STRIDE) at California Polytechnic State University (Cal Poly) was subcontracted to put SL interventions in place in SLO County. The research portion of this project was supported by Cal Poly. The team consisted of the supervisor (Aydin Nazmi), program coordinator (Polina Zhuzhina), and research assistant (Amy Bruter). The team collaborated with the SLO Public Health Department to choose intervention sites, and identify key stakeholders. Two elementary school sites were identified in Paso Robles, CA.: Winifred Pifer and Bauer Speck. The schools were selected based on the relationships that were already established with the public health department, and their National School Lunch Program (NSLP) participation, which was at least 50% participation.

After identifying school sites, stakeholder meetings were initiated for approval of the project at the two schools. The Paso Robles Food Service Director, Rod Blackner, was the first key stakeholder we met with. At the time of the study, he oversaw the centralized kitchen that provided all of the food for the Paso Robles Unified School District. We provided him with a background on the SL Movement, and obtained

permission to make changes to his lunchrooms. After obtaining his permission, we met with staff at both lunchrooms to determine which interventions would be best suited to the lunchrooms' unique needs. Both cafeterias had a similar layout, and featured the same food items daily, since they were all coming from the centralized kitchen in Paso Robles. We decided that the two interventions that would be most practical involved creatively naming all the fruits and vegetables that were featured on the salad bar, and moving fruit into decorative bowls. Before moving forward with the interventions, a research protocol was submitted to the Institutional Review Board (IRB) at California Polytechnic State University. The project did not require approval due to the research not observing humans and only focusing on food service facilities and food trays to track food consumption.

Once IRB approval was waived, we met with key stakeholders at both school sites to move forward with interventions. Meetings with school Principals were set up to gain their approval in implementation of the project. Following Principal approval, we attended staff and PTA meetings to provide training for both staff and interested parents on what the SL Movement was and how it could be sustained after interventions were put into place. After gaining key stakeholders buy in, baseline data was collected to track what the students at the two schools were eating prior to intervention.

Both schools have two different lunch periods; the first lunch period begins at 11:40 and ends at 12:20 for 1st-3rd graders, and the second lunch period begins at 12:10 and ends at 12:50 for 4th-5th graders. To collect baseline data on student consumption, stickers numbered from 1-300, were placed on each tray at the schools before lunch began. A photograph was taken of each tray from directly above after the student had

taken their lunch, and at the end of lunch before the tray was thrown out. The photos were then paired using the numbered stickers on the tray, and the photos were arranged side by side on a PowerPoint slide. The photos were compared before and after lunch to track whether the students took a fruit, vegetable, and/or entrée, and how much of their fruit, vegetable, and entrée they ate. Consumption was analyzed on a 4-point scale for each item; a 4 was given if the entire item remained uneaten, 3 if $\frac{3}{4}$ was left, 2 if $\frac{1}{2}$ was left, 1 if $\frac{1}{4}$ was left, and 0 if none of the item was left on the tray (Hanks, Wansink, & Just, 2014). For the purposes of this study, the 4-point scale was utilized as a proxy for consumption, as has previously been done in SL research (Hanks et al., 2013). Consumption was analyzed by Polina and Amy, rating the food items and concluding and establishing a final rating through discussion.

The items that were offered on the salad bar stayed fairly consistent throughout the school year, with slight variability depending on what was available to the food service director. The main entrees offered at the schools varied on a weekly basis, and for data collection ideally coming back on days where the same entrée would be served was planned. However, entrée items did change last minute based on what was available to the food service director, and scheduling of baseline data collection dates.

Baseline data

Baseline data was collected at Winifred Pifer on February 10 and 17, 2015, which featured nachos and a meatball sub sandwich as the main entrée, respectively. At Bauer Speck data was collected on February 18, 24 and March 3, 2015. The third date was added to complement the lack of data collected on the first visit. Bauer Speck featured a grilled cheese sandwich, chicken nuggets, and orange chicken, respectively.

Intervention

Following baseline data collection, interventions were put into place. Creative age appropriate names were designed for all of the fruits and vegetables featured on the salad bar (Appendix A) (Wansink et al., 2012). Signage was created featuring the new names as well as personified images of the fruit and vegetables (Appendix A). The resulting signage featured fruit and vegetable superhero-like characters that were placed on the salad bar in clear plastic sleeves so that they were interchangeable. Along with the new signage, decorative bowls were placed near the salad bar and filled with fruit. Colorful plastic bowls were used for sliced fruits like oranges, and wicker bowls were used for whole fruits like apples and bananas.

The interventions were put into place on April 15, 2015 at both Winifred Pifer and Bauer Speck. The interventions were installed prior to the beginning of the lunch period. The first post-intervention data collection occurred on that same day at both schools. Data was collected in the same manner as for the baseline data collection. Once the installation of the intervention was complete, the lunchroom staff maintained the salad bar signage and bowls until the end of the study. Post- intervention data was collected at four dates following implementation at both schools, for a total of five post-intervention data collection dates. At Winifred Pifer data collection took place on April 15, 21, May 5, 19 and 26, 2015. At Bauer Speck data collection took place on April 15,22, May 6, 20 and 27, 2015. After the photos were collected, they were analyzed in the same manner as for the baseline data collection.

Statistical Analysis

After the choice and consumption data was logged for all observations, they were entered into an Excel document and organized by category: tray, date, pre/post intervention, school, period, fruit taken, vegetable taken, fruit consumed, vegetable consumed, and entrée consumed. Fisher exact chi-squared tests (2-sided) for used for comparing pre and post intervention data to analyze the differences between fruit or vegetable taken during lunch, and amount of fruit and vegetable eaten during lunch. Analyses were stratified by school (Bauer Speck and Winifred Pifer) and grade level (1-3 and 4-5), as both variables showed significant heterogeneity in exploratory analyses.

CHAPTER 4

RESULTS

Food choice and consumption was assessed at Winifred Pifer and Bauer Speck Elementary Schools in Paso Robles, CA, before and after SL Intervention (Table 1). Both schools had a similar socio demographic makeup as demonstrated in Table 2. Winifred Pifer and Bauer Speck had 59% and 72% free and reduced lunch rates, respectively.

Table 2. Dates of assessments before and after Smarter Lunchrooms Intervention

Winifred Pifer		Bauer Speck	
Pre	Post	Pre	Post
2.10.15	4.14.15*	2.18.15	4.15.15*
2.17.15	4.21.15	2.24.15	4.22.15
	5.5.15	3.3.15	4.29.15
	5.19.15		5.20.15
	5.26.15		5.27.15

*Date of implementation of Smarter Lunchroom intervention

Table 3. Socio Demographics by School

	White	African American	Latino/Hispanic	Other
Winifred Pifer	34%	2%	55%	5%
Bauer Speck	45%	2%	48%	5%

Fruit and vegetables taken

At the school level, the proportion of students taking fruit was measured before and after the intervention at the two schools. At Winifred Pifer, fruit taken decreased from 99% to 91% (p-value<0.001). At Bauer Speck, fruit taken increased from 60% to 73% (p-value= 0.008). The proportion of students taking vegetables taken was also measured before and after the intervention at both schools. At Winifred Pifer, vegetables taken decreased from 96% to 84% (p-value<0.001). At Bauer Speck, vegetables taken increased from 80% to 84% (p-value=0.3).

Stratified by school and grade level (grades 1-2 and 3-5), results were mixed (Table 3). For Winifred Pifer, fruit taken significantly decreased after the intervention at both grade levels. For grades 1-2 it decreased from 99% to 93% (p-value=0.03). For grades 3-5 it decreased from 100% to 89% (p-value=0.03). Vegetables taken decreased in Grades 1-2 from 97% to 86% (p-value=0.003), and not significantly decreased in Grades 3-5 from 94% to 82% (p-value=0.09).

At Bauer Speck, fruit taken increased after intervention at both the 1st-3rd and 4th-5th grade level, as reflected at the overall school level. For grades 1-3 it increased from 64% to 70% (p-value=0.3). For grades 4-5 it increased from 52% to 77% (p-value=0.002). Vegetables taken also increased at both grade levels, but neither of these was significant. For grades 1-2 it increased from 82% to 83% (p-value=0.9). For grades 3-5 it increased from 77% to 87% (p-value=0.2).

Table 4. Proportion of Fruits and Vegetables Taken by Students, by School and Period, Before and After Smarter Lunchrooms Intervention

	Winifred Pifer						Bauer Speck					
	Grades1-3			Grades4-5			Grades1-3			Grades4-5		
	Pre	Post	p-value	Pre	Post	p-value	Pre	Post	p-value	Pre	Post	p-value
F	99%	93%	0.03	100%	89%	0.03	64%	70%	0.3	52%	77%	0.002
V	97%	86%	0.003	94%	82%	0.09	82%	83%	0.9	77%	87%	0.2

N= 186-454 depending on school and period

Figure 3 Proportion of Fruit and Vegetables Taken by Students During 2 Lunch Periods by School, Before and After Smarter Lunchrooms Intervention

Consumption of fruits, vegetables, and main entrée

Consumption of fruits, vegetables and main entrée was also measured at both schools, before and after intervention. Consumption was assessed using a 0-4 scale, where 0 represented the student consuming the entire item and 4 represented the item apparently not being touched (i.e. photo suggested that the student did not eat any of the item).

Consumption data for fruits and vegetables were only gathered for students who took fruits or vegetables.

School level

At the school level, assessments of both 0 and 4 became more common following the intervention at Winifred Pifer ($p < 0.001$). This suggests that more students ate all the fruits they took (score 0) whereas more students also did not eat any of the fruits they

took (score 4). The proportion of students who ate the entire fruit increased from 26% to 32%, and the proportion of students who did not eat any of their fruit increased from 19% to 38%. For amount of vegetables consumed, the proportion of students who ate all of their vegetables increased from 7% to 13%, and the proportion of students who did not eat any of their vegetables decreased from 76% to 67% ($p=0.2$). The proportion of students who ate $\frac{1}{4}$ to $\frac{3}{4}$ of their vegetables stayed fairly consistent before and after the intervention. Main entrée consumption stayed consistent for the proportion of students who ate all of their entrée before and after intervention. The proportion of students who did not eat any of their main entrée decreased from 30% to 4% ($p\text{-value}<0.001$). In sum, at Winifred Pifer, the intervention resulted in more students eating all of their fruits and vegetables. In parallel, more students did not eat *any* of their fruits while fewer students ate none of their vegetables.

At Bauer Speck, assessments of fruit at both 0 and 4 became more common following the intervention ($p\text{-value}=0.005$). This suggests that more students ate all the fruits they took (score 0) whereas more students also did not eat any of the fruits they took (score 4). The proportion of students who ate the entire fruit increased from 20% to 25%, and the proportion of students who didn't touch their fruit increased from 36% to 54%. Assessments of vegetables at both 0 and 4 became more common following the intervention ($p\text{-value}=0.02$). The proportion of students who ate all of their vegetables increased from 11% to 14%, and the proportion of students who didn't touch their vegetables increased from 48% to 56%. Main entrée consumption stayed fairly consistent before and after intervention, and did not show any significance ($p\text{-value}=0.5$). In sum, at

Bauer Speck, the intervention resulted in more students eating all of their fruits and vegetables. However, more students also didn't eat any of their fruits or vegetables.

Figure 4 Proportion of Students Consuming Entire Fruit, Vegetable, and Main Entrée, by School, Before and After Smarter Lunchrooms Intervention

Figure 5 Proportion of Students Consuming None of their Fruits, Vegetables, and Main Entrée, by School, Before and After Smarter Lunchrooms Intervention

School and grade level

Consumption was then stratified by school and grade level, as seen in Table 4. At Winifred Pifer, for 1st-3rd grade level, fruit consumption significantly increased at both ends, similar to observations at the school level. The proportion of students who finished all of their fruit increased (21% to 28%), as did the proportion of those that did not eat any of their fruit (15% to 40%), $p<0.001$. For 4th-5th grade level, the proportion of students who finished all of their fruit stayed consistent before and after intervention, while the proportion of students who left their entire fruit increased (28% to 36%), $p=0.09$.

For vegetable consumption, at the 1st-3rd grade level, the consumption of vegetables stayed consistent before and after intervention ($p=0.8$). At the 4th-5th grade level, the proportion of students who ate all of their vegetables increased (10% to 19%), and the proportion of students who left all their vegetables decreased (69% to 57%), however these results did not achieve statistical significance ($p=0.5$).

Main entrée consumption at the 1st-3rd grade level was significantly impacted by the intervention ($p<0.001$). The proportion of students who ate all of their entrée stayed consistent, but the proportion that left their entire entrée decreased by 91% (or 31 percentage points). At the 4th-5th grade level, both ends of the consumption spectrum significantly decreased (46% to 37% for completely eaten and 19% to 5% for none eaten), while the students who ate $\frac{1}{2}$ - $\frac{3}{4}$ of their entrée increased, 4% to 20% and 8% to 20%, respectively ($p=0.01$).

In sum, at Winifred Pifer, the proportion of students who consumed all or none of their fruits significantly increased at the 1-3 grade level. The proportion of students at

both grade levels who ate at least some of the main entrée also increased significantly.

Vegetable consumption did not significantly change.

At Bauer Speck, fruit consumption at the 1st-3rd-grade level significantly increased for the proportion of students who left all of their fruit (24% to 48%), p-value=0.02. At the 4th-5th grade level, there was a significant increase at both ends of the spectrum. The proportion of students who ate all of their fruit increased from 0% to 19%, and the proportion of students who left all of their fruit increased from 58% to 63% (p-value=0.03).

Vegetable consumption, at the 1st-3rd-grade level increased at both ends as well. The proportion of students who ate all of their vegetables increased from 12% to 14%, and the proportion of students who left all of their vegetables increased from 49% to 56% (p-value=0.2). At the 4th-5th-grade level it also increased significantly at both ends. The proportion of students who ate all of their vegetables increased from 10% to 15%, and the proportion of students who left all of their vegetables increased from 45% to 56% (p-value=0.05).

Main entrée consumption stayed fairly consistent at both grade levels before and after intervention. These results were not significant at the 1st-3rd grade (p-value= 0.5) or 4th-5th grade level (p-value=0.96).

In sum, at Bauer Speck, the proportion of students who consumed all or none of their fruits significantly increased at both grade levels. The proportion of students who consumed all of or none of their vegetables significantly increased at the 4-5 grade level. Main entrée consumption did not significantly change.

Table 5. Consumption of Fruits, Vegetables, and Main Entrée, by School and Period, Before and After Smarter Lunchrooms Interventions

Winifred Pifer					Bauer Speck			
	Grade 1-3		Grade 4-5		Grade 1-3		Grade 4-5	
Fruit	Pre	Post	Pre	Post	Pre	Post	Pre	Post
0	21%	28%	38%	37%	30%	29%	0%	19%
1	12%	5%	7%	9%	11%	3%	11%	2%
2	21%	17%	24%	8%	22%	11%	11%	6%
3	31%	10%	3%	12%	14%	9%	21%	10%
4	15%	40%	28%	36%	24%	48%	58%	63%
p-value	<0.001		0.09		0.02		0.03	
Veg	Pre	Post	Pre	Post	Pre	Post	Pre	Post
0	6%	8%	10%	19%	12%	14%	10%	15%
1	3%	3%	10%	5%	8%	3%	13%	1%
2	4%	7%	3%	9%	10%	15%	16%	15%
3	9%	7%	7%	10%	22%	12%	16%	14%
4	78%	75%	69%	57%	49%	56%	45%	56%
p-value	0.8		0.5		0.2		0.05	
Main	Pre	Post	Pre	Post	Pre	Post	Pre	Post
0	25%	27%	46%	37%	36%	42%	60%	54%
1	13%	21%	4%	20%	20%	19%	17%	21%
2	19%	28%	8%	20%	30%	19%	20%	17%
3	9%	21%	23%	18%	11%	14%	0%	2%
4	34%	3%	19%	5%	3%	6%	3%	5%
p-value	<0.001		0.01		0.5		0.96	

N=116-392 depending on school and period

0: 100% eaten; 1: 75% eaten; 2: 50% eaten; 3: 25% eaten; 4: 0% eaten

CHAPTER 5

DISCUSSION

This study aimed to determine whether implementation of SL interventions would alter choice and consumption of fruits vegetables, and main entree in two elementary school in Paso Robles, CA. Findings indicated that SL interventions increased choice of fruits and vegetables at Bauer Speck, but decreased choice at Winifred Pifer. The proportion of students who consumed all of the fruit and vegetable they put on their tray increased at both Bauer Speck and Winifred Pifer, while the proportion of students who ate none of the vegetables they put on their tray decreased at Winifred Pifer. Main entrée consumption stayed fairly consistent at both schools following intervention.

SL interventions have been shown to increase the choice and consumption of healthy food items in the lunchroom by altering the environment. These interventions have been shown to be successful in increasing fruit and vegetable choice and consumption. The aim of most of these studies has been to increase the accessibility of fruits and vegetables by moving fruit and vegetables into accessible areas of the lunchroom, moving fruit into decorative bowls, and giving the fruits and vegetables descriptive names (Hanks et al., 2012). Most of the studies that have incorporated Smarter Lunchrooms interventions have been researched with middle and high school aged students.

There have been fewer studies observing the effect on elementary school aged children. Most studies suggest that elementary school children are different than older groups in terms of what is accessible for them. For example; slicing fruit can increase its accessibility and therefore promote its choice and consumption among children too

young to successfully maneuver cutting/eating larger fruits. One study examined the effect of slicing fruit on choice and consumption of apples and oranges. Choice of both fruit was higher, while consumption of the oranges was higher compared to the students exposed to whole fruit (Wansink et al., 2013). Young children are also extremely influenced by branding, especially if food marketing features bright colors, pictures, and cartoon characters. One study observed the effect that branding meals with McDonald's logos had on the acceptance and liking of those foods by low-income 3-5 year olds. The results indicated that 3-5 year olds were more likely (4 out of 5 comparisons) to prefer the tastes of foods if they thought they were from McDonalds, this demonstrates how branding can impact children's taste perceptions (Robinson, Borzekowski, Matheson, & Kraemer, 2007). Another study that was done with elementary school children focused on increasing taste expectation by giving vegetables creative age-appropriate names. The results indicated that vegetable choice and consumption was higher in vegetables that had creative names compared to those that did not (Wansink et al., 2012).

This was consistent with our findings in that the proportion of children selecting vegetables increased following intervention, as did the proportion of children who consumed 100% of their chosen vegetables at both sites. Our intervention included renaming all of the fruit and vegetables on the salad bar, as well as branding them with fruit and vegetable characters. The signage created for the salad bar incorporated the names and images in one sign that was on the salad bar.

At Winifred Pifer, the proportion of children selecting fruit and vegetables decreased following intervention. This is not consistent with other data that has implemented SL interventions, about 10 other studies have shown increase in fruit and

vegetable choice following SL interventions. However the proportion of students who consumed the entire fruit of those who took fruit increased following intervention. This indicates that of those students who took fruit, more of them finished all of their fruit following the intervention, even though the proportion of students taking fruit decreased. At the same time, the proportion of students who did not eat any of their fruit also increased following intervention. This means there was a U-shaped distribution of consumption of fruit, with increases on both ends of the spectrum (0% and 100% eaten) following intervention. On the other hand, the proportion of students who ate all of their vegetables increased and the proportion that ate none of their vegetables decreased following intervention. This indicates that while fewer students took vegetables from the salad bar, more of them ate all of their vegetables, and more students at least tried their vegetables following intervention. Another study observed similar results following a SL intervention, students were 16% more likely to eat an entire serving of fruit ($p=0.006$) and 10% more likely to eat an entire serving of vegetables ($p=0.022$)(Hanks et al., 2013).

Bauer Speck had different outcomes following intervention. The proportion of students who took fruit and vegetables of the salad bar increased following intervention. At the same time, the proportion of students who ate all or none of their fruits and vegetables increased following intervention. Those students who did not eating any fruits or vegetables, may be partially due to the fact that some students who decided to take fruits and vegetables for the first time following the intervention did not try the fruits and vegetables they picked. However, by simply taking the fruits or vegetables, the students increase their exposure to that specific food. Repeated exposure to fruit or vegetable over time may eventually lead to consumption of the particular food. Studies have shown that

repeated opportunities to taste unfamiliar foods results in increased preferences and consumption (Cooke, 2007). The simple action of students taking a fruit or vegetable can, therefore, eventually increase acceptance and enjoyment of that fruit or vegetable.

There was a difference between the two schools in fruit and vegetable choice following intervention. Winifred Pifer had decreased choice of both fruit and vegetable consumption, while Bauer Speck had increased choice of both. This finding was interesting, since both schools are very similar in terms of socio-demographic makeup and lunchroom layout. While the decrease in choice at Winifred Pifer was surprising, it may be due to the fact that Winifred Pifer had a higher proportion of students who were taking fruits and vegetables before the intervention began compared to Bauer Speck. At Winifred Pifer 99% and 96% of students were taking fruit and vegetables respectively before the intervention, compared to Bauer Speck with 60% and 80% taking fruits and vegetables prior to intervention. While both schools had a similar lunchroom layout, the lunch staff at Winifred Pifer noticeably engaged more intentionally with the students and employed suggestive selling prior to and during the intervention. Suggestive selling is part of the SL principles, and includes giving students verbal cues about taking a healthy food item such as “Don’t forget fruit comes with your meal.” Verbal cues in one pilot study increased the choice and consumption of a fruit serving in elementary school students (Shwartz, 2007). Social support and role models, such as parents, teachers, and lunchroom staff, have an impact on children’s eating behavior(Perry et al., 2004). In a study examining the effect of parent modeling and prompting on children’s willingness to try fruits and vegetables, it was observed that parents that modeled positive eating habits, such as eating food enthusiastically in front of children, had the highest success rate with

52% ($p=0.05$) of children trying the fruit or vegetable. While using a neutral prompt such as “try your peas” was successful 38.5% of the time (Edelson, Mokdad, & Martin, 2016). This indicates that the staff engagement and encouragement with students can have a positive influence on their eating behaviors during lunch.

Prior to the intervention, staff at Winifred Pifer were observed to cue the students to take a fruit or vegetable. After the intervention, the staff seem to cue less frequently, as observed during site visits following intervention. This may have been due to the relatively sudden new tasks and adjustment brought on by the intervention. At Bauer Speck, the staff was engaged with students, but was not observed to cue students to take a fruit or vegetable prior to or during the intervention.

This study had several strengths. This intervention focused on a primarily Latino/Hispanic population. Most SL interventions that have been implemented in the literature have been with a primarily non-Hispanic white populations (Hanks et al., 2013)(Just & Wansink, 2009). It is possible that culturally appropriate changes to a lunchroom containing a majority of Hispanic students should be implemented. While we did observe that the interventions were effective at increasing choice of fruits and vegetables at Bauer Speck, we saw the interventions have an opposite effect at Winifred Pifer. This discrepancy may in part be due to the intervention not targeting a Hispanic population, but more research must be conducted among diverse populations with different cultural backgrounds to more fully understand this phenomenon.

Tailoring interventions to specific age groups is also important. The current study examined findings from grades 1-3 and 4-5, corresponding to ages approximately 6-8 and 9-11 years, respectively. While this intervention was targeting elementary school

children, there are significant differences between younger and older students in elementary school. For this study, we could not distinguish the groups by age, but we were able to stratify by grade. At Winifred Pifer, the intervention affected the older grades (4-5) differently than it did the younger grades (1-3). Following the intervention, a lower proportion of older students took both fruits and vegetables compared to the younger students. This could be due in part that the signage created for the salad bars featured images that may have appealed more to a younger population. The images created were meant to brand the fruits and vegetables at the salad bar by personifying them as a type of “superhero” character. While this may have appealed to the younger students, it may have created a negative or potentially childish view of the fruits and vegetables for the older students. This was not observed at Bauer Speck, in fact, students there actually had a higher proportion of the older students who took fruits and vegetables compared to the younger students. Again, to decipher the associations between different types of intervention strategies and outcomes, more research employing a wider range of intervention tactics is needed among a more diverse age range of students.

Many of the SL interventions in the literature have been implemented in primarily non-Hispanic white populations and older students including middle and high school level. SL has been shown to be effective in these populations in increasing choice of fruits and vegetables as well as consumption of fruits, vegetables, and other healthy food items such as white milk. Fewer interventions have been implemented in Latino/Hispanic populations and younger students. This study adds to the research on SL by showing that interventions in these populations can be effective in increasing the choice of fruits and vegetables, as seen at Bauer Speck, and that it can aid in increasing the proportion of

students finishing all of their fruits and vegetables following intervention. SL looks to influence student food choice via minor changes to their environment. A variety of schools have implemented these changes, and have found them to be an effective intervention strategy.

This study did have some limitations. Baseline and post-evaluation dates were chosen based on the researcher availability, possibly introducing bias into the findings. Ideally the researchers would have studied outcomes on dates when identical meals were being offered at both schools. The salad bar was a main focus of the intervention, and while most of the items on the salad bar did remain consistent throughout the study, certain fruits and vegetables changed day to day based on availability, and sometimes varied by school.

Capturing all students that obtained a school lunch during the data collection dates was another challenge. Tray data was collected as the students left the lunch line with their meal and before they discarded their tray. Some students may have been not captured as they left the lunch line or before they threw out their tray. To track consumption of fruits, vegetables, and entrées during lunch, the same tray was observed pre and post lunch based on a numbered sticker placed on the tray. During the photo matching and analysis to measure consumption, it was evident that some trays were missing stickers if students removed them during lunch, or the sticker was not clear in the photos (Table 1). This prevented the matching of certain trays to analyze consumption of food items during lunch, indicating that not all of the students who were eating a school lunch were captured during the study, which may have introduced bias into our findings. Despite these limitations, this study was able to expand upon and add to the SL literature.

Table 6. Proportion of students captured for pre and post lunch analysis during the study

	Winifred Pifer		Bauer Speck	
	Students taking Lunch	Students Captured	Students taking Lunch	Students Captured
Pre-Intervention	267	126	409	112
Post-Intervention	933	635	814	377

The lunchroom environment is an important venue for obesity prevention, since it can have a major influence on food choice and acceptability. This is especially important with younger children, such as those in elementary school, because their eating habits are in a formative phase (L. L. Birch & Fisher, 2015), and by influencing those habits relatively early in life, healthier behavioral patterns may be reinforced. The food environment can influence food preference since preferences are learned through experiences with food and eating (Neumark-Sztainer, Story, Perry, & Casey, 1999). Further, exposure and accessibility of healthy foods can increase their acceptance over time (S. a French & Stables, 2003). SL aims to make healthy foods more accessible and appealing in the lunch line, improving students' familiarity with the fruits and vegetables in order to increase consumption of more healthful foods. Humans have a genetic preference for foods that are high in sugar, fat, and salt (L. L. Birch & Fisher, 2015). Children will tend to reach for foods high in sugar, fat, and salt when given the opportunity, and will tend to prefer them more when restricted from these foods (Birch, 1999). SL attempts to overcome this by not removing the "junk" foods from the lunchroom, but by simply decreasing accessibility of less healthy foods and increasing access to more healthy ones. The objective of this approach is to not create reactance that

causes children to seek out those foods elsewhere and promote an increased liking for them by putting the decision in the hands of the children, even if that decision is slightly rigged. More systemic changes to the meal structures at schools can also positively influence children's eating habits. By giving students more time to eat their lunch, by reordering play and meal time, students can make more healthful choices while enjoying their food further.

It is evident that establishing healthy dietary habits early in life can be beneficial in preventing childhood obesity (L. Birch, Arbor, Savage, & Ventura, 2009). Food preference and acceptance starts at an early age, and by making healthier foods more appealing to younger students at the school level, we can start to ingrain healthful eating habits and mitigate the onset of obesity. SL has shown promise on improving habits through simple alterations to school lunchroom environments. While this study showed mixed results among primarily Hispanic elementary school aged children, some of the results are in line with previous findings showing largely beneficial outcomes.

Future research should aim to focus on implementing SL interventions in more diverse populations (racially/ethnically, age, and socioeconomic status) to determine whether there are differences in outcomes according to various intervention strategies between socio-demographic groups. Research should also focus on younger students, as they are still developing their eating habits, and making changes in this age group may lead to more powerful influence, compared to trying to change eating habits that are already developed which occurs as children get older. As mentioned earlier, there have been no studies observing the effect of portion sized plates, bowls, and utensils in schools. Research should incorporate this area of the SL principles to determine how the

size of utensils and plates in lunchrooms will influence children's food intake, as it has shown to be effective in adults. Also, future studies should collect data on choice and consumption on days when identical food items are being offered. As this was not part of our study design, and different food items could influence student's food choice based on favorability. Future studies should also focus on sustainability. One of SL key points is that it can be sustainable over time, we did not return to the schools after the study ended, so we are not certain if the staff continued with the interventions once the researchers left. Studies need to observe whether these interventions are kept up after leaving the schools, by returning months or years later to assess whether the interventions are still in place and whether they are still having a positive influence on students food choice and consumption.

If SL strategies and similar interventions are causally associated with improvement of dietary outcomes among school children, these simple and low-cost approaches may be an effective part of more holistic approaches to stemming the public health impact of childhood obesity risk.

REFERENCES

- Adams, M., Bruening, M., Ohri-vachaspati, P., & Hurley, J. C. (2015). Location of School Lunch Salad Bars and Fruit and Vegetable Consumption in Middle Schools: A Cross-Sectional Plate Waste Study. *Journal of the Academy of Nutrition and Dietetics*, 116(3), 407–416. doi:10.1016/j.jand.2015.10.011
- Alpern, J. D., Stauffer, W. M., & Kesselheim, A. S. (2014). Proteting Progress against Childhood Obesity- The National School Lunch Program. *New England Journal of Medicine*, 371(20), 1859–1862. doi:10.1056/NEJMp1408376
- Beck, A. R. (2016). Psychosocial Aspects of Obesity. *NASN School Nurse*, 23–27. doi:10.1177/1942602X15619756
- Bhadoria, A., Sahoo, K., Sahoo, B., Choudhury, A., Sufi, N., & Kumar, R. (2015). Childhood obesity: Causes and consequences. *Journal of Family Medicine and Primary Care*, 4(2), 187. doi:10.4103/2249-4863.154628
- Birch, L., Arbor, A., Savage, J. S., & Ventura, A. (2009). Influences on the Development of Children’s Eating Behaviours:From Infancy to Adolescence. *Canadian Journal of Dietetic Practice and Research*, 68(1), 1–11. doi:10.1097/MD.0000000000000215
- Birch, L. L., & Fisher, J. O. (2015). Development of Eating Behaviors Among Children and Adolescents. *Pediatrics*, 488–495.
- Budd, M. G., & Hayman, L. L. (2010). Childhood obesity. *Lancet*, 375(9727), 1737–1748. doi:10.1016/S0140-6736(10)60171-7
- Caraher, M., Seeley, A., Wu, M., & Lloyd, S. (2013). When chefs adopt a school? An evaluation of cooking intervention in English primary schools. *Appetite*, 62, 50–59.
- Cawley, J. (2010). The economics of childhood obesity. *Health Affairs*, 29(3), 364–371. doi:10.1377/hlthaff.2009.0721

- Cawley, J., & Meyerhoefer, C. (2012). The medical care costs of obesity: an instrumental variables approach. *Journal of Health Economics*, 31(1), 219–30.
doi:10.1016/j.jhealeco.2011.10.003
- Childhood Obesity Facts. (2014). Retrieved September 15, 2015, from <http://www.cdc.gov/obesity/childhood/causes.html>
- Childhood Obesity Facts. (2015). Retrieved November 15, 2015, from <http://www.cdc.gov/obesity/data/childhood.html>
- Csabi, G., Torok, K., Jeges, S., & Molnar, D. (2000). Presence of metabolic cardiovascular syndrome in obese children. *European Journal of Pediatrics*, 159(1-2), 91–94.
- Daniels, S. R., Arnett, D. K., Eckel, R. H., Gidding, S. S., Hayman, L. L., Kumanyika, S., ... Williams, C. L. (2005). Overweight in children and adolescents: Pathophysiology, consequences, prevention, and treatment. *Circulation*, 111(15), 1999–2012. doi:10.1161/01.CIR.0000161369.71722.10
- Davis, A., Bennet, K., Befort, C., & Nollen, N. (2014). Obesity and related health behaviors among urban and rural children in the United States: data from the National Health And Nutrition Examination Survey 2003-2004 and 2005-2006. *JAMA : The Journal of the American Medical Association*, 36(6), 669–676.
doi:10.1001/jama.2014.732
- Dietz, W. H., & Gortmaker, S. L. (2001). Preventing Obesity in Children and Adolescents. *Public Health*, (22), 337–353.
- Edelson, L. R., Mokdad, C., & Martin, N. (2016). Prompts to eat novel and familiar fruits and vegetables in families with 1-3 year old children: Relationships with food

- acceptance and intake. *Appetite*, 99, 138–148.
- Evers, C. (1997). Empower children to develop healthful eating habits. *Journal of the American Dietetic Association*. doi:10.1016/S0002-8223(97)00742-6
- Finkelstein, E. A., Graham, W. C. K., & Malhotra, R. (2014). Lifetime Direct Medical Costs of Childhood Obesity. *Pediatrics*, 133(5), 1–9. doi:10.1542/peds.2014-0063
- French, S. a, & Stables, G. (2003). Environmental interventions to promote vegetable and fruit consumption among youth in school settings. *Preventive Medicine*, 37(6), 593–610. doi:10.1016/j.ypmed.2003.09.007
- French, S. A. (2003). Symposium : Sugar and fat — from genes to culture pricing effects on food hoices. *The Journal of Nutrition*, 133(12), 841S–843S.
- French, S. A., Story, M., Jeffery, R. W., Snyder, P., Eisenberg, M., Sidebottom, A., & Murray, D. (1997). Pricing strategy to promote fruit and vegetable purchase in high school cafeterias. *Journal of the American Dietetic Association*. doi:10.1016/S0002-8223(97)00242-3
- Friend, A., Craig, L., & Turner, S. (2013). The Prevalence of Metabolic Syndrome in Children: A Systematic Review of the Literature. *Metabolic Syndrome and Related Disorders*, 11(2), 71–80. doi:10.1089/met.2012.0122
- Getlinger, M. J., Laughlin, C. V. T., Bell, E., Akre, C., & Arjmandi, B. H. (1996). Food waste is reduced when elementary-school children have recess before lunch. *J Am Diet Assoc*. doi:10.1016/S0002-8223(96)00245-3
- Guo, S., Wu, W., Chumlea, W., & Roche, A. (2002). Predicting overweight and obesity in adulthood from body mass index values in childhood and adolescence. *American Journal of Clinical Nutrition*, 76(3), 653–658. Retrieved from

http://apps.webofknowledge.com.ezproxy.vub.ac.be:2048/full_record.do?product=WOS&search_mode=GeneralSearch&qid=4&SID=Y2fbu8RQH42vgzTHmlN&page=3&doc=21&cacheurlFromRightClick=no

- Gurnani, M., Birken, C., & Hamilton, J. (2015). Childhood Obesity: Causes, Consequences, and Management. *Pediatric Clinics*, (62), 821–840.
- Hanks, A. S., Just, D. R., Smith, L. E., & Wansink, B. (2012). Healthy convenience: nudging students toward healthier choices in the lunchroom. *Journal of Public Health (Oxford, England)*, 34(3), 370–6. doi:10.1093/pubmed/fds003
- Hanks, A. S., Just, D. R., & Wansink, B. (2013). Smarter Lunchrooms Can Address New School Lunchroom Guidelines and Childhood Obesity. *The Journal of Pediatrics*, 162(4), 867–869. doi:10.1016/j.jpeds.2012.12.031
- Hanks, A. S., Wansink, B., & Just, D. R. (2014). Reliability and accuracy of real-time visualization techniques for measuring school cafeteria tray waste: Validating the quarter-waste method. *Journal of the Academy of Nutrition and Dietetics*, 114(3), 470–474. doi:10.1016/j.jand.2013.08.013
- Harshena, K., Hyder L., M., & Poston, C. (2003). Childhood Overweight An Expanding Problem. *Treatments in Endocrinology*, 2(6), 375–388.
- Intro Into Behavioral Economics. (n.d.).
- Jaime, P. C., & Lock, K. (2009). Do school based food and nutrition policies improve diet and reduce obesity? *Preventive Medicine*, 48(1), 45–53. doi:10.1016/j.ypmed.2008.10.018
- Just, D. R., & Wansink, B. (2009). Smarter Lunchrooms: Using Behavioral Economics to Improve Meal Selection. *Choices*, 24(3).

- Lautenshlager, L., & Smith, C. (2007). Understanding gardening and dietary habits among youth gardening program participants using the Theory of Planned Behavior. *Appetite*, 49, 122–130.
- Lytle, L. A., Stone, E. J., Nichaman, M. Z., Perry, C. L., Montgomery, D. H., Nicklas, T. A., ... Galati, T. P. (1996). Changes in Nutrient Intakes of Elementary School Children Following a School-Based Intervention: Results from the CATCH Study. *Preventive Medicine*, 25(4), 465–477. doi:10.1006/pmed.1996.0078
- McDowell, K. M., Gunther, C. W., & Kennel, J. A. (n.d.). Determining the Effectiveness of a Behavioral Economics Cafeteria Intervention at Big Walnut High School Designed to Improve Healthfulness of Student Purchases McDowell, K. M., Gunther C.W., Kennel J.A. Department of Nutrition, The Ohio State University,.
- Mullainathan, S., & Thaler, R. H. (2000). Behavioral Economics. *The National Bureau of Economic Research*, 3, 12. doi:JEL No. D0, H0, JO
- Neumark-Sztainer, D., Story, M., Perry, C., & Casey, M. A. (1999). Factors Influencing Food Choices of Adolescents. *Journal of the American Dietetic Association*. doi:10.1016/S0002-8223(99)00222-9
- O'Loughlin, J., Paradis, G., Kishchuk, N., Barnett, T., & Renaud, L. (1999). Prevalence and Correlates of Physical Activity Behaviors among Elementary Schoolchildren in Multiethnic, Low Income, Inner-City Neighborhoods in Montreal, Canada. *Annals of Epidemiology*, 9(7), 397–407. doi:10.1016/S1047-2797(99)00030-7
- Ogden, C. L., Carroll, M. D., Curtin, L. R., McDowell, M. A., Tabak, C. J., & Flegal, K. M. (2006). Prevalence of Overweight and Obesity in the United States, 1999-2004, 295(13), 1999–2004.

- Ogden, C. L., Yanovski, S. Z., Carroll, M. D., & Flegal, K. M. (2007). The Epidemiology of Obesity, 2087–2102. doi:10.1053/j.gastro.2007.03.052
- Pérez-Rodrigo, C., & Aranceta, J. (2001). School-based nutrition education: lessons learned and new perspectives. *Public Health Nutrition*, 4(1A), 131–139. doi:10.1079/PHN2000108
- Perry, C. L., Bishop, D. B., Taylor, G. L., Davis, M., Story, M., Gray, C., ... Harnack, L. (2004). A Randomized School Trial of Environmental Strategies to Encourage Fruit and Vegetable Consumption among Children. *Health Education & Behavior*, 31(1), 65–76. doi:10.1177/1090198103255530
- Price, J., & Just, D. R. (2015). Lunch, recess and nutrition: Responding to time incentives in the cafeteria. *Preventive Medicine*, 71, 27–30. doi:10.1016/j.ypmed.2014.11.016
- Puhl, R. M. (2011). Weight Stigmatization Toward Youth: A Significant Problem in Need of Societal Solutions, 7(5), 359–363. doi:10.1089/chi.2011.0500.pers
- Puhl, R. M., & Latner, J. D. (2007). Stigma, Obesity, and the Health of the Nation's Children, 133(4), 557–580. doi:10.1037/0033-2909.133.4.557
- Robinson, T. N., Borzekowski, D. L. G., Matheson, D. M., & Kraemer, H. C. (2007). Effects of fast food branding on young children's taste preferences. *Archives of Pediatrics & Adolescent Medicine*, 161(8), 792–7. doi:10.1001/archpedi.161.8.792
- Rossen, L. M., & Talih, M. (2014). Social determinants of disparities in weight among US children and adolescents. *Annals of Epidemiology*, 24(10), 705–713. doi:10.1016/j.annepidem.2014.07.010
- Sinha, R., Fisch, G., Teague, B., Tamborlane, V. W., Banyas, B., Allen, K., ... Caprio, S. (2002). Prevalence of impaired glucose tolerance among children and adolescents

- with marked obesity. *The New England Journal of Medicine*, 346(11), 802–810.
- Sobal, J., & Stunkard, A. J. (1989). Socioeconomic status and obesity: a review of the literature. *Psychological Bulletin*, 105(2), 260–75. Retrieved from <http://www.ncbi.nlm.nih.gov/pubmed/2648443>
- Speiser, P. W., Rudolf, M. C. J., Anhalt, H., Camacho-Hubner, C., Chiarelli, F., Eliakim, A., ... Hochberg, Z. (2005). Childhood Obesity. *The Journal of Clinical Endocrinology & Metabolism*, 90(3), 1871–1887. doi:10.1210/jc.2004-1389
- Springer, A. E., Kelder, S. H., & Hoelscher, D. M. (2006). The influence of a verbal prompt on school lunch fruit consumption: a pilot study. *International Journal of Behavioral Nutrition and Physical Activity*, 10, 1–10. doi:10.1186/1479-Received
- Story, M. P. D., Kaphingst, K. M., & French, S. (2006). The Role of Schools in Obesity Prevention. *The Future of Children*, 16(1), 109–142. doi:10.1353/foc.2006.0007
- Swanson, M., Branscum, A., & Nakayima, P. J. (2009). Promoting consumption of fruit in elementary school cafeterias. The effects of slicing apples and oranges. *Appetite*, 53(2), 264–7. doi:10.1016/j.appet.2009.07.015
- Taveras, E. M., Gillman, M. W., Kleinman, K., Rich-Edwards, J. W., Rifas-Shiman, S. L., Ogden, C., ... Daniels, S. (2010). Racial/Ethnic Differences in Early-Life Risk Factors for Childhood Obesity. *Pediatrics*, 125(4), 686–695. doi:10.1542/peds.2009-2100
- Trasande, L., Cronk, C., Durkin, M., Weiss, M., Schoeller, D. A., Gall, E. A., ... Gillman, M. W. (2009). Environment and obesity in the national children's study. *Environmental Health Perspectives*, 117(2), 159–166. doi:10.1289/ehp.11839
- USDA. (2012). *Department of Agriculture Food and Nutrition Service* (Vol. 77).

- Wansink, B. (2015). Slim By Design: Moving from Can't to. *Behavioral Economics and Public Health*, 237–264.
- Wansink, B., & Chandon, P. (2014). Slim by design: Redirecting the accidental drivers of mindless overeating. *Journal of Consumer Psychology*, 24(3), 413–431.
doi:10.1016/j.jcps.2014.03.006
- Wansink, B., & Hall, W. (2011). Move the Fruit: Putting Fruit in New Bowls and New Places Doubles Lunchroom Sales. *Journal of Nutrition Education and Behavior*, 43(4), S1. doi:10.1016/j.jneb.2011.03.013
- Wansink, B., Just, D. R., Hanks, A. S., & Smith, L. E. (2013). Pre-Sliced Fruit in School Cafeterias. *American Journal of Preventive Medicine*, 44(5), 477–480.
doi:10.1016/j.amepre.2013.02.003
- Wansink, B., Just, D. R., Payne, C. R., & Klinger, M. Z. (2012). Attractive names sustain increased vegetable intake in schools. *Preventive Medicine*, 55(4), 330–2.
doi:10.1016/j.ypmed.2012.07.012
- Wansink, B., van Ittersum, K., & Painter, J. E. (2006). Ice Cream Illusions: Bowls, Spoons, and Self-Served Portion Sizes. *American Journal of Preventive Medicine*, 31(3), 240–243. doi:10.1016/j.amepre.2006.04.003
- WHO. (2000). *Obesity: Preventing and Managing the Global Epidemic*.
- Young, L. R., & Nestle, M. (2002). The contribution of expanding portion sizes to the US obesity epidemic. *American Journal of Public Health*, 92(2), 246–249.
doi:10.2105/AJPH.92.2.246

APPENDIX

**Spicy
Black Bean
Bonanza**

**Spicy
Black Bean
Bonanza**

**Chick a boom
Chick Peas**

**Kool
Kidney
Beans**

**Tiny Tree
Cauliflower**

**Bombastic
Beets**

**Tree
Chompin'
Broccoli**

**Crunchy
Munchy
Celery**

**Fiesta
Chili
Beans**

**Super Sweet
Potato
Wedges**

**Veggie
Monster
Medley**

**Super
Strength
Salad**

Cream of the crop
**Golden
Corn**

**Spudzilla
Mashed
Potatoes**

**Super Hero
Spinach
Salad**

**X-Ray Vision
Carrots**

**Sunrise
Strawberries**

**Killer
Kiwis**

Pack a Punch
Pears

Cherries
Jubilee

Perfectly Picked
Peaches

Totally Tropical
Pineapple

**Almighty
Apples**

**Oh say can
you vitamin C
Oranges**