An Acquired Taste:
Evolving Approaches to Nutrition Education in the United States

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Abstract

This thesis considers the effectiveness of three approaches to nutrition education in the United States: classroom lessons about nutrition, cooking classes, and a mandate for educators to improve the food environment. It brings interviews with eight Philadelphia-area nutrition educators into conversation with scholarly program evaluations in order to explore the impacts and outcomes of nutrition education policy change on students, educators, and communities. Especially given high rates of obesity, it is a goal of nutrition education to influence children's behavior in a way that is conducive to healthy eating. The feedback of nutrition educators and scientific evaluations of each method support that hands-on nutrition education through cooking classes is more effective than conventional nutrition lessons at improving children's eating behavior. Instead of devoting substantial resources to cooking programs, however, recent federal policy has promoted an abstract mandate for nutrition educators to improve the food environment in and around under-resourced schools. This mandate has strained educators, who are often neither trained nor given the authority to enact environmental change. The thesis concludes with a sketch of food education in Japan, which is built into the school system through teachers of dietetics who engage children in preparing and serving school meals. Japan's system is a compelling model of how to integrate hands-on nutrition education with environmental change initiatives while supporting educators, rather than overtaxing them.

Acronym Index

AUNI	Agatston Urban Nutrition Initiative
ATOAH	A Taste of African Heritage
CDC	Centers for Disease Control and Prevention
CWK	Cooking With Kids for a Healthy Future
DGA	Dietary Guidelines for Americans
HHS	United States Department of Health and Human Services
HHFKA	Healthy Hunger-Free Kids Act
NET	Nutrition Education and Training Program
PSE Change	Policy, Systems, and Environmental Change
SDP	School District of Philadelphia
SNAP	Supplemental Nutrition Assistance Program
SNAP-Ed	Supplemental Nutrition Assistance Education Program
USDA	United States Department of Agriculture
USDA FNS	United States Department of Agriculture Food and Nutrition Service
SHPPS	School Health Policies and Practices Study

Preface

One Friday afternoon at Comegys Elementary School in Philadelphia, a group of third graders and I gathered around a ten-pound box of turnips and looked at each other with apprehension. Turnips are inexpensive, they are nutritious, and most notably, they taste terrible unless you know how to prepare them. This is the case for many foods that are both cheap and healthy: Rice, lentils, and sweet potatoes are all as cost-effective as they are unsavory when eaten raw. By contrast, Flamin' Hot Cheetos cost next to nothing and require no preparation in order to taste phenomenal. Cheetos and their compatriots are also part of the reason that 40% of children and 70% of adults in Philadelphia are overweight or obese (Farley 2018). While a healthy diet has room for the occasional Cheeto, for full nourishment on a budget as tight as is prescribed by the Supplemental Nutrition Assistance Program (SNAP), cooking is vital skill.

This thesis is the product of my research on the evolution of nutrition education in the United States, the efficacy of different methodological approaches, and the experiences of nutrition educators and program administrators in the Philadelphia area. I became involved with nutrition education through an Academically-Based Community Service course at the University of Pennsylvania that was taught by my thesis advisor, Mary Summers. The course, The Politics of Food and Agriculture, combined study of the nation's policies relating to agriculture, school food, and hunger safety net programs with on-the-ground community work. The course's structure informed the methodology of this thesis, which considers the impacts of different approaches to nutrition education in the context of the history, policies, and institutions that have shaped their implementation.

My experience conducting nutrition education through cooking classes made me confident that cooking is an effective method of nutrition education for the real world, in which

Cheetos taste great and turnips usually taste like sawdust. For the past three years, I have been slinging vegetables around Comegys Elementary School as a mentor with Rebel Chefs, an after-school nutrition education program that equips elementary school students in West Philadelphia with the know-how to prepare low-cost, healthy, delicious meals. The program's greatest asset is that it makes healthy eating fun: I have seen students who swore they would never eat a vegetable later passionately advocate for a certain seasoning mix for steamed cauliflower. I love watching students put their energy and creativity to work making healthy meals that are not only delicious, but are also personal accomplishments. In this way, students develop positive connections with fresh fruits and vegetables, cooking processes, and healthy eating.

While there has been a surge of cooking programs in schools within the last decade, the conventional approach to nutrition education looks nothing like the cafeteria strewn with pans, dribbles of olive oil and scattered carrot peelings to which I have grown accustomed. Instead, conventional nutrition education teaches students about food through classroom lessons on nutrition, which often prioritize information about the roles of nutrients in the body. My positive experience teaching cooking classes made me skeptical of this approach. There is no amount of information you can tell a child about a turnip that will actually enable them to eat one, not to mention to enjoy it. And while it is good to know that carrots contain vitamin A, less than one percent of Americans are vitamin A-deficient and the greatest health problem facing our country is one of overconsumption, not undernutrition. So why has so much nutrition education in the United States been centered on feeding kids complex nutritional information instead of healthy food itself? I set out to write this thesis with these questions in mind, and discovered a multidimensional, vigorous debate over the methods and goals of nutrition education in the United States.

Introduction

Nutrition education in the United States aims to influence children's behavior in a way that is conducive to healthy eating. As scholarship on the country's complex, multifactorial obesity epidemic has increasingly considered the environmental determinants of obesity, nutrition education in the United States has evolved to reflect a broader recognition of the factors shaping food choice beyond nutrition knowledge. This evolution can be observed over three approaches to nutrition education, which increasingly prioritize environmental change: classroom lessons about nutrition, cooking classes, and a mandate for educators to improve the food environment.

Drawing on evaluation studies of each approach and interviews with Philadelphia-area nutrition educators, this thesis will argue that hands-on nutrition education through cooking classes is a "sweet spot" between ineffective classroom-based lessons about nutrients and vague mandates for environmental change. By both surrounding children with healthy food and teaching them to prepare it, cooking classes engage and empower children in ways that improve their diets more effectively than conventional classroom lessons about nutrition. Scholarship evaluating the impacts of hands-on nutrition education interventions such as cooking classes has shown that they are more likely to improve dietary behavior than conventional classroom lessons about nutrition. Interviews with eight Philadelphia-area nutrition educators support that cooking classes are effective at engaging children with healthy food and developing their enjoyment of it, as well as building children's confidence related to food and food preparation.

Rather than substantially supporting cooking programs, federal policy responsible for the guidelines and funding of nutrition education in high poverty schools has recently focused on an abstract mandate for nutrition educators to improve the food environment. In response to many

evaluations that have demonstrated that traditional classroom based nutrition lessons fail to change children's eating habits, the Supplemental Nutrition Assistance Education Program (SNAP-Ed) has advanced a Policy, Systems, and Environmental (PSE) change approach to nutrition education. "PSE" directs educators to "change the food and health environments" in the schools and communities where they work without either the resources or the mandate to do so. According to the local nutrition educators interviewed for this thesis, making individual educators responsible for PSE change on top of their work with individual students has resulted in significant strains. Nutrition education programs funded by SNAP-Ed have adopted what is undoubtedly a worthy goal for their educators' work with relatively little attention to how to provide their staff with the kind of training, staffing, and authority necessary to make meaningful PSE change possible.

In studying these trends, this thesis will use a review of the scholarly literature on nutrition education and conversations with a group of nutrition educators in Philadelphia to analyze the key institutional and ideological factors that have shaped nutrition education in the United States, especially since rising rates of obesity became an issue of increasing public concern. The interviews with educators contribute to an understanding of nutrition education beyond the program outcomes measured in official evaluations, delving into the more nuanced, personal impacts of policy change.

The three chapters of this thesis will each consider the impacts of one approach to nutrition education. The first chapter will argue that conventional classroom nutrition lessons are ineffective at enacting behavior change because of their content, which overemphasizes nutrition knowledge, and their didactic style of delivery that does not engage students with food. The second chapter will discuss cooking with kids as an effective method of hands-on nutrition

education that engages students with food in order to improve their diets. The last chapter will explore local educators' critiques of the more recent PSE approach to nutrition education, and will provide a brief comparison to Japan's system of nutrition education as an alternative model of fostering environmental change alongside nutrition education. Having introduced the general structure of and sources for this thesis, this introduction will now review the more general health trends, particularly rising rates of obesity, that have played a significant role in shaping nutrition education over the last thirty to forty years.

The Obesity Epidemic

Since the 1980s, interest in nutrition education in the United States has been primarily driven by the country's obesity epidemic. Literature on the obesity epidemic has established its widespread health impacts, emphasized the importance of obesity prevention among children, and linked changes in American eating patterns to rising rates of obesity. Such studies have increasingly informed the goals of nutrition education, which aims to improve dietary behavior, and the structure of nutrition education programs, which are focused in low-income communities.

Obesity is increasingly prevalent in the United States, especially among low-income and minority populations. Obesity rates since 1980 have doubled among children and tripled among adolescents, and as of 2016, about 60% of adults in the United States and 15% of children were considered overweight or obese (Stanford Health Care 2018). Overweight and obesity increase an individual's risk for conditions including heart disease, stroke, and type 2 diabetes (Stanford Health Care 2018). Obesity and its related chronic disease conditions cost the United States approximately 300,000 lives and 150 billion dollars per year (Stanford Health Care 2018). This

cost is not distributed equally: Obesity and diabetes disproportionately afflict people in low-income and minority communities (Candib 2007).

Researchers focus on whether nutrition education programs successfully impact children's eating habits because they are seeking effective methods of obesity prevention. The overwhelming evidence in favor of a link between diet and chronic disease, and high rates of chronic disease, overweight, and obesity in the United States indicate that comprehensive action must be taken to reduce disease risk (Stanford Health Care 2018). Healthcare professionals especially prioritize obesity prevention because obesity status in childhood impacts children's health outcomes later in life. The likelihood of obese children becoming obese adults increases from about 20 percent at four years old to 80 percent by adolescence (Stanford Health Care 2018). Adopting a healthy diet during childhood is known to reduce the risk of overweight, obesity, and markers of cardiovascular disease in adulthood (Centers for Disease Control and Prevention 2008). Once an adult is obese, it is unlikely that they will return to a "normal" weight. In 2015, a study in The American Journal of Public Health found that the probability of an obese man attaining a normal weight was 1 in 210 and the probability of an obese woman attaining a normal weight was 1 in 124, or 0.8% (Fildes, et al. 2015). Nutrition researchers and educators see the development of effective nutrition education programs as important not only to counter and prevent childhood obesity, but also to give children of all weight statuses tools to consume a healthy diet over the course of their lives.

Tanja Kral, a nutrition scientist who conducts clinical research on childhood obesity, argues that establishing healthy eating and cooking habits in childhood is important for obesity prevention. Dr. Kral, a professor in the University of Pennsylvania School of Nursing and Perelman School of Medicine, underscores that researchers in the field still have a lot to learn in

terms of the physiology and genetics of obesity (Kral 2019). However, she maintains that prevention is especially important because of what we do understand about obesity: "Once you're on this trajectory for excess weight gain, it is so hard to lose weight and maintain that weight loss" (Kral 2019). This is why Kral prioritizes obesity prevention, even in her work as a professor. Kral's course *Obesity and Society* at the University of Pennsylvania includes a service component in which students conduct nutrition education in schools in nearby West Philadelphia. Kral wants her students to understand that it is important to "instill in [children] an early curiosity about nutrition and cooking" as a means of preventing obesity long-term. In short, Kral sees teaching cooking as a form of obesity prevention and expressed concerns that a decades long trend away from learning to cook may be one of the many causal factors that explain rising rates of obesity.

Changes in American Eating Patterns

Kral's concerns stem from a body of research that has linked changing patterns in American food preparation and consumption to rising rates of obesity since the 1980s (Dohle, Rall and Siegrist 2015). As American women have taken on a wider range of societal roles, they have cooked less. Weekly time spent on meal preparation dropped from about 20 hours in the 1950s to 10 hours by 1975 (Bowers 2000). This trend continued into the 2000s. Between 1975 and 2006, American women's time spent preparing food decreased from 92 to 51 minutes per day, or just under 6 hours per week (Zick and Stevens 2009). During the same time period, men's time spent preparing food remained stable at less than 20 minutes per day, or under 2 hours and 20 minutes weekly (Zick and Stevens 2009).

Cooking less in the home has contributed to changes in the composition of the American diet in favor of fast and ultra-processed foods, or packaged formulations that have undergone multiple sequences of industrial processing (Baraldi, et al. 2018). The percentage of daily energy consumed from home food sources and time spent cooking decreased significantly for all socioeconomic groups between 1965 and 2007 (Smith, Ng and Popkin 2013). Dohle, Rall, and Siegrist (2015) cited prepared, ready-to-eat meals, and away-from-home foods, particularly fast foods, as the main food sources that have replaced home-cooked meals. Data from the nationally representative *Continuing Survey of Food Intake by Individuals* has confirmed that much of what Americans eat outside of the home is fast food, and most of what they eat both in and outside of the home is highly processed. These wide-ranging studies of 6,212 children and adolescents and 9,872 adults found that by 1996, about 25% of adults and 30.3% of children and adolescents reported eating fast food on a typical day (Bowman, Gortmaker, et al. 2004) (Bowman and Vinyard 2004). Between 2007 and 2012, about 60% of calories consumed by Americans came from ultra-processed foods (Baraldi, et al. 2018).

Consumption of fast food has been identified as an important risk factor for excess weight gain in the population (French 2000), and diets rich in ultra-processed foods have been found to be "grossly nutritionally unbalanced" (Steele, et al. 2017). Dr. Kral offered examples of how processed and fast foods can contribute to poor diet quality. "The danger of not knowing how to cook is that we fall back on foods in restaurants or fast food outlets or maybe even processed foods in the supermarket. Sometimes these foods are calorically dense, sometimes they are served in larger portions" (Kral 2019). Cunningham-Sabo and Simons identified a "temporal correlation" between these changes in American cooking and eating patterns and

rising rates of overweight and obesity that began in the 1980s, and hypothesized a relationship between the two (2012).

Cooking and Nutrition Education in the United States

Although cooking has been a relatively recent trend within the field of nutrition education over the last decade or so, cooking classes were once a fixture of school curricula in the form of home economics. In 1938, nearly 90% of junior and senior high school girls participated in home economics classes, which taught cooking skills alongside such topics as "organized and efficient housework" (Bowers 2000). It has been a persistent notion throughout American history that primarily women should be responsible for food preparation (Dixey 2006). As the women's liberation movement made social progress in the 1960s and more women entered the workforce, home economics classes were identified as a "mechanism of gender oppression" in that they encouraged the singular role of women as homemakers (Bowers 2000). Cooking, along with the rest of home economics curricula, disappeared from schools over the 1970s and 80s. By 2017, 17% of girls and 13% of boys reported learning to cook in school (Wolfson, et al. 2017). This statistic illustrates the success of the push to remove home economics from schools, and the continued low volume of cooking in schools of any kind.

After the disappearance of home economics, modern nutrition education began with the publication of the *Dietary Guidelines of Americans* (DGA) in 1980 and has increasingly prioritized behavior change over nutrition knowledge. The DGA "serve as the basis for Federal food and nutrition education programs," and are published every five years by the USDA and the United States Department of Health and Human Services (Office of Disease Prevention and Health Promotion n.d.). While the USDA sporadically published food guides prior to 1980, the

formal introduction of the DGA reflected a departure from earlier guides in that they focus not only on nutritional adequacy, but on the link between dietary habits and chronic disease (Contento 2011). Early nutrition classes constructed around food guides focused on the nutritional content of foods and the roles of nutrients in the body. However, increases in nutrition knowledge have not been shown to impact dietary behavior (Lytle 1994).

In the context of their studies of the outcomes of these more traditional types of nutrition classes, researchers like Leslie Lytle have argued persuasively that especially in light of rising rates of obesity, "effective" nutrition education must have a goal of promoting behavior change. Contento offers a parallel philosophical argument that nutrition as a field has the implicit goal of improving behavior. Nutritionist Jean Mayer wrote that "Nutritionists, unlike biochemists and physiologists, but like cardiologists and pediatricians, have to see their science as one whose goal is to benefit people" (Contento 2011). With this philosophy in mind, the work of many nutrition educators has been focused in communities with high rates of overweight and obesity.

In part as a result of the fact that the obesity epidemic disproportionately afflicts low-income and minority communities, federal policy has most actively promoted nutrition education in schools among low-income individuals through SNAP Education (SNAP-Ed). The USDA provides funding for nutrition education to low-income populations through SNAP-Ed, a federally funded grant program that funds "nutrition education and obesity prevention interventions and projects for persons eligible for SNAP" (USDA National Institute of Food and Agriculture n.d.). The Supplemental Nutrition Assistance Program, or SNAP, which was known as the Food Stamp Program before 2008, is the public assistance program that provides eligible low-income individuals with benefits to buy food (USDA Food and Nutrition Service 2017). SNAP-Ed, which complements SNAP through in-school nutrition education, was established in

1992 with $1.2 million in funding, adjusted for inflation. SNAP-Ed's funding increased to $428 million by 2018 (USDA SNAP-Ed Connection 2018; Wolfson, et al. 2017).

The state agencies that administer SNAP-Ed contract with their state land grant university to administer this program, which in turn contract with other organizations to deliver these educational services in their state's low income communities. These subcontracting organizations may include state public health departments, food banks, tribal programs, and non-profit organizations (USDA National Institute of Food and Agriculture n.d.). In Pennsylvania, SNAP-Ed distributes funding to Penn State University, which then divides it among several subcontractors in Philadelphia including Drexel University, the Agatston Urban Nutrition Initiative, Vetri Community Partnership, and other nonprofits. Collectively, these subcontracting organizations reach students in 80% of Philadelphia's public schools (PA Health Promotion Council 2018). Through similar partnerships in states around the country, SNAP-Ed provided education for six million participants in 2012, two thirds of whom were in the K-12 age range (Smelkova 2015).

Nutrition education conducted outside SNAP-Ed varies widely by state and is difficult to measure. There is a general federal mandate that school districts are required to establish a nutrition and physical activity wellness policy that "includes specific goals for nutrition promotion and education" (Smelkova 2015). The broad mandate leaves it to states and school districts to determine their own standards for the hours and methods devoted to nutrition education (Food Research & Action Center 2018). A recent CDC study shows that most school district wellness policies are "weak, fragmented, and do not necessarily require schools to take action" (Bridging the Gap Research Program 2014). While the 2016 School Health Policies and Practices Study (SHPPS) did not report on the number of hours devoted to nutrition education,

the SHPPS conducted in 2006 estimated that nutrition and dietary behavior topics constitute a median of 3.4 hours yearly in elementary schools, 4.2 hours in middle schools, and 5.9 hours in high schools nationwide (Centers for Disease Control and Prevention 2016, 2006).

Nutrition Education in Philadelphia

Because nutrition education policies and SNAP-Ed partnerships vary so much by state and district, this thesis seeks to offer a snapshot of how nutrition education has been conducted in Philadelphia, Pennsylvania. Interviews with eight Philadelphia-area nutrition educators support that reintroducing nutrition education in schools based on SNAP-Ed funding has resulted in a wide range of programs run by people with diverse backgrounds and training.

The educators interviewed for this thesis work for a variety of nutrition education programs, but most have backgrounds in neither nutrition, nor education. Maddy Booth, the Education Program Director at Vetri Community Partnership, studied American Studies and International Relations, and her colleague Mary Bullock, who runs the EAT360 program through Vetri, is trained as a chef, but not a teacher. Dalton Noakes was a Health and Societies major with minors in Nutrition and Urban Studies. Aurora Coon, the University-Assisted Community Schools Site Director at Comegys Elementary School studied Environmental Studies and does have an elementary school teaching certification. Laura Crandall is the Healthy Schools Specialist with the Philadelphia Mayor's Office of Education - Community Schools Initiative and previously worked as an educator and program manager at the Agatston Urban Nutrition Initiative for four and a half years. Crandall studied Women's Studies and has a master's degree in Community and Regional Development. Helen Nadel is the education director of Greener Partners, a nonprofit that teaches about food through farming, and has a master's degree in

Education. Judith Ensslin, the program director of the PA SNAP-Ed partnership with Drexel University called Eat Right Philly, has a degree in dietetics and worked as a consultant in nutritional services before transitioning into program management. Jarrett Stein, a former nutrition educator for the Agatston Urban Nutrition Initiative who later founded two hands-on nutrition education programs, studied Communications because the low credit limit allowed him to take as many courses as possible about food (Stein 2019). These educators are clearly passionate and hardworking, but they have had to learn principles of nutrition, education, or both on the job.

Because nutrition education and cooking in schools have been conducted through a groundswell of individual programs, which are local responses to a limited federal funding stream as opposed to school district or state priorities, most schools do not have a designated nutrition educator who is a full-time staff member. Instead, most nutrition educators work for programs that receive contracts through the state's SNAP-Ed administrators to conduct nutrition education programming at multiple schools (Booth 2019). A theme among my interviews with educators was that this structure makes it difficult to build relationships within schools, and can result in nutrition educators seeming like "outsiders" in the school environment. Stein raised the important point that nutrition educators often come from different or more privileged backgrounds than the students they work with, such that "philosophically, there is a general problem with a white person not from a community coming in … (with) the responsibility of telling someone what is healthy or not healthy in a community of color" (Stein 2019). Both the structure of SNAP-Ed and the makeup of the country's limited pool of nutrition educators can contribute to educators not being fully integrated into the schools where they work.

The educators interviewed for this thesis are in many ways exceptional, both in their commitment to nutrition education and their high level of motivation to serve their students. The author met most of these interviewees through a voluntary monthly meeting for Philadelphia-area nutrition educators; their attendance at these meetings reflects their interest in and enthusiasm for their work. These educators' strong preference for hands on nutrition education, especially in the form of cooking classes, cannot be taken as representative of the experience and preferences of the majority of their fellow nutrition educators. The additional flexibility and culinary skills required by cooking classes may not suit the teaching styles of a more random sample of educators.

Nonetheless, the enthusiasm that these dedicated educators expressed about the effectiveness of cooking with children, together with evidence from formal studies that demonstrate the positive outcomes of hands-on nutrition education over conventional nutrition education, suggest that SNAP-Ed administrators should support resources for and studies of cooking programs as a means of nutrition education. Further studies are needed to determine what elements of cooking programs are essential to their success, but both extensive evaluations and the experience of these educators suggest that it is possible to develop effective cooking classes even within the constraints faced by often part-time nutrition educators in under-resourced schools. The same cannot be said, however, for recent SNAP-Ed mandates for educators to undertake a PSE approach, which has thus far been proven to have a significant impact only in schools where there is strong support from administrators, teachers, and school cafeteria staff. It is difficult for individual educators to generate this additional buy-in, and the PSE approach has not given educators additional the tools or authority to do so effectively.

Evaluating Nutrition Education

As the above suggests, a key goal of this thesis is to bring Philadelphia nutrition educators' insights about the challenges they face in schools into conversation with scholarly evaluations of the effectiveness of different types of nutrition education. These evaluations measure multiple potential outcomes not limited to dietary behavior. More general reviews have suggested that effective nutrition education can be a significant factor in improving children's dietary behavior and psychosocial mediators of food intake, but that many programs fail to have such significant impacts. (Contento, Balch and Bronner 1995; Hersch, et al. 2014; Muzaffar, Metcalfe and Fiese 2018)

Scholars use a range of tools to measure program effectiveness. In a review of the evaluation measures used in 265 nutrition education intervention studies published between 1980 and 1999, Contento, Randell, and Basch (2002), found that studies measured outcomes in four general areas: nutrition knowledge, dietary behavior, psychosocial mediators, and occasionally anthropometric measures (Contento, Randell and Basch 2002). These authors found that dietary intake measures were used in almost all studies, and that dietary intake was measured most frequently through food recalls, records, and quantitative food frequency questionnaires (2002). Although these are the most widely used methods of measuring intake, they are also subject to human error in that it can be difficult to remember everything eaten in even a 24 hour period (Pollan 2008). Visual plate waste estimation is a more reliable, but also more difficult method of measuring intake. Dietary intake measures often target specific foods, such as fruit, vegetable, or whole grain intake. Most studies also measured nutrition knowledge, usually through questionnaires that ask about such subjects as functions of nutrients in the body in relation to health, food sources of nutrients, or the food group system. However, nutrition knowledge has

been measured less frequently in more recent interventions because greater nutrition knowledge has not been shown to improve dietary behavior (Lytle 1995).

Many studies also examined psychosocial variables related to food, which are wide-ranging and can be roughly thought of as assessing a child's relationship with food. Psychosocial assessments include children's attitudes towards food, often assessed via questionnaire, and or willingness to try new fruits and vegetables. Later studies also assess cooking confidence, or a child's confidence in preparing his or her own food (Appendix 2). These questionnaires include items such as "how confident do you feel about tasting foods that you have never tasted before," and "how confident do you feel about following a simple recipe" (Barton, Wrieden and Anderson 2011). These variables are usually assessed through pre- and post-intervention questionnaires or surveys that have been externally validated to reflect changes in intake.

Finally, very few studies include physiologic or anthropometric assessments such as body mass index, serum cholesterol, or blood pressure (Contento, Randell and Basch 2002). Measuring these outcomes is more likely to be invasive or costly, but they are the most powerful indicators available of whether a program is effective at reducing or preventing obesity. While none of the anthropometric assessments are a perfect representation of one's bodily health, each can point to the development or reduction of overweight and obesity. For this reason, reviews of nutrition education often point to anthropometric measures as important methods for evaluation in future research.

Literature on nutrition education, and nutrition in general, often uses the words "healthy" or "unhealthy" to describe foods or diet patterns. Generally, "healthy" references nutrient-dense, unprocessed or lightly processed foods such as fruits and vegetables and whole grains, and "unhealthy" references foods that are not nutrient-dense but may be high in calories, sugar and

salt. Dr. Paul Rozin, who is a preeminent researcher on food psychology at the University of Pennsylvania, notes that "humans have a tendency to create dichotomies that arbitrarily separate continua into two categories," and laments the healthy versus unhealthy dichotomy that has taken root in American nutritional and public discourse (Rozin 2019). Rozin describes this categorization as misinterpreted by many consumers to suggest "that they should not consume 'unhealthy' foods at all, rather than that they should be consumed in moderation" (Rozin 2019). While this thesis will employ these terms because they are so prevalent in the literature, it is an important caveat that such language is reductive, and that an overall balanced diet has room for foods deemed "unhealthy."

Having established the impetus for nutrition education and its institutional context, this thesis will now consider three approaches to nutrition education in terms of scholarly assessments of their impacts on dietary behavior, as well as their implementation in Philadelphia according to local nutrition educators. These three approaches–conventional nutrition education, hands-on nutrition education, and PSE change–have increasingly recognized the complex relationships between children and food and the factors shaping food choice beyond nutrition knowledge. Of these approaches, hands-on nutrition education has most effectively combined engaging instruction of students with improvements to the food environment. The hands-on approach to nutrition education emerged partially in response to the ineffectiveness of the conventional, classroom-based approach. The first chapter will discuss the limitations of both the ideology behind conventional nutrition lessons and their method of delivery.

Chapter 1: Conventional Nutrition Education

The dominant method of delivering nutrition education in the United States since the 1980s has been conventional nutrition education, which teaches students information about nutrition in a classroom setting. Educator feedback and studies of conventional nutrition education interventions support that nutrition lessons do not improve students' dietary behavior. This chapter will argue that the impacts of conventional nutrition education are limited because of the method's content, which overemphasizes impractical knowledge about nutrients, and its unengaging style of delivery.

Conventional nutrition education, which mirrors general education in its method of delivery, is an insufficient approach to nutrition education because learning about food is different from learning other school subjects. First, while most subjects aim to increase knowledge, nutrition education aims to improve behavior. While conventional nutrition education does increase nutrition knowledge, studies of conventional nutrition education interventions have shown this does not translate to improved dietary behavior (Hoelscher, et al. 2002; Appendix 1). Second, conventional nutrition education focuses on boring and impractical information about nutrients rather than experience with food, which educators say makes it unengaging to students. Third, conventional nutrition education "preaches" to students about healthy eating rather than helping them build the skills to make healthier choices. This makes the method ill-equipped to succeed in under-resourced schools, where nutrition education through SNAP-Ed is focused.

This chapter will first discuss nutritionism, the ideology behind talking and teaching about food in terms of its nutrients. Nutritionism has resulted in a public discourse about food that exaggerates the effects of individual nutrients while de-emphasizing overall diet quality, and

generates confusion among eaters by divorcing them from the experience of eating food. The chapter will then turn to the feedback of educators, who discussed the challenges of engaging students in nutrition lessons and making those lessons meaningful in struggling schools. Finally, this chapter will examine scholarly evaluations of the effectiveness of conventional nutrition education interventions, which suggest that the method does not improve dietary behavior.

Nutritionism

Understanding the limited success of conventional nutrition education requires first understanding the drawbacks of its underlying ideology: nutritionism. Australian academic Gyorgy Scrinis introduced the term in 2002 to describe the affinity of Western food discourse for the nutrients contained within food rather than the foods themselves (Scrinis 2002). Nutritionism, which emerged in the 1980s not-so-coincidentally with the rise of processed foods, encourages people to "make the connection between particular nutrients and bodily health, and to conduct 'nutritionally balanced' diets on this basis" (Scrinis 2008). By this logic, an understanding of food in terms of the nutrients it contains will translate to better quality diets. Michael Pollan refers to nutritionism as "the official ideology of the Western diet," and conventional nutrition education in the United States relies heavily on teaching children about the nutrients contained within food (Pollan 2008).

Michal Pollan argues that nutritionism was written into United States food policy not out of concern for the American public, but due to pressure from powerful players in the food industry (Pollan 2008). In 1977, the Senate Select Committee on Nutrition and Human Needs, which was led by South Dakota Senator George McGovern, published the *Dietary Goals for the United States* in response to research that cultures consuming plant-based diets experienced

lower rates of chronic disease. The original Dietary Goals advised that Americans, increasingly afflicted by chronic disease, should reduce consumption of red meat and dairy products. The document's publication generated an immediate "firestorm of criticism" stemming from the meat and dairy industries, whose profits would suffer were these guidelines to be followed (Pollan 2008). In response, the Committee rewrote the guidelines to isolate nutrients rather than foods as responsible for chronic disease. The Committee's earlier advice to eat less meat became "choose meats, poultry, and fish that will reduce saturated fat intake" (Pollan 2008).

The strategy of discussing nutrients rather than foods in order to sidestep offending food lobbies became common practice, and was built into U.S. food policy and conventional nutrition education. The final results of the McGovern Committee's Dietary Goals for Americans served as the template for the Dietary Guidelines for Americans, which to this day offer advice about food in terms of its nutrients: "Limit calories from added sugars and saturated fats and reduce sodium intake" is one of the 2015-2010 Dietary Guidelines (HHS and USDA 2015). Conventional nutrition education, supported by government funding and resources, adopts the government's language about food. SNAP-Ed guidance states that the program's goal is to make it more likely that people enrolled in SNAP will eat and exercise in a way that is "consistent with the current Dietary Guidelines for Americans and the USDA food guidance" (Gleason, Wolford, et al. 2018). In this way, United States food policy has infused conventional nutrition education with nutritionism.

The Impacts of Nutritionism

While studying and understanding nutrients is a worthy goal for nutritionists, it is not a useful way for everyday people, especially children, to think and learn about food. Nutritionism

relies on oversimplified messages about the effects of nutrients, and these messages are often further simplified in lessons for children. Most American elementary school students can tell you that vitamin A in carrots strengthens your vision, but less than one percent of Americans are vitamin A-deficient and two thirds of the country is overweight or obese (Weaver 2013; CDC 2012). While nutrient deficiencies can be treated with supplementation of certain micronutrients, problems of overconsumption and chronic disease cannot. Since the goals of nutrition education are tied to obesity prevention and reduction, the content of nutrition education must go beyond information about nutrients.

Nutritionism removes nutrients from their context within food, and as a result, can attribute to single nutrients effects that may be the result of whole foods or broader dietary patterns. T. Colin Campbell, a nutritional biochemist from Cornell, has been critical of many studies linking dietary fat to cancer, for example. Not only did the groups in those studies with higher rates of cancer consume more fat, they also consumed more animal foods and fewer plant foods (Pollan 2008). Campbell argued linking cancer to dietary fat may exaggerate the impact of fat, while de-emphasizing the broader role that a meat-based diet could potentially play as a cause of cancer. It is for this reason that Scrinis says nutritionism is characterized by "simplified, exaggerated, and decontextualized explanations of the health effects of particular nutrients" (Scrinis 2013).

Nutritionism also decontextualizes food from the experience of eating, which has many inputs beyond the nutritional profile of the meal. In her senior thesis, University of Pennsylvania undergraduate Grace Weaver coined the term "food noise" to describe the impact of nutritionism on the experience of the everyday eater (Weaver 2013). She argues that food noise unnecessarily overcomplicates Americans' relationships with food in a way that "diminishes the actual

experience and enjoyment of eating food" (Weaver 2013). Nutritionism maintains that food should be understood in terms of its nutrients, but the actual experience of eating food revolves around flavor, social connection, and cultural context. This mismatch between nutritional advice and lived experience generates confusion for the eater.

Amidst this confusion, nutritionism can lead to the consumption of more processed foods. Marion Nestle argues that nutritionism confuses people about what they should eat despite the fact that "[nutritionists'] advice about the health benefits of diets based largely on food plants—fruits, vegetables and grains—has not changed in more than 50 years and is consistently supported by ongoing research" (Nestle 2003). While this basic advice has changed very little, popular trends glorifying and demonizing specific nutrients have changed with relative frequency (Scrinis 2008). Processed food companies stand to profit from nutrient-based trends because they are able to "endlessly reengineer" their products, then proclaim their nutritional content on their packaging (Pollan 2008). It is to the benefit of these companies that oat bran, omega-3s, or polyunsaturated fats become popular, whether or not that information is in line with nutritional advice. Because nutritionism has confused many American adults about how to eat, its prevalence in conventional nutrition education does not suggest that the approach will positively influence dietary behavior.

Educator Perspectives on Conventional Nutrition Education

The educators interviewed for this paper struggled with both the content and method of delivery of conventional nutrition education. Laura Crandall, who worked as an educator and program manager at the Agatston Urban Nutrition Initiative for four and a half years, lamented that conventional nutrition education lessons relied on prescriptive, nutrient-focused rules

(Crandall 2019). She wished "there were more guidelines around what to do rather than what to limit." Instead of talking to students only about the health detriments of salt, she urged that it was important to also talk about all of the other delicious ways to season foods. And in addition to discussing nutritional compounds to limit, like sugar or saturated fats, it was important to talk about foods in the positive sense through guidelines such as "eat more whole foods," or "choose whole grains" (Crandall 2019). These broader rules are about foods, not nutrients, which are more recognizable to students, and they present healthy eating as a positive goal to work towards rather than a series of pitfalls to avoid (Crandall 2019).

Educator Jarrett Stein said that the nutrition-focused lessons were poorly received in the under-resourced schools where he taught. Stein was hired as a recent college graduate to teach SNAP-Ed funded nutrition classes at four middle schools in Philadelphia. He taught information about nutrients and food groups in a stand-and-deliver, conventional manner (Stein 2019). His lessons on proteins, fats, and carbohydrates paled in comparison to "front-burner issues" faced by the school, including behavior issues and violence (Stein 2019). The school was under pressure to improve standardized test scores, so administrators discouraged Stein from teaching nutrition lessons because they would not help students succeed on these exams. Overall, Stein said that "There was some sort of mandate somewhere that students are supposed to get some amount of hours of nutrition education, but it didn't seem to translate to any priority in the school" (Stein 2019). Nor could it have, Stein argued, because educators teaching non-engaging lessons that compete with more pressing initiatives in struggling schools are set up for failure (Stein 2019).

In addition to receiving pushback from the school staff, Stein said that his didactic method of delivery repelled students. On his first day at Vare Middle School, Stein had planned a

lesson about apples and started by reading a history of the fruit. A few seconds into the lesson, a student raised his hand and said "Don't you know we don't give a fuck about your white-people food?" (Sole-Smith 2018). Students started throwing Stein's apples around the room, and the PE teacher stepped in to suggest that everyone play basketball instead. When asked if he thought his lessons improved students' dietary behavior, Stein responded that they might have done the opposite, because the students so disliked him, and therefore were motivated to reject his advice. "Most directly, kids would say things like 'fuck health'" following his lessons (Stein 2019). Virginia Sole-Smith, who interviewed Stein for her book on America's complex, guilt-ridden food culture, described Stein's approach, and the approach of conventional nutrition education in general, as "preaching about food groups and calories to kids who didn't ask to be saved" (Sole-Smith 2018).

Stein stopped preaching and started working alongside students instead. He left his job teaching conventional nutrition education lessons in order to pursue a hands-on, cooking-focused approach because of its greater success at meaningfully engaging students (Stein 2019). Stein says that he did not become a "decent teacher" until he "didn't try to teach traditionally anymore." Stein's approach to non-traditional nutrition education was centered upon involving kids with hands-on food interaction. He wrote and received a grant to buy mortars and pestles for his lessons and began involving students in the tactile experience of crushing, which he cites as one of the catalysts for his eventual love of cooking (Nangia and O'Donnell 2015). He noticed higher engagement among students in hands-on work with the mortars and pestles and other cooking projects, notably one that involved the preparation of granola bars by 35 seventh grade girls. This project developed into Rebel Ventures, a healthy food business run by high school students. Stein also founded Grub Club in 2013, renamed Rebel Chefs in 2018, a hands-on

cooking program that encourages healthier eating by exposing students to a wide range of healthy foods and teaching them how to prepare them (Nangia and O'Donnell 2015).

Educators Aurora Coon and Dalton Noakes have also struggled with the non-engaging nature of conventional nutrition education lessons. Coon has taught conventional nutrition education lessons through a variety of SNAP-Ed and nonprofit programs in Vermont and Philadelphia, and Dalton Noakes is an educator with Vetri Cooking Lab, a nonprofit that conducts after-school cooking classes. Of the SNAP-Ed lessons, Coon said that "some of it is just boring," and that "if you were to follow the script exactly and make no changes, it would be less valuable" (Coon 2019). Coon adapted lessons by making them more "engaging, fun, and hands-on." For example, Coon incorporated exercise into a lesson about MyPlate by creating a workout circuit with one activity for each food group (Coon 2019). Dalton Noakes pointed out that engaging students is even harder in an after-school program: "It is really hard after kids have sat down for seven hours after being lectured to all day. You have a good ten minutes of peace and lecture time, and then you're gonna lose them really fast" (Noakes 2019). This is why Vetri programs limit the amount of didactic lecture time in their lessons, instead moving to hands-on cooking processes soon after establishing the relevant recipe context or overviewing necessary skills. Noakes, Coon, and Stein all commented that talking to students about food was less effective than involving them in food-related activities such as cooking.

Evaluations of Conventional Nutrition Education

Scientific reviews of nutrition education interventions support that conventional, knowledge-based interventions are not particularly effective at improving dietary behavior. Contento, Manning, and Shannon's review of major school-based nutrition education research

studies during the 1980s found that their impact on behavior was "minimal" (1992). Lytle's 1995 review of 17 interventions found that 8 had some measurable impact on dietary behavior, but that overall, knowledge-based interventions are not "highly or consistently effective at bringing about behavior change" (Lytle 1995). Most recently, Hoelscher et al. (2002) reviewed 17 nutrition education interventions conducted since Lytle's review, and concluded that "knowledge-based programs have not been particularly effective for changing nutrition-related behavior" (Hoelscher, et al. 2002).

This thesis examined nine studies of classroom-based nutrition lessons among children, which are detailed in Appendix 1, and found that they were mostly unsuccessful at improving dietary behavior among children. While this is not a comprehensive review of the literature on conventional nutrition education, it includes studies either published in peer-reviewed journals or conducted by the USDA that provide insight into the range and effectiveness of classroom-based approaches. Appendix 1 includes five rigorous evaluations of SNAP-Ed interventions that fit this paper's definition of conventional nutrition education. It includes two additional interventions among low-income students: the first is notable for its analysis of the weak correlation between nutrition knowledge and dietary behavior, and the second includes an Intervention+ condition that supplements a nutrition education curriculum with parental involvement and teacher training. Finally, it includes two evaluations of the now-discontinued Nutrition Education and Training program, a USDA-funded program that offered grants for nutrition education and educator training among students of all income levels.

Studies included contain intervention and control groups, often divided into intervention and control schools or classrooms, and all have sample sizes over 390. The five SNAP-Ed and two NET program studies are notable for their reach, meaning that the programs themselves (if

not the intervention groups studied) impact at least 1,000 students each. The two NET program studies were published significantly earlier than the rest of the studies, in the early 1980s as opposed to the 1990s and 2000s, but they are included to acknowledge that before the NET program was de-funded in 1993, nutrition education was federally funded among adequately resourced, as well as under-resourced, schools. Weaknesses among these studies and among evaluations of nutrition education in general include the lack of follow-up evaluations, lack of measurements of biomarkers of obesity, and human error related to food self-reporting.

Most of the programs evaluated in this section were not successful at improving dietary behavior among children. All nine programs assessed dietary behavior in some capacity, often through the metric of fruit and vegetable or dairy intake, and only two out of nine programs found a significant positive impact on dietary behavior. A third program found a positive impact on dietary behavior only for the youngest students, but not for the older two thirds of students (St. Pierre and Glotzer 1981). The most common method used to measure change in dietary quality was pre- and post-intervention questionnaires, but some interventions also measured plate waste. Although none of the interventions discussed in this chapter measured anthropometric measures of obesity, the fact that most conventional interventions do not change dietary behavior suggests that they do not improve anthropometric measures of obesity.

Five out of nine programs assessed psychosocial indicators of children's relationships with food such as willingness to try new fruits or vegetables, and yielded mixed results. Three studies examined children's attitudes towards healthy food as assessed by pre- and post-intervention questionnaire. One found positive effects on food attitudes (St. Pierre, Glotzer, Cook, and Straw 1981), one found mixed positive effects (St. Pierre and Glotzer 1981), and one found positive effects only in its Intervention+ iteration, and none in its regular program iteration

(Prelip, et al. 2012). Two studies measured student's willingness to try fruits and vegetables. One found no improvement (Deehy, et al. 2013), and one found improvement only in willingness to try fruit, not vegetables (Long, Cates, et al. 2013). These results do not suggest any consistently measured impacts of conventional nutrition education on children's psychosocial mediators of food consumption.

Based on the feedback of educators and studies of the effectiveness of conventional nutrition education, this chapter has argued that classroom lessons about nutrition are an inadequate approach to nutrition education. Conventional nutrition education has been largely unsuccessful at improving dietary behavior because of its content, which overemphasizes nutrients, and its style of delivery, which does not engage students. Especially in the context of under-resourced schools, educators can come across as "preaching" about healthy eating instead of helping students learn how to do it. The next chapter will discuss hands-on nutrition education, which aims to build students' experiences and skills related to healthy food rather than simply telling them about it. It also immediately changes children's food environment by providing them with opportunities to taste and develop preferences for healthy food. Hands-on nutrition education marks the introduction of environmental change into the goals of nutrition education, and abandons much of the nutritionism characteristic of conventional nutrition education.

Chapter 2: Hands-On Nutrition Education

Scholarship and advocacy from the late 1990s through today have increasingly promoted nutrition education that takes place through hands-on interaction with food, namely instruction in food preparation through cooking classes, as a practical means of encouraging healthy dietary behavior. This thesis will refer to this approach as *hands-on nutrition education*. Peer-reviewed academic studies and interviews with practitioners provide significant evidence that hands-on interventions are a more effective approach to nutrition education than conventional nutrition lessons: They have demonstrated greater success at improving dietary behavior, they have been embraced by educators for their success engaging students in practical, experiential learning about healthy food, and they combine elements of individual instruction with environmental change.

Hands-on nutrition education has two main differences from conventional nutrition education. First, it is experiential, which allows students to taste, touch, and smell food. In conventional nutrition lessons, students are told about food instead of experiencing it themselves. Second, it takes a step away from the nutritionism that permeates many conventional interventions, by discussing eating primarily in terms of food and ingredients rather than nutrients. While some hands-on interventions incorporate nutrition information, they also engage students with food in a way that many knowledge-based conventional interventions do not. For this reason, interventions of this type are sometimes labeled "food education" in order to distance them from nutritionism and highlight their practicality. While this is an encouraging, inclusive label that merits future consideration, this paper will continue to refer to hands-on interventions as forms of "nutrition education," because most USDA policy and sources of funding still consider them as such.

This chapter will first discuss the resurgence of cooking in schools, examining the various calls to action and sources of funding that helped fuel recent interest in hands-on nutrition education. Second, it will present educators' feedback on the many advantages of hands-on nutrition education when it comes to immersing students in practical experience with food: engaging students; improving food exposure and perceptions of healthy food; building skills and confidence; and reinforcing other school subjects and interpersonal relationships. The interviews also identify several practical challenges for cooking in schools. Third, a review of 15 studies will describe the promising impact of hands-on nutrition education on children's dietary behavior and relationships with food, and identify mechanisms through which hands-on nutrition education may encourage healthy eating. Overall, this research demonstrates that hands-on nutrition education fortifies children with skills and confidence that for many will be a source of pleasure for life, as well as modestly improving eating behavior and providing a set of tools for navigating the obesity epidemic.

The Resurgence of Cooking in Schools

Concerned about changing eating patterns in the United States and rising obesity rates, experts in the field have recommended policies that promote teaching cooking skills to children. Smith, Ng, and Popkin (2013) argue that efforts to improve Americans' diets should focus on promoting food preparation. Lichtenstein and Ludwig (2010) go a step further by arguing that instruction in food preparation should take place in schools, mirroring home economics classes without the gender bias. Wolfson et al. (2017) found that teaching cooking in schools also has significant policy support among the public. In a nationally representative survey with 1,117 subjects, 64% of respondents supported requiring schools to teach cooking skills as part of a

standard health education, and 67% supported requiring schools to offer home economics-type classes that taught students to cook and shop for healthy food. These results did not differ by gender. Cooking is increasingly being thought of as a useful skill for all Americans, not just women (Wolfson, et al. 2017).

Support for food preparation in schools has also made its way into United States food policy guidance. The Scientific Report of the 2015 US Dietary Guidelines Committee recommended that "that age appropriate nutrition *and food preparation* education be mandatory in primary and secondary schools" (Dietary Guidelines Advisory Committee 2015). These recommendations represent a change from the analogous document from 2010, which recommended that cooking skills be taught, but not that they should be made mandatory (Dietary Guidelines Advisory Committee 2010).

As further evidence that hands-on nutrition education programs have grown in popularity in the past two decades, research on the effectiveness of such programs has also grown significantly. The author could find no meta analyses of cooking-based interventions with children prior to 2014, but robust analyses published in 2014 (Hersch, et al. 2014) and 2018 (Muzaffar, Metcalfe and Fiese 2018), as well as a similar meta-analysis of cooking classes among adults published in 2016 (Garcia, et al. 2016). Increased attention to the hands-on approach among scholarly calls to action, federal food policy guidance, and program evaluations has fueled the reintroduction of cooking in schools, which has taken different forms through government and privately-funded programs.

Examples of Cooking Programs

Although nutrition education programming varies widely from state to state, most hands-on programs in Philadelphia are either funded through SNAP-Ed and based on SNAP-Ed-approved curricula, or funded privately. For example, some Philadelphia programs use the Cooking With Kids for a Healthy Future (CWK) curriculum, a popular SNAP-Ed curriculum which has provided nutrition education to over 17,000 students across the nation in the past 20 years, and currently reaches 5,000 students annually (UNC Center for Health Promotion and Disease Prevention 2018). The program is comprised of ten total two-hour-long lessons for students grades 2-3 and 4-5. The lesson plans provide recipes and cooking instructions as well as information about where foods come from and relevant cultural traditions (Cooking With Kids, Inc. 2015). For example, the Cuban Beans lesson plan includes a 20 minute introduction and discussion about the health benefits of beans before moving on to a demonstration of knife safety techniques, 60 minutes of food preparation, and then 40 minutes of guided discussion for eating and cleaning together (Cooking With Kids, Inc. 2015). An evaluation has demonstrated that the program increases children's vegetable preferences and their attitudes and self-efficacy towards cooking (Cunningham-Sabo and Lohse 2013). SNAP-Ed partner organizations can apply for USDA funding for the curriculum materials, food ingredients, and equipment in order to implement CWK in their schools (Ensslin 2019).

Similar programs are conducted through private funding, such as Vetri Cooking Lab, an after-school program in Philadelphia. Maddy Booth is the Education Program Director of Vetri Community Partnership, the 501c3 nonprofit that houses the program (Booth 2019). Vetri Cooking Lab reaches about 950 students across 29 schools per year. It is funded by GlaxoSmithKline, a pharmaceutical company which supplies charitable grants of up to $40,000

in 6 areas including nutrition and physical activity (GlaxoSmithKline 2018). The mission of Vetri Cooking Lab is similar to that of CWK. Booth said that her goal was for kids to "eat something, learn something, and make something" (Booth 2019). The program is made up of 10 lessons that are 2 hours apiece, and incorporate a wide range of topics with food preparation including knife safety, recipes and measurement, breakfast, eating whole foods, food access, and food marketing and politics (Booth 2019). While Vetri Cooking Lab is fully funded through GlaxoSmithKline, a second branch of the Vetri Community Partnership called EAT360 began receiving SNAP-Ed funding in 2017 to support its mission of conducting hands-on nutrition education during the school day (Bullock 2019).

Programs funded by SNAP-Ed are subject to restrictions on portion size that do not apply to privately funded programs. SNAP-Ed restricts serving sizes of food to "sample" or "tasting" sizes (USDA Food and Nutrition Service 2015). Mary Summers, a lecturer at the University of Pennsylvania who has extensive experience working with healthy food programs in schools, noted that restrictions on portion size are intended to keep nutrition education programs from interfering with school meals: "Historically, there are regulations against serving foods during the school day that might compete with the official school meal program" (Summers 2019). Because Vetri Cooking Lab is a privately funded after-school program, it can engage children in cooking full meals, rather than just tasting size portions. Because some school lunches are served as early as 11a.m., students are often eager to eat this meal by 4:30 p.m. (Booth 2019). The traditional divisions between the funding and organization of school meals programs and SNAP-Ed also typically prevent educators from working with food served through school lunches.

Another significant difference between Vetri and SNAP-Ed funded cooking programs is that SNAP-Ed programs must either work from a set of approved recipes or submit recipes for

nutritionist approval. At the Agatston Urban Nutrition Initiative (AUNI), new recipes have to be decided at least two weeks ahead of time and analyzed by a staff nutritionist based on their nutritional content–sodium, saturated fat, overall calories, and sugar are restricted per serving (Coon 2019). This restriction is intended to ensure that everything cooked within these programs meets nutrition standards consistent with the Dietary Guidelines for Americans, reflecting the nutritionism present in conventional interventions. On the other hand, some privately funded programs such as Vetri Cooking Lab and Stein's program, Rebel Chefs, have more flexibility. At Vetri Cooking Lab, Booth and her team are able to create their own recipes and implement them as they see fit. Booth enjoys the programming that results: "We can do whatever we want. We have so much freedom; it makes it more fun" (Booth 2019). In Rebel Chefs, Stein and his staff often purchase ingredients that are on sale within a few days of scheduled lessons. If Rebel Chefs was subject to the same restrictions as AUNI, Stein would not be able to encourage children to develop their own recipes from these last-minute purchases of discounted ingredients.

Educator Perspectives on Hands-On Nutrition Education

The educators interviewed for this thesis asserted that hands-on nutrition education is a practical and engaging method of immersing students in healthy eating habits and empowering them to pursue those habits beyond the classroom. They spoke to a range of concepts supporting that cooking lessons develop students' interest in and preference for healthy food.

Focus on Food

These educators spoke highly of the fact that hands-on nutrition education leaves much of nutritionism behind, and instead applies relevant nutritional information to practical interaction with food. Booth and Nadel both argued that hands-on nutrition education bridges the key gap in

conventional nutrition education between learning about nutrients and learning about food. A person can reap all of the health benefits of certain foods without knowing the names or metabolic pathways of its biochemical components. Cooking skills, however, are often critical to enjoying the benefits of whole plant foods, which usually require some level of preparation in order to be eaten at all, not to mention what is necessary for them to taste good. Booth offered butternut squash as an example of why a focus on practical food preparation skills within nutrition education is necessary. "If you're handed a butternut squash, awesome. But if you don't know how to prepare it, that thing is daunting. It's got a hard skin, it's hard to cut through, so how are you going to get that into your body for it to do what it needs to do?" (Booth 2019). By teaching students how to prepare butternut squash, Vetri Cooking Lab makes it possible for them to actually access the nutrients that other programs may only have told them about.

Cooking classes also create a learning environment in which students can eat healthy foods. Judith Ensslin, who works with SNAP-Ed programming, noted that the School District of Philadelphia, the poorest big city in the United States, has been the subject of considerable attention and resources to reduce obesity rates (Philadelphia Department of Public Health 2017). As a result, "a large portion of the kids in the school district … have had this nutrition education program throughout their education. Their base knowledge is really good. It's just a question of having the resources and the motivation to be able to make healthy choices. And that's the barrier" (Ensslin 2019). Hands-on nutrition education addresses some of these concerns. By conducting a cooking class or tasting, educators de facto improve the food resources available to students, at least in the short term, by bringing fresh foods and cooking equipment into the classroom. Hands-on nutrition education has also made it possible for federal resources, particularly SNAP-Ed funding, to be put towards supplying food and cooking equipment to

schools (Ensslin 2019). While greater interventions to improve food access are still necessary, hands-on nutrition education connects students to healthy food in a way that conventional nutrition education does not.

Some educators maintained that interaction with food without much emphasis on nutrition knowledge was effective. Noakes was less interested in nutrition information than practical cooking skills, and said, "at the end of the day, I would rather them walk out saying confidently 'I know what an eggplant is, I know it's good for me, and I know how to cook it.' As opposed to 'I know what vitamin K is'" (Noakes 2019). Of in-depth information on nutrients' roles in the body, Booth said "they don't need all of that stuff….[Vetri Cooking Lab] trims a lot of that information out, and focuses on things that kids are able to remember, recall, and utilize" (Booth 2019). All of the educators interviewed offer students clear messages about the health benefits of eating more fruits and vegetables. Nadel works with students of all ages, and noted that more specific nutrition information may not resonate with younger students. Instead, she provides examples and tastings of healthy fruits and vegetables that resonate with students of all ages (Nadel 2019).

Other educators weave nutrition information into hands-on activities. Coon discussed nutrition information through the lens of empowerment: "I do think it is valuable to talk about nutrients and nutrition fact labels and ingredients and things that are more technical and boring. Because I use those things to decide what I eat, and I think that students and families should be empowered to do that" (Coon 2019). Coon integrates nutrient-based guidance such as eating less sodium into her cooking lessons. To give a practical application of how to decrease sodium intake, she conducted a tasting of different seasonings, then cooked carrots with students to demonstrate how they could be made to taste more flavorful without salt (Coon 2019).

Student Engagement

Educators also highlighted the strength of the hands-on approach when working with students who receive more traditional instruction throughout the school day. "It's just a different experience for the students, They're used to being talked at all day, and not getting their hands dirty. It's fun," said Mary Bullock, who is a trained chef and the program manager of EAT360, the school-day cooking program run by Vetri Community Partnership (Bullock 2019). Kral remarked that hands-on programs are more impactful than conventional lessons because of their immersive method of delivery. "Just teaching kids in a classroom about nutrients is probably not the best approach. It's really that hands-on experience, perhaps combined with some nutrition knowledge, that can make an impact" (Kral 2019). She maintained that knowledge is most useful when coupled with engaging activities such as cooking.

Educators prioritize cooking because it is exciting and motivating for students. When asked about teaching the more conventional portions of lessons versus the cooking portions, Vetri Cooking Lab Educator Dalton Noakes said, "Cooking is so much more interesting… Every week kids come in excited and curious about what they're going to make" (Noakes 2019). Similarly, educator and program administrator Aurora Coon called cooking with students "the best part" of her wide-ranging experiences with nutrition education (Coon 2019). Coon is the University-Assisted Community Schools Site Director at Comegys Elementary School in Philadelphia, where she oversees the after-school cooking program Rebel Chefs. Coon described kids' interest and motivation to work with food as so powerful that it "almost eliminates the need for classroom management" (Coon 2019). She reported that telling a student they would not be allowed to cook if they misbehaved was highly effective in making sure they paid attention: "I think that's true across grade levels, from kindergarten to 12th grade." Finally, Coon noted that

the high levels of interest and engagement that come with cooking can extend beyond students to their families: “Even families that don’t eat healthy, or have health challenges, people are always interested” (Coon 2019).

Because cooking is a sensory and immersive learning method, it can engage students with a wide range of learning styles. A student does not have to excel at memorization or logical reasoning to resonate with tactile learning processes such as those conducted in Stein’s classes: crushing toasted cinnamon with a mortar and pestle, or dicing and roasting garlic. Coon also offered that students who struggle with traditional learning styles respond well to cooking:

> Preparing food with kids is hugely impactful. It reaches students whose learning styles aren’t usually reached in the school day, like kids who are kinesthetic learners, or English language learners, or special education students. It’s very inclusive. And it’s super engaging. Kids who really struggle behaviorally are successful at cooking because they want to do it so badly. (2019)

While not every elementary school student will grow up to pursue history or geometry or many other subjects taught in school, every elementary school student will eventually be responsible for feeding him or herself. Therefore, it is advantageous that a subject as widely applicable as nutrition education should adopt a method that is inclusive of as many learning styles as possible. In addition, hands-on nutrition education benefits the overall learning environment, engaging students who are sometimes left behind in traditional classroom settings and ensuring that a wider range of students are able to engage with some aspect of their learning experience.

Hands-on nutrition education primarily engages children in cooking, but Helen Nadel’s work with Greener Partners supports that children can be included in many steps of growing, harvesting, preparing, and eating food as well. As Education Director of Greener Partners, a nonprofit in Philadelphia, Nadel offered evidence that expanding the scope of children’s hands-on interaction with food to include gardening provides more ways to engage with food. “There

are many connection points that people have to food," she said. "For some people, it's going to be taste. For other people, it's cooking. For other people, it's 'wow that was unbelievable, I didn't know that's how a tomato grew,' or 'I've never pulled a carrot out of the ground.' So by including gardening, your ability to find that connection with an individual child is greatly enhanced" (Nadel 2019). Like Coon, Nadel believes that hands-on nutrition education offers more varied, more sensory opportunities for children to become invested in healthy food. She sees that initial engagement, and eventually, investment in healthy food as a way to build healthy eating habits over time.

Food Exposure and Perception

Hands-on nutrition education, unlike conventional nutrition education, addresses a central element of learning about food: taste. Different sensory experiences are more relevant to some subjects than others. It would seem ridiculous to teach an elementary school music class without ever involving students in listening to music, because hearing is a necessary sensory experience in order to meaningfully learn about music. In the same way, taste is a necessary sensory experience in order to meaningfully learn about food, and nutrition education that disregards taste omits a sensory experience that is essential to understanding the subject matter. Just as music classes are designed to encourage children to listen to music, or even create it, Kral argued that nutrition education should involve students in tasting or creating food. "A hands-on experience and taste exposure to healthy foods is critically important. It's one thing to learn about healthy nutrition, it's another thing to taste healthy foods. And not just once, but built into the curriculum" (Kral 2019). If humans were capable of making every food choice based on nutrition alone, overweight and obesity would not be a widespread problem. Practical nutrition

education must acknowledge and embrace that taste is a key part of human food choice, and that this condition will not change.

Including taste in nutrition education helps students overcome food neophobia, or an aversion toward novel or unfamiliar foods, which serves a biological purpose in preventing ingestion of toxins or pathogens (Rozin 1976). For example, kids often declare that they hate mushrooms, or similar foods, having never tried them. Overcoming food neophobia requires introduction to a range of foods over time, which is often referred to as food exposure. Kral argued that food exposure is crucial in developing preferences for foods like fruits and vegetables, which vary widely in texture and taste. "Food preferences and eating preferences that we establish early in life will shape their eating patterns later in life. What we see in our laboratory often is that kids haven't been exposed to fruits and vegetables, so they may miss out on learning about these taste components and establishing preferences for healthy foods early in life" (Kral 2019).

Multiple educators told stories of students overcoming food neophobia and increasing food exposure through hands-on nutrition education. Noakes referenced a student who ate mushroom barley pilaf she had made in Vetri Cooking Lab and reversed her original stance contra mushrooms. Ensslin said that through one of her hands-on SNAP-Ed programs, a student who had only eaten four foods started drinking seltzer water and slowly incorporating other foods into her diet (Ensslin 2019). Nadel recounted a student saying, "I'll taste that, I grew that," about a vegetable she grew and harvested herself. Other educators raved about students growing to love eggplant, cinnamon, and kale. These stories took a common form: Educators found that involving a student in preparation of food made them more likely to taste it; and that multiple tastings over time resulted in enjoyment of that food. Booth said, "we often find that we can

convert kids from hating a food to liking or not minding it, just because they were involved in making it, and that makes them willing to taste it" (Booth 2019).

In sharing excitement about preparing meals with their students, educators push back on students' assumptions that they will not like healthy foods. Coon said that one of her main goals was "for students to know that healthy food can taste good," and Noakes said he aimed "to reframe what kids think about vegetables and healthy food having to be bleh" (Coon 2019) (Noakes 2019). An advantage that both Coon and Noakes bring to this proposition is that they genuinely get excited about cooking, and that excitement is transmitted to students. In training volunteers from the University of Pennsylvania to assist with his Rebel Chefs program, Stein plays a six-minute video of chef Jose Andres excitedly preparing an olive tapa (PBS 2009). The video is notable because of just how passionate Andres is about the dish, and Stein shows it to volunteers to demonstrate that excitement about food can be contagious. At a recent training, a University of Pennsylvania volunteer remarked that she did not even like olives, but that the video made her want to try the dish anyway. While healthy meals usually do not contain the precisely calculated quantities of sugar, and fat that make a candy bar so pleasurable, they do have the advantage of being the result of passion and hard work.

Confidence

Hands-on nutrition education differs from conventional nutrition education in that it emphasizes the agency of the student. Rather than a teacher telling a student how they should eat for the duration of the lesson, students in hands-on interventions are in control of different aspects of the cooking process, such as washing vegetables or dicing onions. Engaging in these activities connects to the goal of increasing students' confidence relating to food and cooking

processes, and on a larger scale, "putting students in a position of power and control of their own food environment and their own health" (Stein 2019). Booth noted that Vetri Cooking Lab educators are there to facilitate, but not to do much of the cooking themselves. Instead, educators should have the mindset of "here is the recipe and here are the materials that I've brought, but you [students] are leading the charge" (Booth 2019). Similarly, Stein's volunteer training offers "Step up, step back" as a general rule to encourage college-age volunteers to refrain from cooking too much, instead encouraging students to step up. Students cannot be expected to become confident in cooking processes unless they are given the opportunity to practice them. By emphasizing the role of the student and de-emphasizing the role of the educator in food preparation, hands-on interventions encourage students to build confidence in cooking practices.

Hands-on nutrition education also aims to increase students' confidence with food by allowing them the space to make mistakes. Booth pointed to building resilience as an outcome of allowing students to take the lead in cooking processes, because students were motivated to learn from their mistakes:

> We really treat kids as adults. Kids are doing all of the preparation. They are learning how to read a recipe, prepare it, deviate from it if necessary, fail, and fix it. We're kind of throwing them in and they're learning some resilience while they're learning how to cut an onion or build flavor in a stew. (2019)

Errors in cooking are easy to make and even easier to identify. A student does not need to know the exact oven temperature to be able to taste that a sweet potato has been singed. Noakes argued that there is some satisfaction involved in making mistakes and figuring out how to overcome them. When he asked what one student's favorite parts of cooking lessons were, she responded, "food, friends, and faults," and explained that she liked knowing that it was okay if she messed up cooking because she was allowed to figure out how to fix it (Noakes 2019). Resilience built in

cooking classes need not apply only in that setting. Noakes noted: "That resilience is an attitude that she can take into other areas of her life."

Hands-on nutrition educators also offered an expansive view of the skills necessary to eat healthfully, which include making sense of a confusing and often overwhelming food environment. Educators spoke of building students' confidence related to learning about food and nutrition. Coon spoke to the nutritionism-ridden food environment that prioritizes fads over stable eating advice: "Particularly with nutrition, there's so much bad reporting and confusing information, so I think SNAP-Ed should teach students and adults how to be critical consumers of science and news" (Coon 2019). Teaching students to be discerning about what information about food they give credence empowers them to question nutritionism's stranglehold on United States food discourse. Where nutritionism dictates that individual foods and nutrients be coded as "healthy" or "unhealthy," educators today are more likely to emphasize that an overall healthy diet can be comprised of a range of foods. Booth said, "We want students to come out as educated food consumers. Rather than saying don't eat that or eat this, we're saying, be thoughtful" (Booth 2019). In this way, educators working with hands-on nutrition education programs build confidence not only in food preparation, but also in the more complex domain of food choice.

Impacts Beyond the Classroom

Hands-on nutrition education programs can work to connect students to different cultures, other school subjects, and each other. Some hands-on educators incorporate cultural education about different cuisines and global food history into their lessons. Booth's Vetri Cooking Lab curriculum is careful to extend beyond the traditional Western diet, but also to rely mainly on

ingredients available in Philadelphia. Booth said, “We’re not dumbing anything down. We’re making ratatouille, we’re making Moroccan stew, we’re trying to teach foods that have different cultural backgrounds and different flavor profiles” (Booth 2019). As Booth pointed out, an advantage of cooking foods from a variety of cuisines is that it exposes children to a wider range of tastes and flavors. Bullock said she uses elements of the A Taste of African Heritage (ATOAH) curriculum in her school-day SNAP-Ed lessons (Bullock 2019). ATOAH is a six-week cooking and nutrition education curriculum that “brings to light a culinary legacy and often-unsung cultural ownership of healthy eating for people of African descent” (Oldways 2018). The curriculum, which was created in 2012 and added to the SNAP-Ed library in 2018, offers a proactive, culturally appropriate response to the fact that a quarter of SNAP recipients are African American (Oldways 2018; USDA Food and Nutrition Service 2018).

Cooking classes also provide ample opportunity to learn about math and science. Booth believes that “the kitchen can be a classroom,” and highlighted the use of fractions and measurement involved in preparing food from a recipe. Ensslin spoke about a lesson in which students read soft drink labels, then physically measure out the amount of sugar contained in those drinks in order to conceptualize how much sugar is contained in 8 liquid ounces of soda (Ensslin 2019). As early as 1974, the National Council of Teachers of Mathematics cited cooking as an engaging method of teaching students about mathematical concepts (Bingham Smith 1974). Through gardening, Nadel has a unique opportunity to work environmental science into her lessons: “Because of the way that we do our work, we are also teaching biology and ecology, as well as nutrition.” Learning these subjects in the context of growing actual food is valuable in getting students to connect to the material (Nadel 2019). This logic applies beyond just gardening programs. Stein’s cooking program, Rebel Chefs, familiarizes children with scientific

concepts such as heat, enzymes, and acidity through cooking (Stein 2019). In one activity, students soak sliced apples in lemon juice to demonstrate how the acidity of the juice prevents the apples from oxidizing, or turning brown. The hands-on, highly engaging nature of cooking programs makes them an ideal foundation for reinforcing elements of other school subjects.

Educators also highlighted that cooking and eating together builds relationships. Most hands-on programs included in this thesis involved children working together to prepare food rather than each preparing their own portions alone. The collaborative nature of hands-on nutrition education informs Bullock's belief that "[Cooking] is great for relationship development. It's a good way to get students talking, to get them moving first, and to have them doing something they don't do every day. It leads to fun conversations between students and our educators" (Bullock 2019). In addition to preparing food together, hands-on curricula including Cooking With Kids, A Taste of African Heritage, and Vetri Cooking Lab allow time for students to eat together. In this time, students build relationships with each other and their educators, all while enjoying a meal that they worked together to create.

Equipment Challenges

Despite the advantages of hands-on nutrition education, the educators interviewed for this paper pointed to a series of challenges for hands-on nutrition education. These challenges stem from the fact that cooking is unlike other school subjects in terms of the infrastructure and equipment it requires. Many schools have inadequate or outdated kitchen equipment, especially in cities. For example, one study reports that only about half of New York's 1,385 school kitchens have adequate cooking equipment for staff to sauté or boil over a flame (Severson 2009). Even when schools do have full-service kitchens, students and cooking programs are

often not allowed to use them. As a result, many of the educators interviewed for this thesis cooked in classrooms or cafeterias and rarely had on-site equipment beyond a sink. "You're not guaranteed a room with a sink, probably cooking on classroom desks, and you have to bring all of your materials. Sometimes it's 84 degrees and you're heating things up in a classroom without air conditioning" (Noakes 2019). This can make the cooking environment challenging and even unpleasant for educators and students.

Because many schools do not have existing setups conducive to cooking, it sometimes falls to educators to bring their own materials, which can be heavy and difficult to transport. Coon reported that "[My colleague] would make fun of me for carrying 20 knives and 20 cutting boards and food to a site to do cooking, which I didn't have to do for SNAP-Ed. I could have just brought a prepared sample. But to me it's very worth it" (Coon 2019). Even given the challenges of bringing unwieldy equipment, Coon maintained that involving students in the cooking experience was worth the struggle. Still, the lack of equipment in schools took a physical toll on Coon, who hurt her back carrying heavy equipment to schools on public transportation and filling bins with dishwater (Coon 2019).

Hands-on nutrition education programs have found some successful strategies to combat the challenges of working in schools not designed for cooking. For Vetri Cooking Lab, Booth has the funding to build compact cooking "kits" of equipment that can be delivered to schools by truck and left there for the duration of the program. This eliminates the need for educators to carry all materials back and forth for every lesson (Booth 2019). Stein uses a "4-Bin System" of inexpensive plastic tubs that can be filled with hot water, soap, and bleach to process a high volume of dishes in schools with small sinks (Stein 2019). And both Vetri Cooking Lab and Rebel Chefs have developed many recipes that don't require access to an oven, instead using

portable camping burners for processes like sautéing, steaming, or boiling. These minor solutions, although inventive, do not comprehensively address the problem that schools today are not set up for cooking. A long-term commitment to cooking in schools would require that school kitchen facilities be updated or other spaces in schools be developed as cooking classrooms. While this is a costly, long-term goal, it is not impossible. Many schools once contained home economics classrooms complete with cutting spaces, large sinks, ovens, and stovetops, which could represent a model for future school cooking classrooms.

An additional challenge of cooking in schools is that it relies on some dangerous equipment, such as knives and burners. Noakes was up front about the inherent risk in letting students use knives, "We trust them. But find the instructor out there who says they aren't a little bit nervous about giving kids knives, and they'd be lying to you. It is a safety hazard. But for the most part, kids use them safely. I've only had a kid cut himself once" (Noakes 2019). Despite the risk, knife skills are essential to food preparation, and it is safer to learn knife skills in a structured, supervised environment than to experiment with them without supervision. Many of Vetri Cooking Lab's lessons include knife safety components that allow students to slowly, safely practice cutting (Booth 2019). Students using knives are likely to pay close attention to their work because they understand that they are being trusted with a piece of potentially dangerous equipment. When someone expresses concern that his cooking classes involve knife use, Stein often jokes, "If a kid is misbehaving, I give them a knife" to highlight that knives command children's attention and focus. Ensuring that students can carefully work with knives contributes to the role of cooking classes in building confidence, independence, and trust.

In addition to equipment challenges, food itself is difficult to work with in school environments. Concisely put, Bullock described working with food as "a logistical nightmare"

(Bullock 2019). Her programming prioritizes fresh fruits and vegetables, but bringing fresh produce to a school is difficult. If school is cancelled or even if an individual classroom is running behind, food can spoil (Bullock 2019). Refrigeration is hard to find and expensive (Bullock 2019). Food itself can also be expensive, although Coon mentioned that the smaller-sized portions mandated by SNAP-Ed can be helpful to this end. If an educator is only distributing tasting-sized portions, "you can feed 20 kids with one grapefruit" (Coon 2019). And despite the higher cost of food than, say, a presentation on riboflavin, Coon remarked that "the (SNAP-Ed) funding is adequate to do a lot of cool samples and recipes" (Coon 2019). Maximizing the available funding means minimizing food waste, which is difficult with limited access to refrigeration and without being able to predict exactly how much students will eat. As a means of addressing food waste, in 2019 Stein is piloting a program in which a small group of students creatively prepare leftover food the day after his program's main cooking lessons.

Food Access Challenges

Beyond the challenges of preparing food in schools, limited food access provides structural barriers to both hands-on nutrition education and healthy eating in general. Lack of time, lack of resources, and lack of cooking skills were the most frequently reported barriers to food preparation among young adults (Larson, et al. 2006). A 2013 report found that 30 million Americans, between 6 and 9 percent of households, live in areas where the closest supermarket is more than one mile away (Bell, et al. 2013). Even with physical access, the high cost of many healthy, fresh foods can be serious barriers to their consumption among low-income individuals (Gordon-Larsen 2014). The relative cost of fresh fruits and vegetables has climbed by about 40%

since the 1980s, and more shelf-stable, inexpensive sodas and packaged options have become available over the same time period (Nestle 2010).

Reducing these barriers to healthy eating has been the focus of many initiatives outside of nutrition education. For example, a recent surge of efforts throughout Philadelphia have increased food access. Between 2005 and 2013, there has been a 56% decrease in Philadelphians without access to healthy food options and a 48% net increase in the number of full-service grocery stores over the same time period (Stephens 2015). Improving food access is a necessary public health goal that overlaps with some nutrition education initiatives.

Hands-on nutrition educators have found some ways to work around these food access issues. Lack of access to fresh produce does not mean that no produce is available whatsoever. On the subject of hands-on nutrition education happening in food deserts, Kral said that "a way to incorporate that in nutrition classes is to talk about alternatives. Talk about canned vegetables, for example" (Kral 2019). Canned foods are more shelf-stable and more widely available than fresh produce, as are frozen fruits and vegetables. This is why Vetri highlights "any vegetable, any way" in its curriculum, which encourages students to eat fruits and vegetables in any form they can, even if it is not fresh (Booth 2019). As Kral noted, "In terms of the nutritional content, there are not too many differences between fresh and canned fruits and vegetables" (Kral 2019; Rozin 1976). Canned vegetables are certainly no substitute for equitable food access, and even expertly prepared canned and frozen foods often do not taste as good as fresh ones. However, teaching students how to find healthy options in low-access areas, and how to make those options taste good, is a way to capitalize upon what healthy foods are available in low-income communities.

In addition to working around food access problems, some hands-on nutrition educators are confronting those problems head-on. At Greener Partners, Nadel has seen a shift over the past decade towards programs that supply fresh food to schools (Nadel 2019). She said that her early programs sought to expand kids' palates with foods like tricolor potatoes, but that she recognized that these particular items were not always accessible. She also realized that fruits and vegetables in general were inaccessible in certain neighborhoods. Today, Greener Partners grows fruits and vegetables and distributes them to hundreds of families per week through schools, shelters, and hospitals at reduced cost or for free. In 2017, Greener Partners donated more than 20,000 pounds of fresh fruits and vegetables (Greener Partners 2015). The organization incorporates education into most of its distribution sites through cooking demonstrations and tastings.

Nutrition education ties into food access initiatives because even as access improves, people who formerly had little access to fresh food will be especially unlikely to know how to prepare it (Booth 2019). This is the rationale behind the Vetri Mobile Teaching Kitchen, which is a modified food truck that carries fresh food to schools, community events, and farmer's markets and conducts demonstrations of how to prepare its contents. A Vetri Community Partnership video introducing the project explains how it unites better food access with hands-on nutrition education:

> There are a lot of awesome organizations bringing food into neighborhoods, whether it's a farmer's market, or food stand, or a healthy corner store. The access is beginning to happen, but there's a gap between having healthy produce in your area and knowing what to do with it. That's where the Mobile Teaching Kitchen comes in. We want to bridge that gap and give our neighbors the skills to make food in delicious, affordable, and healthy ways. (2017)

The Mobile Teaching Kitchen is designed to translate improved food access into healthier dietary habits by combining access with education. Although the scope of food access issues

extends far beyond nutrition education, it is encouraging that educators have found ways to work both around and against lack of access to fresh foods.

Evaluations of Hands-On Nutrition Education

Despite the challenges of cooking in schools, research demonstrates that hands-on nutrition education is more successful than conventional nutrition education at improving students' dietary behavior. Appendix 2 summarizes evaluations of 15 hands-on nutrition education interventions among children. Excluding duplicates, 11 of these interventions were included in reviews by Hersch et al. (2014) and Muzaffar, Metcalfe and Fiese (2018) and met inclusion criteria of being a hands-on cooking intervention with participants aged 5-12, and having an evaluation published in a peer-reviewed journal. Appendix 2 includes five additional studies of hands-on nutrition education that took place in school settings with children between the ages of 5 and 14.[1] Two were published more recently than 2013, which is why they were not included in the prior reviews (Overcash, et al. 2018; Chen, et al. 2014). The other three differed slightly from the inclusion criteria for the prior studies, but still met this thesis's definition of hands-on nutrition education. The studies most frequently assessed changes in dietary behavior (12), often assessed psychosocial indicators of children's relationships with food (11), and rarely assessed biomarkers of obesity (1).

In all three areas of assessment, the studies found significant positive impacts of hands-on nutrition education. Hands-on interventions were more successful than the conventional interventions surveyed in Appendix 1 at improving dietary behavior. All 12 studies that assessed impact on dietary behavior found improvement in at least one outcome of interest, and many

[1] These studies are: Overcash, et al. (2018), Chen, et al. (2014), Brown and Hermann (2005), Townsend, et al. (2006), and Jarpe-Ratner, et al. (2016)

found improvement in multiple areas of interest. Among the interventions included in Appendix 2, improved dietary behavior was observed through such measurements as increased fruit and vegetable consumption, greater nutrient content of meals, greater consumption of fiber and minimally processed whole grains, and higher fruit and vegetable preference scores. Interventions also observed improvements in psychosocial variables related to food consumption including increased confidence in cooking, greater willingness to try new foods, increased participation in meal preparation, and increased communication about healthy eating.

The single study including anthropometric measures cannot be taken alone to establish that hands-on interventions are effective in that regard, and even the numbers of studies assessing dietary behavior and relationships with food are still relatively small (Davis, et al. 2011). Still, the study by Davis, et al. is significant for its demonstration of improvements in dietary behavior, blood pressure, and BMI. The study measured the impact of a cooking and gardening program on the dietary intake and health outcomes of predominately Hispanic fourth and fifth grade students (Davis, et al. 2011). The program took place across 24 lessons, 45-minutes each on cooking and gardening. The study found that participants' dietary fiber intake increased by 22% as opposed to the control group, that participants' blood pressure decreased significantly, and that overweight children in the intervention group gained less weight and had a greater improvement in BMI than did overweight participants in the control group (Davis, et al. 2011). The success of this intervention suggests that future studies should aim to measure the impacts of hands-on nutrition education on anthropometric improvements.

Beyond the lack of anthropometric assessments of nutrition education programs, limitations of the studies included in Appendix 2 are that most programs did not include follow-ups, so they do not imply long-term results, and many programs relied on self-reporting of food

intake. To more definitively determine the efficacy of this type of intervention, future studies should assess the impacts of hands-on nutrition education on biomarkers of obesity, include long-term follow-ups, and include more reliable measures of intake, such as plate waste measurement.

Mechanisms for Improved Dietary Behavior

Other research has identified mechanisms through which hands-on nutrition education may impact dietary behavior. Studies suggest that taste exposure makes children more willing to try novel foods, which can translate to better diet quality later in life. Park and Cho (2018) found that a 12-session tasting program among children aged 7-9 significantly reduced food neophobia and made students more willing to try novel foods. Martins, Pelchat, and Pliner (1997) found that providing participants with nutrition information and the opportunity to taste a food (a hands-on approach) made them more willing to try that food, but providing nutrition information alone (the conventional classroom approach) did not. Increasing children's willingness to try new foods has been linked to better diet quality later in life. A widely cited longitudinal study by Skinner, Carruth, Bounds, & Ziegler (2002) found that children who were introduced to a healthy and varied diet earlier in life were more likely to develop future healthy food preferences.

Both educator feedback and program evaluations of hands-on nutrition education interventions support that they improve children's confidence related to food, which has also been linked to better dietary behavior. A longitudinal study of 8,500 students by Utter et al. (2016) found that self-perceived cooking skills in adolescence predicted better dietary behavior and intake a decade later. The study also found that adolescents reporting the greatest cooking

abilities were about twice as likely to meet recommendations for fruit and vegetable consumption, probably because many fruits and vegetables require preparation to be eaten, and especially to taste good. A study of 426 Australian households by Winkler and Turrell (2009) found that when a household's main food preparer reported confidence in preparing vegetables, their families purchased a greater variety of vegetables on a regular basis (Winkler and Turrell 2009). The increased variety observed within preparation-confident households may reflect the fact that many food preparation skills are applicable to a wide range of foods; learning to dice an onion also effectively teaches a person how to dice a zucchini, carrot, or celery. These studies support that confidence in food preparation can have measurable positive impacts on food choice and dietary behavior.

Research has also drawn connections between food enjoyment, cooking enjoyment, and cooking skills. A study by Dohle, Rall, and Siegrist (2015) found that participants liked healthy foods more when they had prepared them themselves. The same effect did not hold for unhealthy foods, which suggests that a way to close the gap in taste between healthy and unhealthy foods would be to encourage food preparation (Dohle, Rall and Siegrist 2015). Enjoyment of food preparation may even predict cooking skills: Hartmann, Dohle, and Siegrist (2013) developed and validated a cooking skill scale in order to determine predictors for cooking skills among men and women. Data from 4,436 participants found that the most important predictor for cooking skills was enjoyment of cooking (Hartmann, Dohle and Siegrist 2013). This result suggests that fostering enjoyment of cooking among students may be valuable in developing their cooking skills. To this end, it is encouraging that educators report such high levels of engagement and enjoyment among their students.

Taste exposure, confidence in food preparation, and enjoyment of food and cooking are just three mechanisms that may contribute to the improvements in dietary behavior observed following hands-on interventions. This chapter has demonstrated that the hands-on approach to nutrition education is associated with a greater propensity for improving dietary behavior and developing children's confidence and relationships with food than conventional nutrition education. Educators describe hands-on nutrition education as better engaging students in practical interactions with food instead of lecturing about nutrition knowledge. By bringing healthy food into cafeterias, classrooms, and after-school programs, hands-on nutrition education also combines individual instruction with elements of environmental change.

Despite evidence from educators and program evaluations that cooking with kids is engaging, exciting, and effective, SNAP-Ed policy has heavily promoted a Policy, Systems, and Environmental (PSE) change approach to nutrition education rather than substantially increasing resources for cooking programs. PSE change encompasses hands-on nutrition education because working with food in school modifies that school's environment, but the method extends beyond hands-on nutrition education by including structural change initiatives that do not directly involve students. The next chapter will explore the PSE change approach to nutrition education, which has strained educators. It will conclude by exploring an alternative model of fostering change to the food environment alongside hands-on nutrition education that has taken place in Japan.

Chapter 3: Changing the Food Environment

While conventional and hands-on approaches to nutrition education aim to improve health outcomes by changing individual behavior, the Policy, Systems, and Environmental (PSE) change approach, which has been advanced by SNAP-Ed within the past decade, aims to improve the food environment. This method reflects the variety of factors that shape food choice, and PSE initiatives such as improving food access, ensuring clean drinking water, and promoting the availability of healthy foods in schools are clearly worthwhile. However, my interviews with highly skilled and dedicated, if over-worked nutrition educators suggest that the implementation of PSE through SNAP-Ed has required taking on environmental change projects well beyond their realm of expertise without the resources or authority to do so.

This chapter will explore these educators' critiques of the PSE change approach, which suggest that an abstract mandate for SNAP-Ed educators to address major structural issues regarding the school and community food environment is not a sustainable approach to nutrition education. While the educators I interviewed believe that addressing these structural issues is desirable and necessary, they do not think that SNAP-Ed, an under-funded and under-staffed educational program that is not integrated with the administrative structures of individual schools, is a viable means of doing so. Without adequate resources, training, and school-based administrative support, the PSE mandate sets educators up for failure. Nonetheless, research has suggested that combining individual-level instruction with improvements to the food environment can improve dietary behavior, so it is worth considering more sustainable ways to support both of these goals.

This chapter will contrast the PSE change approach with Japan's more robust method of combining nutrition education with environmental change. In 2005 Japan enacted the Basic Law

on *Shokuiku*, or food education, which initiated a better staffed, institutionalized approach to providing effective hands-on nutrition programming and healthy school food. The program has placed full-time, well-trained educators in every public school who facilitate both the lunches in that school and hands-on education that involves children in the preparation of their lunches. In this way, Japan has recognized that environmental change and nutrition education efforts can be complementary. Unlike the PSE change approach in the United States, Japan has built these complementary goals into the institutional structure of their system of education.

Policy, Systems, and Environmental Change

Many challenges of nutrition education are embedded within greater structural problems in the United States: issues such as food access, income inequality, education quality, and prevalence of processed and fast foods. The outsize role of these environmental factors has prompted a shift within nutrition education through SNAP-Ed toward policy, systems, and environmental (PSE) change, which broadens the scope of nutrition education beyond learning about food and into improving the food environment (Ensslin 2019). For this reason, PSE does not focus on teaching individuals how to make better choices; instead it alters the food environment to make those better choices possible (Lyn, et al. 2013).

Since 2013, PSE change has gained momentum as an approach to nutrition education administered through SNAP-Ed. SNAP-Ed defines PSE change as strategies that "seek to reshape or modify structures beyond the individual to support and influence positive behavior change" (The Food Trust 2012). This method has grown out of the acknowledgement that there are many environmental factors that limit one's ability to eat healthfully, such as restricted food access, lack of money to buy food, or high availability and low cost of unhealthy food (Lyn, et

al. 2013). The PSE change approach was first introduced in the SNAP-Ed Guidelines in 2013 and has been pushed strongly by the USDA Food and Nutrition Service that administers SNAP-Ed ever since. Whereas the 2013 SNAP-Ed guidelines announced that PSE work was an allowable use of SNAP-Ed funds, the 2019 guidelines document "advises states that all SNAP-Ed plans must include PSE change efforts" (USDA Food and Nutrition Service 2012, 2018). States have responded accordingly. PSE change initiatives were included in 60% of state SNAP-Ed plans in 2014, and 90% of plans in 2016 (Gleason, Wolford and Wilkin 2018).

The PSE approach has displaced and diverted resources from some SNAP-Ed programs that work more directly with children. Between 2014 and 2016, the reach of "direct education" via SNAP-Ed, or programs in which educators work with students, as opposed to fostering change around them, declined by 25%. The USDA Food and Nutrition Service explains this decline as likely due to the increased emphasis placed on PSE change strategies over this time period" (Gleason, Wolford and Wilkin 2018). Despite the evidence that some "direct education programs," such as cooking classes, can be effective at improving dietary behavior, the growth of the PSE change approach has diverted attention and resources from such hands-on strategies.

Examples of PSE change initiatives are wide-ranging. Coon said her colleague attended school district meetings to advocate for more water fountains with filters–an example of a local initiative to improve school health at the district level (Coon 2019). Crandall said that the Philadelphia Department of Health has established 8 paid internships for high school students who spearhead their own school nutrition projects. At Kensington Health Sciences Academy, these students developed a survey about participation in school meals and met with representatives from the division of food services to discuss how to increase participation (Crandall 2019). A document on the SNAP-Ed website published by the Philadelphia-area

nonprofit The Food Trust gives broader examples of PSE change including schools requiring healthy vending machine options for students, improving availability of healthy options in school cafeterias, and even changing zoning laws so that corner stores can display produce outside (The Food Trust 2012).

While hands-on nutrition educators are able to temporarily improve the food environments of the classrooms or cafeterias where they work, attempts at community-level environmental change can be limited by policy issues beyond the scope of nutrition educators, school staff, and program administrators. As an example, Marion Nestle points to environmental change efforts to make corner stores healthier (Nestle 2010). These efforts have been hampered by the fact that making corner stories healthier also makes them less profitable as a result of the relative increase in cost of fresh fruits and vegetables since the 1980s and relative decrease in cost of sodas and packaged foods, which comprise most of the corner stores' products (Nestle 2010). While environmental efforts to improve corner stores are well-intended, they must be associated with policy change to be sustainable. Nestle's suggestion is that "the government should adopt agricultural policies that reduce the relative cost of healthier foods" (Nestle 2010). She also suggests improvements in the federal school meals programs to ensure that students have enough nutritious breakfast and lunch in school each day "so they are less likely to be ravenous when they encounter a bodega" (Nestle 2010).

Both of the structural changes that Nestle proposes, however, require major revisions in federal legislation and policies: the Farm Bill governing agricultural policies; and the Childhood Nutrition Act that sets guidelines for school meals. Nutrition educators can work for these types of change as citizens and as members of nutrition-related organizations, but there are significant restrictions on paying federal employees to engage in lobbying efforts. In addition, working on

such long term policy goals is unlikely to have the more immediate impact on the school and community health environment that the PSE mandates seem designed to achieve. There is no question that nutrition educators can make some improvements to school food environments: for example, by bringing in fresh food for cooking lessons. They are typically not equipped, however, to facilitate the high-level policy change that the PSE mandates suggest. Coon eloquently placed her SNAP-Ed programming within the context of the overwhelming barriers to academic and economic success, as well as healthy living that apply to low-income students regardless of the quality of their nutrition education:

> SNAP-Ed has to be one piece of the puzzle. Information and education in general are really important. At Comegys, we want kids to do better academically. But even if they did amazingly academically, they'd still face a lot of environmental health challenges, economic barriers, political barriers. These are things that require large-scale policy solutions that aren't just about food or about education. They have to be about things like who has access to credit, and residential segregation. So [SNAP-Ed] is a step in the right direction, but it has to be accompanied by more: regulation of food companies, huge changes to our tax policies, things like that. (2019)

This is not meant to diminish the role of nutrition education in better outcomes in health and in life, but to underline the complexity of the factors impacting those outcomes. Coon is a skilled educator who has instilled a love of healthy eating in many students. As she noted, however, the idea that she should be held accountable for significantly improving low-income students' access to health and opportunity represents a staggering underestimation of the kind of multi-level fundamental change necessary to achieve such outcomes.

Educator Perspectives on PSE Change

PSE change has been a topic of vigorous discussion among nutrition educators because even on a more limited scale, this approach to "nutrition education" seems to require such significant change in educators' roles. While most of the educators interviewed for this paper

agreed that it is necessary to work against the environmental contributors to obesity, they also saw assigning that mission to SNAP-Ed educators as placing unreasonable expectations on an already demanding role.

Before SNAP-Ed administration developed this mandate for PSE change in 2013, the role of nutrition educators was to work directly with students. The task of using SNAP-Ed funding to implement PSE change has now fallen to those same educators. They describe the charge to lead such change initiatives, however well-intended, as increasing the burdens associated with their already demanding jobs, especially when they are asked to initiate PSE change in addition to their existing lessons. Coon described the resulting strains:

> "They're just taxing nutrition educators because they're like 'Keep doing everything you're doing, but add these seven other things that you have no training in. And go meet with the principal and city government and parents and change the whole school.' And you're like, 'that sounds great, but I'm teaching twelve lessons a week, so I'm not sure when I could do that.'" (2019)

Educators in schools receiving SNAP-Ed funding are often facing serious challenges even before being asked to add PSE to their responsibilities. PSE overworks educators who are expected to maintain their output of lessons while fostering population-level change in the food environment through setting up meetings with the city government, or developing strategies to change the practices of schools where they often only work part-time.

Other educators are being asked to teach fewer lessons to make room for this change agent role, which creates tension between schools that are used to receiving lessons and educators who are being directed away from them. Crandall described schools as "asking for education. So having to choose between one or the other is difficult. Most of those folks are already so overwhelmed with what's going on in their schools. It's just asking a lot of people" (Crandall 2019). Ensslin also acknowledged significant challenges for the educators she

supervises: “They’re so used to teaching lessons. But they’re missing that piece and we’re struggling with getting them to transition” (Ensslin 2019). People who work in nutrition education often do so because they enjoy teaching. With the transition to PSE, educators who signed up to teach are instead being encouraged to become organizers and run clean water or food access initiatives. While these initiatives are undoubtedly worthwhile, experienced nutrition educators are not automatically the right people to champion them.

Nonetheless, most of the educators I interviewed were supportive of the mission of PSE, despite saying that they were being required to become change agents without the requisite authority or clear institutional role to do so. Some suggested increasing staffing or changing the structure of delivering PSE initiatives to address these issues. Coon is a proponent of the flexibility and creativity afforded by PSE, but proposed that “some direct ed. needs to be cut to make room for this, or staffing structures need to change and they need to add more investment in staff” (Coon 2019). Crandall agreed: “There’s just not enough people to do the work to make this stuff feel easier” (Crandall 2019). While arguing for greater resources to support PSE initiatives, neither Coon, nor Crandall wanted to cut back on efforts to improve the food environment or to improve individual behavior. Instead, Coon declared that the two “should complement each other” (Coon 2019). Bullock suggested that if nutrition educators took on the task of initiating PSE change, she hoped that full-time staff in each school would support those initiatives long-term: “By promoting wellness within the school, we are creating a sustainable initiative that can be taken up by leaders within the school, as opposed to us being the key group delivering these messages” (Bullock 2019).

Bullock underlined that educators spread thin between many schools may not be able to deliver PSE change. She thereby raised the larger question of how to develop a more effective

role for nutrition education, including PSE change, within the structure of American education. United States nutrition education policy has struggled with this question, but Japan has answered it more clearly by building full-time nutrition educator positions into its public school system.

Early Evaluations of PSE Change

Because PSE is a recent initiative and made up of varied interventions, there is no clear set of reviews or evaluations that assess its effectiveness. However, two PSE-type interventions were evaluated in the context of a broader review of multicomponent interventions by Meiklejohn, Ryan, and Palermo (2016). These evaluations suggest that effective PSE change initiatives in combination with individual-level nutrition education may reduce the incidence of overweight and obesity.

Meiklejohn, Ryan, and Palermo assessed 11 multicomponent nutrition education programs and found that interventions that incorporated "changes in canteens, food supply, and vending machines" were associated with significant changes in dietary intake (Meiklejohn, Ryan and Palermo 2016). Two studies in this review relied heavily on PSE change interventions: Foster, et al. (2008) and Millar, et al. (2011). Foster, et al. evaluated a policy-based school intervention to prevent overweight and obesity among 1,349 fourth through sixth graders, assessed at baseline and after 2 years in both intervention and control schools (Foster, et al. 2008). The intervention was comprised of staff training in nutrition education, 50 hours of food and nutrition education per student per year, and a nutrition policy improving school meals and removing unhealthy foods from vending machines, replacing them with items that meet the Dietary Guidelines for Americans. The program had an impressive impact on children's anthropometric measurements: The odds of incidence of obesity and overweight were

approximately 33% lower for the intervention group and 15% lower at 2-year follow-up (Foster, et al. 2008).

Millar, et al. evaluated a 3-year intervention that took place in Australian schools among 1,852 adolescents (Millar, et al. 2011). The intervention aimed to "build the capacity of families, schools, and communities to promote healthy eating and physical activity" through objectives including promoting healthy breakfasts, increasing the nutrient density of school foods, and reducing soft drink consumption (Millar, et al. 2011). Like the Foster, et al. study, students in the intervention group gained significantly less weight and did not increase their BMI as much as students in the control group (Millar, et al. 2011). These interventions suggest that improving the school food environment may be a component of successful interventions that improve children's anthropometric measures of overweight and obesity. The PSE change approach to nutrition education clearly seeks to replicate the way that these successful interventions combined environmental change with initiatives aiming to improve individual behavior. However, SNAP-Ed educators suggest that their "outsider" positions across several schools make it difficult for them to orchestrate extensive changes to the food environment like the ones implemented in the Foster, et al. and Millar, et al. studies. Therefore, it is worth considering the more substantial investments in nutrition education needed to make environmental change in individual schools more effective.

Japan's Model of Nutrition Education

Japan made nutrition education a national priority in 2005 with the enactment of the Basic Law on Shokuiku. Japan's system provides a potential approach to resolving some challenges of nutrition education in the United States by developing and funding a more

substantial role for nutrition educators within schools (Miyoshi, Tsuboyama-Kasaoka and Nishi 2012). It puts trained educators in control of the school lunch program and integrates hands-on nutrition education with school lunches, thereby using the meals as an opportunity for education (Ishida 2015). Unlike the PSE change approach in the United States, Japan's system equips educators with the necessary training and jurisdiction to improve both individual behavior and the food environment.

The Basic Law on Shokuiku required every Japanese public school to teach food education starting in kindergarten and established a Diet and Nutrition Teacher System that places a trained educator and dietitian in each school full-time (Miyoshi, Tsuboyama-Kasaoka and Nishi 2012). This educator's role is both to teach about food and nutrition and to oversee the school lunch program. Crucially, these two jobs work together, as children are involved in the preparation and serving of high-quality, varied school meals (Nerman 2015). In short, the Japanese approach to hands-on nutrition education takes advantage of the fact that the school meals program is made up of "repeated dietary experiences that give children several opportunities to develop behavior," and therefore is an ideal time to teach all children about food (Ishida 2015). This approach builds meal-sized food learning consistently into the school day. Nutrition education messaging and the school lunch program are consistent because they emanate from the same well-trained person. Students have an opportunity to participate in preparing, serving and eating meals that are structured to combine the best aspects of hands-on nutrition education with the school meal program.

The Diet and Nutrition Teacher system has thus addressed two concerns expressed by the Philadelphia nutrition educators whom I interviewed: that there are not enough of them, and that they may not have relevant education and/or nutrition training. Since the Law on Shokuiku was

enacted, the number of diet and nutrition teachers in Japan's public schools has gone from 34 to more than 4,000 (Nerman 2015). Many universities in Japan have also set up certificate programs so that people already registered as dietitians can obtain an additional teacher's certificate in order to assume the joint role of diet and nutrition educator (Ishida 2015). In 2006, Korea implemented a Nutrition Teacher System modeled on Japan's. As of 2010, 4,531 nutrition teachers trained in both education and dietetics were employed in Korean public schools, and many universities opened graduate programs to train these teachers (Yoon, Kwon and Shim 2012). By formalizing the role of nutrition educators in schools, Japanese and Korean officials also committed to training those educators appropriately.

The Japanese system places nutrition educators into school environments with clear institutional roles and mandates. Whereas SNAP-Ed employs educators through diverse partner organizations and assigns them to conduct education part-time in several schools, Japanese educators are employed by one school apiece (Miyoshi, Tsuboyama-Kasaoka and Nishi 2012). The Japanese system of engaging children in cooking their meals in school kitchens also addresses the equipment concerns expressed by Coon, who hurt her back carrying ingredients and cooking utensils from school to school on public transportation (Coon 2019). In comparing nutrition education in the United States and Japan, Stein described the United States' piecemeal approach as resulting in a "devaluing of this [educator] role being important in any way." Alternatively, the Japanese system represents a conscious, national policy change that better equips nutrition educators to succeed (Stein 2019).

Japan's system of nutrition education also takes an expansive, holistic view of the relationship between children and food rather oversimplifying it through nutritionism. Like the United States, Japan builds its nutrition education around a set of nationally-published dietary

guidelines. Unlike the United States, Japan's first of ten dietary guidelines is "Enjoy your meals," which prioritizes a child's healthy relationship with food (FAO 2010). Another guideline is to "develop your understanding of food and review your dietary life," which encourages conscious, well-informed food choices, rather than demonizing certain foods or nutrients (FAO 2010). In fact, only one of the ten guidelines employs prescriptive language: "Avoid too much salt." The rest of the guidelines are written in positive language about foods rather than nutrients; for example, "combine vegetables, fruits, milk products, beans, and fish in your diet" (FAO 2010). Finally, Japan's system encourages students to understand food's broader roles within society beyond its biochemical roles in the human body. Hiromi Ishida, a professor in dietetics at Kagawa Institute of Nutrition, writes that "[*Shokuiku*] not only aims to form desirable eating habits, but also strengthens children's understanding of food production, transportation, and food culture, as well as an appreciation of the gift of nature that supports us" (Ishida 2015).

Dietary Guidelines in the United States have become more like Japan's in that they are more food-focused and accessible, and less prohibitive. Take this United States Dietary Guideline from 2005: "Consume less than 10 percent of calories from saturated fatty acids and less than 300 mg/day of cholesterol, and keep trans fatty acid consumption as low as possible" (U.S. Department of Health and Human Services and U.S. Department of Agriculture 2005). In addition to being written in technical language that everyday Americans, not to mention children, cannot easily apply to their own diets, it focuses on excluding biochemical components of foods, rather than telling people what foods are good to eat. Today's dietary guidelines still lack Japan's emphasis on a holistic relationship with food, but they do use more accessible, less prescriptive language. Two examples are "Focus on variety, nutrient density, and amount" and "follow a healthy eating pattern across the lifespan" (U.S. Department of Health and Human Services and

U.S. Department of Agriculture 2015). Everyday Americans are more likely to be able to follow guidelines that talk about food rather than nutrients and suggest a healthy, varied diet over time, rather than a nutritionally perfect diet at every single meal.

The United States has also improved the nutritional quality of its school lunch program. In 2010, the United States made a major update to its National School Lunch program through the Healthy, Hunger-Free Kids Act (HHFKA), which was championed by Michelle Obama and raised nutrition standards for school lunch. School meals post-HHFKA provide children with more whole grains, fruits and vegetables, lean protein and low-fat dairy, as well as less sugar and sodium (USDA Food and Nutrition Service 2014). Johnson, et al. found that the improved nutrition standards were associated with the selection of foods that are more nutrient-dense and less energy-dense, and that children were eating 16 percent more vegetables and 23 percent more fruit as a result (Johnson, et al. 2016). Critics of the HHFKA have argued that the law did not increase funding enough for schools to meet the heightened requirements, but over time, its reception has been increasingly positive (Calthorpe 2015).

While the United States has improved its school lunches and dietary guidelines, there has not yet been any policy commitment to training and supporting nutrition educators in the U.S. as is done in Japan and Korea. Nonetheless, at least some states have moved in a similar direction. Before moving to Philadelphia, Coon worked for a school district in Vermont that emulated the integration between school lunches and nutrition education taking place in Japan. When asked what made this integration possible, she said:

> "Having complete integration and having a staff culture and a community culture where food and wellness are valued, and feeling like everyone at the table is working on it, from the food service director to farmers and local businesses, to families, to teachers, to kids, to the principal. It has to come top-down. The state has to value it, the principal has to value it, the community has to value it, all of these people have to buy in. That has happened and worked in Vermont, but for it to work in Pennsylvania and Philly would be

a bigger ask." (2019)

Strengthening nutrition education, especially in under-resourced schools, is certainly a big ask at all levels; however, effective policy change, "from the top down" would address a big need in the United States education system.

The relatively new requirement for PSE change initiatives within SNAP-Ed suggests a growing awareness of the inadequacy of traditional nutrition education and the need to address the many environmental determinants of health. At the same time, however, this mandate has placed an additional burden on nutrition educators who may not have the training or ability to foster environmental change on top of their already challenging teaching jobs. It is too much to expect already overwhelmed nutrition educators to shoulder the lack of district, business, state, and community support for healthy school environments. The Japanese model suggests that necessary environmental change could be far more effectively established through updated policy from the top down that helps to organize the school around a culture of healthy eating.

Japan offers a compelling model for combining nutrition education and environmental change that stands in stark contrast to the United States' attempts to do the same. Japan's system institutionalizes both individual instruction through hands-on nutrition education as well as healthy school food environments. It fortifies educators with the training and jurisdiction to feed children healthy meals and involve students in their preparation. In this way, it combines the most effective elements of hands-on nutrition education with well-supported environmental change.

Conclusion

Facing dangerously high rates of overweight and obesity, United States nutrition education policy has evolved beyond the conventional approach of teaching students about the nutrients within food. The obesity epidemic has made apparent that increasing knowledge about food and nutrients is an insufficient goal of nutrition education, which must also aim to promote healthy dietary behavior. Because behavior is predicated on more than just knowledge, nutrition education has expanded its initiatives to include building the cooking skills necessary to eat many healthy foods, fostering positive relationships between children and food, and even improving the food environment to make healthier choices possible. This evolution has distanced nutrition education from the ideology of nutritionism, which has imbued Western food discourse with a frenzy for nutrients rather than a love of whole foods.

This thesis has argued that hands-on nutrition education is more effective at enacting behavior change than conventional nutrition education, as evidenced by the positive impacts of hands-on interventions on dietary behavior and the feedback of educators. Hands-on nutrition education gives students skills and taste exposure that make them more likely to eat and enjoy healthy food both in school and in the future. Hands-on nutrition education also overcomes a key downside of conventional nutrition education in that it includes relevant sensory experiences to learning about food, namely taste and smell. Educators have noted that these sensory experiences alongside the fun, experiential aspects of cooking, are highly engaging for children. Finally, hands-on nutrition education pushes back on a trend away from cooking both in schools and homes that may connect to the rise of obesity. The educators interviewed for this this thesis are certainly exceptional in their commitment to nutrition education and familiarity with cooking programs. However, taken together with the positive outcomes for hands-on nutrition education

demonstrated in the scholarly literature, their observations make a strong case for investing more research and resources in the implementation of hands-on nutrition education across varied schools and districts.

Improving individual behavior is an important goal of nutrition education, but structural barriers to healthy eating continue to negatively influence dietary behavior, especially in low-income communities. Given this reality, SNAP-Ed policy since 2013 has promoted a PSE change approach led by nutrition educators, as opposed to focusing on more extensive efforts to promote hands-on nutrition education. SNAP-Ed has not, however, provided substantial resources or training to support educators in taking on this difficult mission. Too little attention has been paid to the fact that educators assigned to multiple schools generally lack the power, time, and authority to advance significant change in school or community food environments. Successful environmental change initiatives are clearly critical to children's health and well-being, but they have not been adequately supported through the SNAP-Ed model.

Japan has adopted an alternative model that empowers educators to engage students in effective hands-on nutrition education programs *and* promote a healthy school food environment. Japan's system, which places one well-trained diet and nutrition teacher in every public school, combines the best elements of hands-on nutrition education with adequately supported environmental change. It constitutes a national commitment to healthier school lunches and the involvement of students in their preparation. Japan's system conducts nutrition education in all schools. The United States focuses nutrition education in low-income schools and has very few requirements for its implementation in other schools, despite the fact that overweight and obesity and their related health problems are an important issue throughout the nation. Developing and

implementing effective federal nutrition and wellness policies in all schools would ensure that all students at risk of chronic disease receive appropriate nutrition education.

Looking to the future, the Japanese system offers a range of positive approaches that could improve nutrition education in the United States. Establishing carefully considered training programs and job descriptions for nutrition educators, engaging children in cooking and serving school meals, and emphasizing food culture and enjoyment in addition to nutritional content all represent important goals for improving the efficacy of nutrition programs. In the long term, restructuring nutrition education such that it emanates from within schools rather than outside organizations could help address the frequent concern among educators that their roles are not a priority within their schools and system of education. Even in the context of the United States' current patchwork of nutrition education programming, interviews with educators and scholarly program evaluations make it clear that nutrition education is most effective when it promotes hands-on engagement with food. Hands-on methods most effectively combine individual instruction and at least modest improvements in school food environments. By surrounding children with fresh, delicious ingredients and facilitating early positive experiences with eating and cooking, nutrition education can help build healthy relationships between children and food.

Appendix 1: Evaluations of Conventional Nutrition Education Interventions

	Purpose	Intervention Components	Sample Size	Duration	Outcome of Interest	Evaluation Method	Major Findings
Deehy, et al. 2013: LEAP2	To increase consumption of fruits and vegetables among primary school-age children in first through third grade	Classroom lessons based on children's storybooks, daily fruit and vegetable recall calendar, take-home materials.	395 children 1st through 3rd grade in elementary schools with at least 50% of students eligible for free or reduced price meals.	240 total minutes over 8 lessons lasting 30 minutes each.	Daily at-home consumption of fruit and vegetables, household availability of fruits and vegetables	Parental reports	No significant effect on consumption of fruits and vegetables or willingness to try fruits and vegetables. Significant impact on household availability of fruits and vegetables.
Gabor, Williams, et al. 2012: All 4 Kids	To promote healthy eating, support age-appropriate physical development, and encourage children's self acceptance and acceptance of differences among peers	Classroom lessons on healthy eating, physical activity and physical development, with three Family Activity sessions	403 preschool-aged children at 6 intervention and 6 comparison centers (511) parent respondents at follow-up	Average of 498 minutes (16.6 classes)	Increase intake of healthy snacks, increase fruit and vegetable consumption	Mail and telephone surveys to parents and caregivers about consumption and dietary behaviors	No significant effect on consumption of fruits and vegetables. Increased child-initiated vegetable snack choices.
Gleason, Blitstein, et al. 2012: Eagle Adventure	To prevent diabetes in Native American families by using a culturally appropriate intervention strategy delivered through schools	The performance of a play about healthy eating followed by four classroom lessons and corresponding homework	5 intervention and 5 comparison schools (723 parent respondents at follow-up), 1st-3rd graders	Average of 145 minutes per child, maximum of four lessons	Intent to choose fruits and vegetables, knowledge and consumption of fruits and vegetables	Mail and telephone surveys to parents and caregivers about consumption and dietary behaviors	No significant effect on consumption of fruits and vegetables. Increased willingness to try new vegetables.
Gabor, Williams, et al. 2012: Eat Well and Play Hard in Child Care Settings (EWPHCCS)	To enhance healthy eating and physical activity behaviors among children	Classroom lesson modules with take-home newsletters and corresponding worksheets on nutrition topics	728 pre-school aged children at 12 intervention and 12 control child care centers (902 parent respondents at follow-up)	Average of 132 minutes (4.4 lessons) over 6 weeks	Consumption of fruits and vegetables, consumption of low-fat milk	Mail and telephone surveys to parents and caregivers about consumption and dietary behaviors	No significant effect on consumption of fruits or overall consumption of fruits and vegetables. Increased at-home consumption of vegetables and 1 percent or fat free milk.
Long, Cates, et al. 2013: BASICS	To increase consumption and willingness to try fruits and vegetables among lower elementary schoolchildren	Classroom lessons, take-home materials, and training for classroom teachers. Intervention plus condition included a social marketing campaign.	513 children in 3rd grade in elementary schools with at least 50% of students eligible for free or reduced price meals.	448 total minutes over 8 (30 minute) lessons, plus 4 extended (50 minute) lessons	Daily at-home consumption of fruit and vegetables, willingness to try fruits and vegetables	Parental reports	Had significant impacts on children's daily at-home consumption of frutis and vegetables combined by 0.24 cups (intervention condition) or 0.31 cups (intervention plus condition). Increased willingness to try new kinds of fruit, but not vegetables.

Appendix 1 (cont'd): Evaluations of Conventional Nutrition Education Interventions

	Purpose	Intervention Components	Sample Size	Duration	Outcome of Interest	Evaluation Method	Major Findings
Powers, et al. 2005	To increase consumption of low-fat diary products, fruits, and vegetables, decrease consumption of soft drinks, and increase participation in regular physical activity	Weekly nutrition lessons on dairy consumption, fruit and vegetable consumption, Food Guide Pyramid knowledge, and information about nutrients	1100 second and third grade students from 64 schools in Alabama where at least 51% of students received free or reduced-price meals	6 lessons lasting 1 hour each	Dairy consumption, fruit and vegetable consumption, nutrition knowledge	Pre and postassessment questionnaires and an interactive game among students	Significant improvements in dairy, fruit, and vegetable consumption and in nutrition knowledge. Weak correlation between gains in dietary behavior and gains in nutrition knowledge.
Prelip, et al. 2012	To assess the impact of a multicomponent nutrition education program on student knowledge, attitudes, and behaviors related to consumption of fruits and vegetables	Standardized nutrition curriculum, teacher training workshops, and parent nutrition education workshops (in Intervention+ condition)	399 low-income third through fifth grade students in the Los Angeles Unified School District	At least 10 hours of nutrition education	Fruit and vegetable consumption, knowledge of food groups, attitudes and beliefs toward FVs	Pre and postintervention questionnaires	No improvement in fruit and vegetable consumption. Improvement in knowledge, attitudes, and beliefs towards vegetables in the Intervention+ condition only.
St. Pierre and Glotzer 1981: Georgia NET Program	To evaluate the impact of a decentralized NET Program on children's nutrition knowledge, attitudes and behaviors	Five-day nutrition workshop for teachers, who then design programming for their schools. Mostly lessons about nutrition	Over 1,400 children in 52 classrooms across grades 1-8	Ranged by school and teacher	Knowledge of nutrition, attitudes and preferences in the nutrition domain, behavioral nutrition habits	Pre and postintervention questionnaires and "battery" of child-level instruments to assess behavior	No significant positive effects on food habits, some positive effects in early grades only on nutrition knowledge
St. Pierre, Glotzer, Cook, and Straw 1981: Nebraska NET Program	To evaluate the impact of a centralized state nutrition education program on nutrition knowledge, attitudes and behaviors	11 lesson plans for grades K-6 on basic nutrition principles	2,300 children in 96 classrooms distributed across grades 1-6	12-20 class hours of activity instruction	Knowledge of nutrition, attitudes and preferences in the nutrition domain, behavioral nutrition habits	Pre and postintervention questionnaires, behavioral assessments of food familiarity and food waste	No effects on food habits, some positive effects on nutrition knowledge.

Appendix 2: Evaluations of Hands-On Nutrition Education Interventions

	Purpose	Intervention Components	Sample Size	Duration	Outcome of Interest	Evaluation Method	Major Findings
Brown and Hermann 2005	To determine the impact of cooking classes on fruit and vegetable intake and food safety behaviors in youth and adults	Produce cooking classes to provide education on basic fruit and vegetable preparation skills, food safety practices, and nutrition related to produce	229 youth and 373 adults, average youth age was 12	An average of 8 classes over a period of two months	Fruit and vegetable intake and food safety behaviors	Pre-versus posteducation questionnaire that was pilot-tested for reliability	Significantly increased fruit and vegetable intake and safe food-handling behaviors, especially among children. 25% increase in the number of youth who consumed the recommended number of vegetable servings per day
Caraher et al. 2013	Teach children about food, food provenance, healthy eating, and food preparation.	Chef-taught sessions covering healthy eating and flavors, practical food preparation, and a visit to a restaurant	169 children ages 9-11	3 sessions over the course of the school year	Changes in food preparation and consumption, cooking confidence	Pilot-tested pre- and postintervention questionnaires	Significant increase in cooking confidence and asking confidence for healthy foods, significant increase in vegetable consumption
Chen et al. 2014	To promote consumption of produce through classroom food demonstrations, tastings and home cooking activities among ethnically diverse elementary-school children and their family members	Classroom food demonstrations and tasting activities using seven recipes incorporating vegetables from Latino, Hmong, or mainstream American cultures	602 intervention students from four low-income schools age 5-8, 600 control students from two additional schools	Four 20-minute in-class tasting activities over the course of four months	Familiarity, preferences, and consumption of featured vegetables, involvement of children in at-home food preparation	Quantitative student and parent pre-post surveys, parent feedback surveys, and qualitiative focus groups	Significantly increased familiarity, preferences, and consumption of featured vegetables, increased involvement of children in at-home food preparation
Cullen et al. 2007	Increase fruit and vegetable consumption through a multimedia-based food preparation and eating behavior curriculum	Cooking lessons, eating behavior curriculum	Intervention group: n=671	10 sessions over 5 weeks	Fruit and vegetable consumption, fruit and vegetable preferences, self-efficacy for eating fruits and vegetables	24-h dietary recall for fruit and vegetable consumption, child questionnaire for self-efficacy for eating fruits and vegetables	An increase of 1 combined serving of fruit, 100% fruit juice, and vegetables was observed for participants who had the highest baseline consumption of fruits and vegetables and completed 2 or 3 goals; increase in vegetable consumption observed among those with highest baseline consumption who completed 0 or 1 preparation goal
Cunningham-Sabo and Lohse 2013	Determine impact of a cooking and tasting program on children's cooking attitudes, cooking self-efficacy, and fruit and vegetable preferences	Cooking lessons, tasting activities	257 fourth grade students. Intervention group: n=137; control group: n=120	3 two-hour cooking classes and 3 one-hour tasting sessions	Fruit and vegetable preferences, attitudes toward cooking, and cooking self-efficacy	Child questionnaire	Treatment group had higher fruit preference scores, vegetable preference scores, and attitudes toward food and cooking self-efficacy than participants in the control group

Appendix 2 (cont'd): Evaluations of Hands-On Nutrition Education Interventions

	Purpose	Intervention Components	Sample Size	Duration	Outcome of Interest	Evaluation Method	Major Findings
Cunningham-Sabo and Lohse 2014	Compare impact on children's cooking attitudes, cooking self-efficacy, and fruit and vegetable preferences between a cooking and tasting program, a tasting-only program, and a control group	Cooking lessons, tasting activities	Cooking and tasting group: n=539; tasting group: n=294, control group: n=397	5 two-hour cooking lessons and 5 one-hour tasting sessions	Fruit and vegetable preferences, attitudes toward cooking, and cooking self-efficacy	Child questionnaire	Cooking and tasting group had highest increases in cooking self-efficacy; changes in fruit and vegetable preferences greater among participants in the cooking and tasting group than participants in control group; changes in vegetable preferences greater among participants in both intervention groups
Davis et al. 2011	Determine effects of a culturally focused gardening and cooking program on dietary intake and health outcomes among predominately Hispanic fourth and fifth grade students	Cooking lessons, nutrition lessons focused on increasing F+V intake of culturally relevant food, gardening lessons	Intervention group: 34 predominantly Hispanic fourth and fifth grade students, control group: 70	12 45-minute nutrition and cooking lessons and 12 45-minute gardening lessons	Overall health, dietary intake	BMI, total body fat, waist circumference, blood pressure, 41-item food frequency questionnaire	Dietary fiber intake increased by 22% in intervention group and decreased by 12% in control group; blood pressure decreased more among participants in intervention group than control group; overweight participants in the intervention group gained less weight and had a greater improvement in BMI than overweight participants in control group
Fulkerson et al. 2010	Pilot a parent-child nutrition education program to increase family dinner frequency, parent self-efficacy in preparing healthy meals and child food preparation skills	Cooking lessons, interactive nutrition lessons, tasting activities, group meals	Intervention group: n=22; control group: n=22	5 90 minute sessions	Food preparation skills, obesity status, family meal quality	questionnaire, BMI measurement, mealtime screener tool	Children in intervention group rated food preparation skills higher than control group, child participation in meal preparation higher in intervention group, suggested higher fruit and vegetable consumption and nutrient content of meals. No change in obesity status
Gibbs et al. 2013	Determine the effectiveness of an in-school nutrition and gardening program on elementary school children's willingness to try new foods	Cooking lessons, gardening lessons	764 children in grades 3-6, 562 parents	Weekly 45-minute garden and 90-minute cooking classes for 2.5 years	Willingness to try new foods, food choices and ability to describe foods	Parent and child questionnaires	Children's willingness to try a new foods (even those they had never tried, cooked, or grown) increased more among participants in intervention schools
Jarpe-Ratner 2006	To evaluate the effect of a community-based, experiential cooking and nutrition education program on consumption of fruits and vegetables and associated outcomes in students from low-income families	Chef-instructor-led program in cafeteria kitchens after school	271 students, 94% of whom were eligible for free and reduced price lunch in grades 3-8	2 hr-per-week lessons over the course of 10 weeks	Change in student nutrition knowledge, cooking self-efficacy, fruit and vegetable liking and consumption, and communication to family about healthy eating	Pre-post survey of participating students and their families	Increased nutrition knowledge, cooking self-efficacy, and vegetable consumption. Increased score for communication about healthy eating that was sustained 6 months after the end of the course.

Appendix 2 (cont'd): Evaluations of Hands-On Nutrition Education Interventions

	Purpose	Intervention Components	Sample Size	Duration	Outcome of Interest	Evaluation Method	Major Findings
Liquori et al. 1998	Primary: Increase children's consumption of minimally processed whole grains and vegetables. Secondary: Enhance Children's preferences for, and attitudes toward, self-efficacy and knowledge about these foods	Hands-on cooking classes and food and environment lessons	590 kindergarten through 6th grade children in urban, low-income schools	10 sessions	Consumption of minimally processed whole grains and vegetables, cooking self-efficacy, intentions and preferences for cooking and eating healthy foods	Plate waste by visual estimate, questionnaires for assessing preferences, attitudes, knowledge, self-efficacy, and behavioral intentions	Increased knowledge, Increased cooking self-efficacy, Increased behavioral intentions for cooking and eating plant foods, Increased preferences for cooking and healthy food, Improved intake of vegetables and minimally processed whole grains. No significant impact on attitudes toward cooking.
Lukas and Cunningham-Sabo 2011	Obtain an in-depth understanding of the classroom cooking experience from the child's and adult participant's perspectives in comparison to their cooking experiences at home.	32 classrooms assigned to 1 of 3 conditions: cooking + tasting intervention, tasting-only intervention, or comparison condition	178 fourth grade students, 17 teachers, 5 food educators	Five 2-hour cooking sessions, five 1-hour tasting sessions	Student and teacher perceptions of cooking and tasting sessions	Qualitative focus group evaluation of students', teachers' and food educators' perceptions.	Significant effects in developing future cooking skills and attitudes, helping students learn school subjects. Students in cooking and tasting intervention groups less averse to cooking at home. No effect on changing the home cooking environment.
Overcash et al. 2017	To evaluate the impact of a vegetable-focused cooking skills and nutrition program on parent and child psychosocial measures, vegetable liking, variety, and home availability	Sessions including demonstration, food preparation, nutrition education lessons, and a meal	89 parent-child dyads in low-income communities with children between 9 and 12	Six 2-hour weekly sessions	Parental cooking confidence and barriers, resource management, child self-efficacy and cooking attitudes, vegetable liking, variety, and home availability	Baseline and postcourse surveys	Increased parental cooking confidence, healthy food preparation, child self-efficacy, vegetable variety, and home vegetable availability
Quinn et al. 2003	Improve attitudes toward and increase the fruit and vegetable consumption of fifth-grade students	Cooking lessons with background information about ingredients	Intervention group 81 fifth-grade students, control group: 68	11 sessions	Dietary intake, food-related knowledge, attitudes toward food, eating habits	Parent and child questionnaires	Significant impacts on fiber, folate, fruit, and milk consumption and willingness to try new vegetables. Parents reported increases in fruit and vegetable consumption, food exposure, and willingness to try new foods.
Townsend 2006	Examine effectiveness of a state's Youth Expanded Food and Nutrition Education Program (EFNEP)	7-lesson education experience with food preparation and tasting, an education experience typical of EFNEP in California	5,111 youth, 9-12 years old, split into 229 groups	6- to 8- hour, 7-lesson education experience	USDA impact indicators: nutrition knowledge, eating a variety of foods, food selection, food preparation and safety practices	Randomized, controlled trial with pre and post surveys	Significantly improved scores for nutrition knowledge and food selection compared to the control group. Insignificant impact on eating a variety of foods.

Bibliography

Interviews

Maddy Booth, Education Program Director at Vetri Community Partnership
January 7, 2019

Mary Bullock, director of the EAT360 program at Vetri Community Partnership
January 7, 2019

Aurora Coon, University-Assisted Community Schools Site Director at Comegys Elementary School
January 24, 2019

Laura Crandall, Healthy Schools Specialist with the Philadelphia Mayor's Office of Education, Community Schools Initiative
February 15, 2019

Judith Ensslin, Program Director of Eat Right Philly
January 18, 2019

Tanja Kral, professor in the University of Pennsylvania School of Nursing and Perelman School of Medicine and researcher on childhood obesity
January 30, 2019

Helen Nadel, Education Director of Greener Partners
February 5, 2019

Dalton Noakes, Vetri Cooking Lab Educator and Marketing Communications Specialist at Vetri Community Partnership
January 23, 2019

Paul Rozin, Professor of Psychology at the University of Pennsylvania
March 15, 2019

Mary Summers, Lecturer in Political Science at the University of Pennsylvania
February 23, 2019

References

Baraldi, Galastri, Euridice Steele, Daniela Canella, and Carlos Monteiro. 2018. "Research Consumption of ultra-processed foods and associated sociodemographic factors in the USA between 2007 and 2012: evidence from a nationally representative cross-sectional study." *BMJ Open* 8.

Barton, K.L., W.L Wrieden, and A.S. Anderson. 2011. "Validity and reliability of a short questionnaire for assessing the impact of cooking skills interventions." *Journal of Human Nutrition and Dietetics* (British Dietetic Association Ltd.) 588-595.

Beckwith, Sara, Melissa Cooper, Heather Goesch, and Gillian MacKinnon. 2017. *Nutrition Education in America's Schools: A Policy Brief.* Association of State Public Health Nutritionists.

Bell, Judith, Gabriella Mora, Erin Hagan, Victor Rubin, and Allison Karpyn. 2013. *Access to Healthy Food and Why It Matters.* PolicyLInk.

Bowers, Douglas. 2000. "Cooking Trends Echo Changing Roles of Women." *USDA FoodReview* 23 (1): 23-29.

Bowman, Shanthy, and Bryan Vinyard. 2004. "Fast Food Consumption of U.S. Adults: Impact on Energy and Nutrient Intakes and Overweight Status." *Journal of the American College of Nutrition* 23 (2): 163-168.

Bowman, Shanthy, Steven Gortmaker, Cara Ebbeling, Mark Pereira, and David Ludwig. 2004. "Effects of Fast-Food Consumption on Energy Intake and Diet Quality Among Children in a National Household Survey." *The Journal of Pediatrics* 113 (1): 112-118.

Bridging the Gap Research Program. 2014. *Local School Wellness Policies: Where Do They Stand and What Can You Do?* Centers for Disease Control and Prevention, Atlanta: U.S. Department of Health and Human Services.

Brown, Barbara, and Janice Hermann. 2005. "Cooking Classes Increase Fruit and Vegetable Intake and Food Safety Behaviors in Youth and Adults." *Journal of Nutrition Education and Behavior* (Society for Nutrition Education and Behavior) 37: 104-105.

Bunnell, Rebecca, Dara O'Neil, Robin Soler, Rebecca Payne, Wayne Giles, Janet Collins, and Ursula Bauer. 2012. "Fifty Communities Putting Prevention to Work: Accelerating Chronic Disease Prevention Through Policy, Systems and Environmental Change." *Journal of Community Health* 37: 1081-1090.

Calthorpe, Lucia. 2015. "Implementation of the Healthy, Hunger-Free Kids Act of 2010: A Case Study of Philadelphia and Two Neighboring Suburban Districts." Senior Thesis, Health and Societies Department, University of Pennsylvania.

Candib, Lucy. 2007. "Obesity and Diabetes in Vulnerable Populations: Reflection on Proximal and Distal Causes." *The Annals of Family Medicine* 5 (6): 547-556.

Caraher, Martin, Annie Seeley, Michelle Wu, and Susan Lloyd. 2013. "When chefs adopt a school? An evaluation of a cooking intervention in English primary schools." *Appetite* (Elsevier) 32: 50-59.

Centers for Disease Control and Prevention. 2008. "Nutrition and the Health of Young People." U.S. Department of Health and Human Services, National Center for Chronic Disease Prevention and Health Promotion, Division of Adolescent and School Health, Atlanta.

Centers for Disease Control and Prevention. 2016. "Results from the School Health Policies and Practices Study." Division of Adolescent and School Health, National Center for HIV/AIDS, Viral Hepatitis, STD, and TB Prevention.

Chen, Qiong, Keiko Goto, Cindy Wolff, Stephanie Bianco-Simeral, Kristin Gruneisen, and Katharine Gray. 2014. "Cooking up diversity. Impact of a multicomponent, multicultural, experiential intervention on food and cooking behaviors among elementary-school students from low-income ethnically diverse families." *Appetite* (Elsevier) 80: 114-122.

Chu, Yen, Kate Storey, and Paul Veugelers. 2014. "Involvement in Meal Preparation at Home Is Associated With Better Diet Quality Among Canadian Children." *Journal of Nutrition Education and Behavior* (Society for Nutrition Education and Behavior) 46 (4): 304-308.

Clarke, Gloria Aponte, Sheryl Cates, Vivian Gabor, Loren Bell, Jonathan Blitstein, and James Hersey. 2012. *SNAP Education and Evaluation Case Study Report: University of Nevada Cooperate Extension's All 4 Kids Program. Volume I: Report.* Altarum Institute and Research Triangle Institute, Alexandria: USDA Food and Nutrition Service.

Clifford, D, J Anderson, G Auld, and J Champ. 2009. "Good Grubbin': impact of a TV cooking show for college students living off campus." *Journal of Nutrition Education and Behavior* (Society for Nutrition Education and Behavior) 41 (3): 194-200.

Contento, Isobel. 2011. *Nutrition Education: Linking Research, Theory, and Practice.* Sudbury, MA: Jones and Bartlett Publishers, LLC.

Contento, Isobel, Amanda Dew Manning, and Barbara Shannon. 1992. "Research perspective on school-based nutrition education." *Journal of Nutrition Education and Behavior* 247-260.

Contento, Isobel, GI Balch, and YL, et al. Bronner. 1995. "The effectiveness of nutrition education and implications for nutrition education policy, programs, and research: a review of research." *Journal of Nutrition Education* 27: 279-418.

Contento, Isobel, Jill Randell, and Charles Basch. 2002. "Review and Analysis of Evaluation Measures Used in Nutrition Education Research." *Journal of Nutrition Education and Behavior* 34: 2-25.

Contento, Isobel, Amanda Dew Manning, and Barbara Shannon. 1992. "Research perspective on school-based nutrition education." *Journal of Nutrition Education and Behavior* 247-260.

Cooking With Kids, Inc. 2015. *Cooking with Kids Integrated Curriculum Guide: Grades 4-5 Cooking Lessons.* Santa Fe.

Cooper, Jenny. 2015. *Cooking trends among millennials: Welcome to the digital kitchen.* June 30. Accessed January 2019.

Corsini, Nadia, Amy Slater, Adam Harrison, and Lucy Cooke. 2013. "Rewards can be used effectively with repeated exposure to increase liking of vegetables in 4–6-year-old children." *Public Health Nutrition* 16 (5): 942-951.

Cunningham-Sabo, Leslie, and Amanda Simons. 2012. "Home Economics: And Old-fashioned Answer to a Modern-Day Dilemma?" *Nutrition Today* (Lippincott Williams & Wilkins) 47 (3): 128-132.

Cunningham-Sabo, Leslie, and Barbara Lohse. 2013. "Cooking with Kids Positively Affects Fourth Graders' Vegetable Preferences and Attitudes and Self-Efficacy for Food and Cooking." *Childhood Obesity* (Mary Ann Liebert, Inc) 9 (6): 549-556.

Cunningham-Sabo, Leslie, and Barbara Lohse. 2014. "Impact of a School-Based Cooking Curriculum for Fourth-Grade Students on Attitudes and Behaviors Is Influenced by Gender and Prior Cooking Experience." *Journal of Nutrition Education and Behavior* (Society for Nutrition Education and Behavior) 46 (110): 110-120.

Davis, Carole, and Etta Saltos. 1999. "Dietary Recommendations and How They Have Changed Over Time." *Agriculture Information Bulletin.*

Davis, Jamie, Emily Ventura, Lauren Cook, Lauren Gyllenhammer, and Nicole Gatto. 2011. "LA Sprouts: A Gardening, Nutrition, and Cooking Intervention for Latino Youth Improves Diet and Reduces Obesity." *Journal of the American Dietetic Association* (The American Dietetic Association) 111: 1224-1230.

Deehy, Karen, Sheryl Cates, Pamela Williams, Ruth Morgan, Katherine Kosa, Loren Bell, and James Hersey. 2013. *Supplemental Nutrition Assistance Program Education and Evaluation Study (Wave II): University of Kentucky Cooperative Extension Service's Literacy, Eating, and Activity for Primary Youth Health (LEAP2) Program. Volume I: Report.* Altarum Institute and RTI International , Alexandria: USDA Food and Nutrition Service.

Dietary Guidelines Advisory Committee. 2010. " Report of the Dietary Guidelines Advisory Committee on the Dietary Guidelines for Americans, 2010, to the Secretary of Agriculture and the Secretary of Health and Human Services." Agricultural Research Service, U.S. Department of Agriculture, Washington, DC.

Dietary Guidelines Advisory Committee. 2013. *2015 DGAC Meeting 1: Materials and Presentations.* National Institutes of Health, Bethesda: United States Department of Agriculture and United States Department of Health and Human Services.

Dietary Guidelines Advisory Committee. 2015. "Scientific Report of the 2015 Dietary Guidelines Advisory Committee: Advisory Report to the Secretary of Health and Human Services and the Secretary of Agriculture." Agricultural Research Service, U.S. Department of Agriculture, Washington, DC.

Dohle, Simone, Sina Rall, and Michael Siegrist. 2015. "Does Self-Prepared Food Taste Better? Effects of Food Preparation on Liking." *Health Psychology* (American Psychological Association) 35 (5): 100-508.

Drexel University. n.d. *Who We Are.* Nutrition Education Program at Drexel University. Accessed December 13, 2018. http://deptapp08.drexel.edu/nutritioneducation/who_we_are.html.

FAO. 2010. *Food-based dietary guidelines - Japan.* Food and Agriculture Organization of the United Nations. Accessed February 24, 2019.

Farley, Thomas. 2018. *Obesity Among Adults in Philadelphia, 2011-2016.* Philadelphia Department of Public Health.

Fattal-Valevski, Aviva. 2011. "Thiamine (Vitamin B1)." *Journal of Evidence-Based Integrative Medicine.*

Fildes, Alison, Judith Charlton, Caroline Rudisill, Peter Littlejohns, A. Toby Prevost, and Martin C. Guilliford. 2015. "Probability of an Obese Person Attaining Normal Body Weight: Cohort Study Using Electronic Health Records." *American Journal of Public Health* 105 (9): e54-e59.

Food Research & Action Center. 2018. *The National School Lunch Program.* Accessed December 13, 2018. http://frac.org/programs/national-school-lunch-program.

Foster, Gary, Sandy Sherman, Kelley Borradaile, Karen Grundy, Stephanie Vander Veur, Joan Nachmani, Allison Karpyn, Shiriki Kumanyika, and Justine Shults. 2008. "A Policy-Based School Intervention to Prevent Overweight and Obesity." *Pediatrics* (American Academy of Pediatrics) 121: e794-e802.

Gabor, Vivian, Pamela Williams, Sheryl Cates, Jonathan Blitstein, Loren Bell, and James Hersey. 2012. *SNAP Education and Evaluation Case Study Report: New York State Department of Health's Eat Well Play Hard in Child Care Settings Program. Volume I: Report.* Altarum Institute and Research Triangle Institute, Alexandria: USDA Food and Nutrition Service.

Gabor, Vivian, Sheryl Cates, Stacy Gleason, Valerie Long, Gloria Aponte Clarke, Jonathan Blitstein, Pamela Williams, Loren Bell, James Hersey, and Melanie Ball. 2012. *SNAP Education and Evaluation Study (Wave I): Final Report.* Altarum Institute and Research Triangle Institute, Alexandria: USDA Food and Nutrition Service .

Garcia, Ada, Rebecca Reardon, Matthew McDonald, and Elisa Vargas-Garcia. 2016. "Community Interventions to Improve Cooking Skills and Their Effects on Confidence and Eating Behavior." *Current Nutrition Reports* (Springer) 5: 315-322.

Gibbs, Lisa, Petra Staiger, Britt Johnson, Karen Block, Susie Macfarlane, Lisa Gold, Jenny Kulas, Mardie Townsend, Caroline Long, and Obioha Ukoumunne. 2013. "Expanding Children's Food Experiences: The Impact of a School-Based Kitchen Garden Program." *Journal of Nutrition Education and Behavior* (Society for Nutrition Education and Behavior) 45 (2): 137-146.

GlaxoSmithKline. 2018. "GSK IMPACT Awards: Registration and Application Instructions."

Gleason, S, B Wolford, and M Wilkin. 2018. *Analysis of Supplemental Nutrition Assistance Program Education Data for All States Study (Summary).* Altarum Institute and Gabor

and Associates Consulting, Inc., United States Department of Agriculture, Food and Nutrition Service.

Gleason, Stacy, Brenda Wolford, Margaret Wilkin, Becca Hofer, Diane Woloshin, Linnea Sallack, and Vivian Gabor. 2018. *Analysis of Supplemental Nutrition Assistance Program Education (SNAP-Ed) Data for All States Study: Final Report.* Altarum Institute, Alexandria: USDA Food and Nutrition Service.

Gleason, Stacy, Jonathan Blitstein, Vivian Gabor, Sheryl Cates, Loren Bell, and James Hersey. 2012. *SNAP Education and Evaluation Case Study Report: Chickasaw Nation Nutrition Services' Eagle Adventure Program. Volume I: Report.* Altarum Institute and Research Triangle Institute, Alexandria: USDA Food and Nutrition Service.

Gonzalez-Suarez, Consuelo, Anthea Worley, Karen Grimmer-Somers, and Valentine Dones. 2009. "School-Based Interventions on Childhood Obesity: A Meta-Analysis." *American Journal of Preventative Medicine* (Elsevier) 37 (5): 418-426.

Gordon-Larsen, Penny. 2014. "Food Availability/Convenience and Obesity." *Advances in Nutrition* (American Society for Nutrition) 5: 809-817.

Greener Partners. 2015. *Fresh Food For All.* Accessed February 4, 2019. https://greenerpartners.org/fresh-food-for-all/.

Hartmann, Christina, Simone Dohle, and Michael Siegrist. 2013. "Importance of cooking skills for balanced food choices." *Appetite* (Elsevier) 65: 125-131.

Harvard School of Public Health. 2019. *Shining the Spotlight on Trans Fats.* The President and Fellows of Harvard College. Accessed January 2019.

Hersch, Derek, Laura Perdue, Teresa Ambroz, and Jackie Boucher. 2014. "The Impact of Cooking Classes on Food-Related Preferences, Attitudes, and Behaviors of School-Aged Children: A Systematic Review of the Evidence, 2003-2014." *Preventing Chronic Disease* (Centers for Disease Control and Prevention) 11.

Hoelscher, Deanna, Alexandra Evans, Guy Parcel, and Steven Kelder. 2002. "Designing Effective Nutrition Interventions fo Adolescents." *Supplement to the Journal of the American Dietetic Association* (Elsevier) 102 (3): S52-S61.

Hursti, Ulla-Kaisa Koivisto. 1999. "Factors influencing children's food choice." *Annals of Medicine* 31 (S1): 26-32.

Ishida, Hiromi. 2015. "Role of School Meal Service in Nutrition." *Journal of Nutrition Science and Vitaminology* 61: S20-S22.

Johnson, DB, M Podrabsky, A Rocha, and JJ Otten. 2016. "Effect of the Healthy HungerFree Kids Act on the Nutritional Quality of Meals Selected by Students and School Lunch Participation Rates." *Journal of the American Medical Association Pediatrics* 170 (1).

Kaiser Family Foundation. 2019. *Overweight and Obesity Rates for Adults by Gender: 2017.* Accessed February 8, 2019.

Larson, Nicole, Cheryl Perry, Mary Story, and Dianne Neumark-Sztainer. 2006. "Food Preparation by Young Adults Is Associated with Better Diet Quality." *Journal of the American Dietetic Association* (The American Dietetic Association) 2001-2007.

Leonhardt, Megan. 2017. *These 2 Charts Show Just How Popular Meal-Kit Services Are.* July 20. Accessed January 25, 2019.

Lichtenstein, Alice, and David Ludwig. 2010. "Bring Back Home Economics Education." *Journal of the American Medical Association* (American Medical Association) 303 (18).

Long, Valerie, Sheryl Cates, Jonathan Blitstein, Karen Deehy, Ruth Morgan, Julia Fantacone, Katherine Kosa, and Loren, Hersey Bell. 2013. *Supplemental Nutrition Assistance*

Program Education and Evaluation Study (Wave II): Iowa Nutrition Network's Building and Strengthening Iowa Community Support (BASICS) for Nutrition and Physical Activity Program. Volume I: Report. Altarum Institute and RTI International , Alexandria: USDA Food and Nutrition Service.

Lyn, Rodney, Semra Aytur, Tobey Davis, Amy Eyler, Kelly Evenson, Jamie Chriqui, Angie Cradock, Karin Goins, Jill Litt, and Ross Brownson. 2013. "Policy, Systems, and Environmental Approaches for Obesity Prevention: A Framework to Inform Local and State Action." *Journal of Public Health Management and Practice* (Department of Health and Human Services) 12 (3): S23-S33.

Lytle, Leslie. 1995. "Nutrition Education for School-aged Children." *Journal of Nutrition Education* 27 (6): 298-311.

Lytle, Leslie. 1994. "Nutrition Education for School-Aged Children: A Review of Research." Information Analysis, Food and Consumer Service, United States Department of Agriculture, Washington, DC.

Martins, Yolanda, Marcia Pelchat, and Patricia Pliner. 1997. " ‘‘Try it; it's good and it's good for you’’: Effects of Taste and Nutrition Information on Willingness to Try Novel Foods." *Appetite* 28: 89-102.

Meiklejohn, Sarah, Lisa Ryan, and Claire Palermo. 2016. "A Systematic Review of the Impact of Multi-Strategy Nutrition Education Programs on Health and Nutrition of Adolescents." *Journal of Nutrition Education and Behavior* (Elsevier) 48 (9): 631-646.

Millar, L, P Kremer, A de Silva-Sanigorski, M McCabe, H Mavoa, M Moodie, J Utter, et al. 2011. "Reduction in overweight and obesity from a 3-year community-based intervention in Australia: the 'It's Your Move!' projectobr_904." *Obesity Reviews* (International Association for the Study of Obesity) 12 (Suppl. 2): 20-28.

Miyoshi, Miki, Nobuyu Tsuboyama-Kasaoka, and Nobuo Nishi. 2012. "School-based "Shokuiku" program in Japan: application to nutrition education in Asian countries." *Asia Pacific Journal of Clinical Nutrition* 21 (1): 159-162.

Monsivais, Pablo, Anju Aggarwal, and Adam Drewnowski. 2014. "Time Spent on Home Food Preparation and Indicators of Healthy Eating." *American Journal of Preventative Medicine* (Elsevier) 47 (6): 796-802.

Mozaffarian, Dariush, Irwin Rosenberg, and Ricardo Uauy. 2018. "History of modern nutrition science—implications for current research, dietary guidelines, and food policy." *The British Medical Journal* 361.

Muzaffar, Henna, Jessica Metcalfe, and Barbara Fiese. 2018. "Narrative Review of Culinary Interventions with Children in Schools to Promote Healthy Eating: Directions for Future Research and Practice." *Current Developments in Nutrition* 2 (6).

Nangia, Gayatri, and Carly O'Donnell. 2015. "A History of Rebel Ventures." University of Pennsylvania.

Nerman, Danielle. 2015. "Food Education the Law in Japan." *CBC News*, January 12.

Nestle, Marion. 2003. *Food Politics: How the Food Industry Influences Nutrition and Health.* 2013. Berkely and Los Angeles: University of California Press.

Nestle, Marion. 2010. "Strategies to Prevent Childhood Obesity Must Extend Beyond School Environments." *American Journal of Preventative Medicine* (Elsevier) 39 (3): 280-281.

Nielsen. 2018. *Meal Kit Mania: Innovation for Foodies.* March 5. Accessed January 25, 2019.

Office of Disease Prevention and Health Promotion. n.d. *History of Dietary Guidelines for Americans.* U.S. Department of Health and Human Services. Accessed December 13, 2018. https://health.gov/dietaryguidelines/history.htm.

Oldways. 2018. *Oldways' A Taste of African Heritage Curriculum Added to USDA SNAP-Ed Library.* June 13. Accessed January 29, 2019.

Overcash, Francine, Allison Ritter, Traci Mann, Elton Mykerezi, Joseph Redden, Aaron Rendahl, Zata Vickers, and Marla Reicks. 2018. "Impacts of a Vegetable Cooking Skills Program Among Low- Income Parents and Children." *Journal of Nutrition Education and Behavior* (Society for Nutrition Education and Behavior) 50 (8): 795-801.

PA Health Promotion Council. 2018. *Eat Right Philly.* Accessed March 20, 2019. https://www.hpcpa.org/programs/eat-right-philly.

Park, Bo-Kyung, and Mi-Sook Cho. 2016. " Taste education reduces food neophobia and increases willingness to try novel foods in school children ." *Nutrition Research and Practice* (The Korean Nutrition Society) 10 (2): 221-228.

PBS. 2009. *Made in Spain Olive Tapa.* January 3. Accessed January 20, 2019. https://www.youtube.com/watch?v=zhC0CPtDWlw&t=164s.

Philadelphia Department of Public Health. 2017. *City finds residents' health has improved, but finds some threats.* November 17. Accessed February 8, 2019.

Pollan, Michael. 2008. *In Defense of Food.* Penguin Press.

Powers, Alicia Raby, Barbara Struempler, Anthony Guarino, and Sondra Parmer. 2005. "Effects of a Nutrition Education Program on the Dietary Behavior and Nutrition Knowledge of Second-Grade and Third-Grade Students." *Journal of School Health* (American School Health Association) 75 (4): 129-133.

Prelip, Michael, Janni Kinsler, Chan Le Thai, Jennifer Toller Erasquin, and Wendelin Slusser. 2012. "Evaluation of a School-based Multicomponent Nutrition Education Program to Improve Young Children's Fruit and Vegetable Consumption." *Journal of Nutrition Education and Behavior* (Society for Nutrition Education and Behavior) 44 (4): 310-317.

Roseman, Mary, Martha Riddell, and Jessica Haynes. 2011. "A Content Analysis of Kindergarten-12th Grade School-based Nutrition Interventions: Taking Advantage of Past Learning." *Journal of Nutrition Education and Behavior* (Society for Nutrition Education and Behavior) 43 (1): 2-16.

Rozin, Paul. 1976. "The selection of food by rats, humans, and other animals." Edited by S Rosenblatt, A Hind, E Shaw and C Beer. *Advances in the Study of Behavior* (Academic Press) 6: 21-76.

Satter, Ellyn. 2007. "Eating Competence: Definition and Evidence for the Satter Eating Competence Model." *Journal of Nutrition Education and Behavior* (Society for Nutrition Education) (39): S142-S153.

Scrinis, Gyorgy. 2013. "Margarine, Butter, & the Ideology of Nutritionism." *Real Clear Science.* December 30.

Scrinis, Gyorgy. 2008. "On the Ideology of Nutritionism." *Gastronomica* (University of California Press) 8 (1): 39-48.

Scrinis, Gyorgy. 2002. "Sorry, Marge." *Meanjin* 61 (4): 108-116.

Severson, Kim. 2009. "Schools' Toughest Test: Cooking." *The New York Times*, September 29.

Sharma, Manoj. 2011. "Dietary Education in School-Based Childhood Obesity Prevention Programs." *Advances in Nutrition* (American Society for Nutrition) 207S-216S.

Skinner, Jean, Betty Carruth, Wendy Bounds, and Paula Ziegler. 2002. "Children's food preferences: A longitudinal analysis." *Journal of the American Dietetic Association* 102 (11): 1638-1647.

Smelkova, Lilia. 2015. "Food Education in America." The Center for Science in the Pulic Interest, Washington, DC.

Smith, Lindsey, Shu Wen Ng, and Barry Popkin. 2013. "Trends in US Home Food Preparation and Consumption: Analysis of National Nutrition Surveys and Time Use Studies from 1965-1966 to 2007-2008." *Nutrition Journal* (BioMed Central Ltd.) 12 (45).

Sole-Smith, Virginia. 2018. *The Eating Instinct: Food Culture, Body Image, and Guilt in America.* Henry Holt and Company.

St. Pierre, R, J Glotzer, T Cook, and R Straw. 1981. *An Evaluation of the Nutrition Education and Training Program: Nebraska's Experience Nutrition Curriculum.* Cambridge: Abt Associates, Inc.

Stanford Health Care. 2018. *How to Prevent Obesity.* Accessed December 14, 2018. https://stanfordhealthcare.org/medical-conditions/healthy-living/obesity/prevention.html.

—. 2018. *What is Obesity?* Stanford University. Accessed December 15, 2018. https://stanfordhealthcare.org/medical-conditions/healthy-living/obesity.html.

Statista. 2019. *Direct-to-door meal kit service market revenue worldwide in 2015 and 2020 (in billion U.S. dollars).* Accessed January 25, 2019.

Steele, Martinez, BM Popkin, B Swinburn, and CA Monteiro. 2017. "The share of ultra-processed foods and the overall nutritional quality of diets in the US: evidence from a nationally representative cross-sectional study." *Population Health Metrics* 15 (1): 6.

Stein, Jarrett, interview by Callie Holtermann. 2019. (January 11).

Stephens, Alexis. 2015. *Investor Sees Good News in Philadelphia Grocery Store Numbers.* April 15. Accessed February 2, 2019.

The American Heart Association. 2019. *Eat More Color.* Accessed February 8, 2019. https://www.heart.org/en/healthy-living/healthy-eating/add-color/eat-more-color.

The Food Trust. 2012. *What is Policy, Systems, and Environmental Change?* USDA Food and Nutrition Service.

The School District of Philadelphia. 2018. *Drinking Water Quality Access and Appeal.* October 18. Accessed February 24, 2019. https://www.philasd.org/greenfutures/focus-areas/health-schools-healthy-living/water/.

U.S. Department of Health and Human Services and U.S. Department of Agriculture. 2015. "2015 – 2020 Dietary Guidelines for Americans." December.

U.S. Department of Health and Human Services and U.S. Department of Agriculture. 2015. "2015–2020 Dietary Guidelines for Americans: 8th Edition."

U.S. Department of Health and Human Services and U.S. Department of Agriculture. 2005. *Dietary Guidelines For Americans, 2005.* Washington, DC: U.S. Government Printing Office.

UNC Center for Health Promotion and Disease Prevention. 2018. *Cooking with Kids for a Healthy Future (CWK).* February 27. Accessed January 17, 2019.

USDA Center for Nutrition Policy and Promotion. 2015. *Healthy Eating Index Scores for Americans.* Accessed December 15, 2018. https://www.cnpp.usda.gov/hei-scores-americans.

USDA. 2018. "Fiscal Year 2019 SNAP-Ed Plan Guidance." Food and Nutrition Service.

USDA Food and Nutrition Service. 2018. *Characteristics of Supplemental Nutrition Assistance Program Households: Fiscal Year 2016.* Washington, DC: United States Department of Agriculture.
USDA Food and Nutrition Service. 2015. "Checklist for Evidence-Based Approaches."
USDA Food and Nutrition Service. 2014. *Fact Sheet: Healthy, Hunger-Free Kids Act School Meals Implementation.* USDA Food and Nutriton Service.
—. 2017. *Facts About SNAP.* September 13. Accessed December 13, 2018. https://www.fns.usda.gov/snap/facts-about-snap.
—. 2018. *MyPlate.* United States Department of Agriculture Food and Nutrition Service. September 5. Accessed December 13, 2018. https://www.fns.usda.gov/tn/myplate.
USDA Food and Nutrition Service. 2015. "Supplemental Nutrition Assistance Program Education Guidance." United States Department of Agriculture, Washington, DC.
USDA. 2004. "Food Stamp Nutrition Education Plan Guidance: Federal Fiscal Year 2005." Food Stamp Program, Food and Nutrition Service.
—. 2015. *MyPlate.* Accessed December 10, 2019. https://www.choosemyplate.gov/.
USDA National Institute of Food and Agriculture. n.d. *Supplemental Nutrition Education Program – Education.* Accessed December 13, 2018. https://nifa.usda.gov/program/supplemental-nutrition-education-program-education-snap-ed.
USDA SNAP-Ed Connection. 2019. *Funding Allocations.* Accessed March 7, 2019. https://snaped.fns.usda.gov/program-administration/funding-allocations.
—. 2018. *FY19 Funding Allocations.* Accessed January 30, 2019. https://snaped.fns.usda.gov/program-administration/funding-allocations.
Utter, Jennifer, Simon Denny, Mathijs Lucassen, and Ben Dyson. 2016. "Adolescent Cooking Abilities and Behaviors: Associations With Nutrition and Emotional Well-Being." *Journal of Nutrition Education and Behavior* (Society for Nutrition Education and Behavior) 48 (1): 35-41.
Vetri Community Partnership. 2018. *EAT360.* Accessed January 5, 2019. https://vetricommunity.org/what-we-do/eat360/.
Weaver, Grace. 2013. *Eliminating Food Noise: Using Anthropological Perspectives in an Out-of-the-Box Approach to Changing Schoolchildren's Eating Choices.* Thesis, Philadelphia: University of Pennsylvania Department of Anthropology.
Whitehead, FE. 1957. "Nutrition education for children in the US since 1900 (Parts I and II)." *Journal of the American Dietetic Association* 33: 885-888.
Winkler, Elisabeth, and Gavin Turrell. 2009. "Confidence to Cook Vegetables and the Buying Habits of Australian Households." *Journal of the American Dietetic Association* (The American Dietetic Association) 109: 1759-1768.
Wolfson, Julia, Shannon Frattaroli, Sara Bleich, Katherine Clegg Smith, and Stephen Teret. 2017. "Perspectives on learning to cook and public support for cooking education policies in the United States: A mixed methods study." *Appetite* (Elsevier) (108): 226-237.
Womach, Jasper. 2005. *Agriculture: A Glossary of Terms, Programs, and Laws, 2005 Edition.* Congressional Research Service.
Woolley, Kaitlin, and Ayelet Fishbach. 2016. "A recipe for friendship: Similar food consumption promotes trust and cooperation." *Journal of Consumer Psychology* (Society for Consumer Psychology).

Yoon, Jihyun, Sooyoun Kwon, and Jae Eun Shim. 2012. "Present status and issues of school nutrition programs in Korea." *Asia Pacific Journal of Clinical Nutrition* 21 (1): 128-133.
Zick, Cathleen, and Robert Stevens. 2009. "Trends in Americans' food-related time use: 1975-2006." *Public Health Nutrition* 13 (7): 1064-1072.