

TASTE TEXTING: USING BEHAVIORAL ECONOMICS AND MOBILE HEALTH TO INCREASE
HIGH SCHOOL LUNCH PARTICIPATION

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ABSTRACT

Tosha Woods Smith: Taste Texting: Using Behavioral Economics and Mobile Health to Increase High School Lunch Participation
(Under the direction of Alice Ammerman)

In 2010, the federal Healthy Hunger Free Kids Act enacted strict new standards on school lunch. As a result, school lunch is healthier than ever. These new standards have already been associated with improved diet quality and weight status of school lunch participants. However, school lunch participation is declining nationally and is especially low among high school students. Research suggests that long lines during short lunch periods are a substantial barrier to school lunch participation. To improve high school lunch participation, we developed Taste Texting, a web-based, behavioral economics-informed program that allows students to pre-order school lunch from their computers or mobile phones and retrieve meals from kiosks, thereby bypassing lunch lines. This study combines mixed methods formative research and a multiple-baselines evaluation of the Taste Texting program in two high schools with identical menus in Chapel Hill and Carrboro, North Carolina (n = approx 2300 students). In AIM 1, we used a series of focus groups (n= 8 groups; 60 students) and surveys (n ~440) to identify the social norms surrounding school lunch and perceived barriers to school lunch participation. In AIM 2, we use longitudinal, student-ID linked transaction data and a multinomial logistic regression model to estimate associations between student-level sociodemographic characteristics and weekly school lunch participation at baseline (n ~ 2100 students, followed for 20 weeks). In AIM 3, we evaluated the impact of Taste Texting program participation on 4, 6, and 8-week changes in school lunch participation, finding that though

program adoption was minimal, the heaviest program users in one school exhibited and maintained a 12% increase in weekly school lunch participation.

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CHAPTER 1: INTRODUCTION

In 2010, the federal Healthy Hunger Free Kids Act (HHFKA) enacted strict new standards for school lunch.¹ The HHFKA mandated increased portions of fruits and vegetables, whole grains, and low fat dairy and gradual reductions in sodium while establishing an age-appropriate calorie maximum for the first time in history. As a result, school lunch is healthier than ever. These new standards have already been associated with improved diet quality² and weight status³ of school lunch participants. Indeed, research suggests that students who eat school lunch often have better diet quality than those who do not,⁴⁻⁶ as school lunch is often healthier even than meals brought from home.⁷⁻¹¹ School lunch is particularly essential for low-income children¹² as research shows that the new standards have made healthy foods more accessible for low-income students at school than they are at home.² Likewise, school lunch may be especially important for high school students, whose chosen alternatives to school lunch likely involve vending machines, fast food, convenience stores, or meal skipping.¹³ However, school lunch participation is declining and is especially low among high school students.¹⁴⁻¹⁶ Low high school lunch participation rates mean that students are missing an important contribution to a healthy diet and that school food operators are struggling to remain solvent while providing healthy, affordable meals despite fewer customers. Low overall school lunch participation also likely stigmatizes school lunch, making school lunch untouchable for students who pay full price for school lunch, and a source of shame for students who qualify for free and reduced price lunch.^{17,18}

Clearly, strategies to increase overall participation in high school lunch are urgently needed. However, little is known about the factors that affect school lunch participation at the

high school level. Limited research suggests that long lunch lines during short lunch periods make school lunch participation inconvenient, and research suggests that this lack of convenience may be a substantial barrier to school lunch participation.^{15,19} Additionally, conversations with local stakeholders including staff, students, administration, and school food service professionals in the local school district suggests that long lunch lines are a local problem which likely affects school lunch participation. To address this issue, we developed *Taste Texting*, a web-based, behavioral economics-informed mobile health program that encourages school lunch participation by allowing students to pre-order school lunch from their phones or computers and bypass cafeteria lines to retrieve their healthy school lunch from kiosks located apart from the cafeteria. The current study is a pilot test of the *Taste Texting* program in two high schools with identical menus in Chapel Hill and Carrboro, North Carolina (n = ~2300 students). This pilot study fills an important gap in our understanding of student perceptions of high school lunch and tests a simple, theory-based solution to the critical problem of low high school lunch participation.

1.1. Specific Aims

This study uses a strategic combination of qualitative and quantitative research methods and electronic student-ID linked cafeteria sales transaction data to accomplish the following aims:

AIM 1: Identify the social norms surrounding school lunch and perceived barriers to school lunch participation using focus groups and surveys.

Eight focus group discussions consisting of 7-10 students at (4 groups per school) were used to identify social norms related to school lunch, usual lunchtime behaviors, barriers to school lunch participation, and student opinions of a pre-ordering program concept. Findings from the focus groups were used to develop a pen-and-paper survey, which was widely distributed to 20% of the student body at each school. Results from this aim adds to limited

knowledge about why students do or do not participate in school lunch and informed the implementation and marketing of Taste Texting in each school.

AIM 2: Determine baseline lunch participation patterns and estimate associations between student-level demographic variables and school lunch participation over time.

This formative aim uses retroactively gathered student-ID linked cafeteria transaction data matched to student-level demographic data to determine school-wide lunch purchasing patterns and relationships between student-level demographic variables and school lunch participation over time during the baseline period.

AIM 3: Determine whether *Taste Texting* increases school lunch participation.

This program evaluation aim uses prospectively gathered student-ID linked cafeteria transaction data to determine whether participation in the Taste Texting program increases school lunch participation at 4, 6, and 8 weeks post initial program engagement.

Though low school lunch participation is a problem that affects millions of high school students and the schools that serve them, very little is known about what motivates students to participate (or not) in school lunch and, to our knowledge, no strategies to increase overall school lunch participation have been thoroughly tested. This pilot study addresses each of these gaps, using rigorous mixed methods and novel data sources to discover who does and does not participate in school lunch (AIM 2), why they do or do not participate in school lunch (AIM 1), and deploying an innovative mHealth solution to the problem of low school lunch participation.

CHAPTER 2: LITERATURE REVIEW

2.1. Benefits of school lunch

As of 2011, the National School Lunch Program (NSLP) was an \$11.1 billion program serving 31 million students in over 100,000 schools nationwide.¹⁶ The impact of NSLP participation on student diet and health has been the subject of much research. Though this body of research offers some mixed results, the majority of recent studies, including those that have used large, nationally representative datasets like the periodic School Nutrition and Dietary Assessment (SNDA) sponsored by the USDA and the annual National Health and Nutrition Examination Surveys (NHANES) sponsored by the Centers for Disease Control and Prevention (CDC) estimate positive associations between school lunch participation and diet quality.^{4-6,20} Both the SNDA and NHANES studies include dietary assessments in the form of 24-hr dietary recalls and assessments of school lunch participation. In 2009, Condon et al analyzed data from the third SNDA study (SNDA III, begun in 2005) and found that school lunch participants were significantly more likely than non-participants to consume milk, fruit, and vegetables and less likely to have consumed desserts, snack items, and beverages other than 100% juice on the days subject to the dietary recall.⁴ Likewise, In 2013, Ishdorj et al analyzed data from the SNDA III and found that students who participated in school lunch consumed more servings of fruits and vegetables than students who did not participate in school lunch.⁶ In 2013, Hanson et al used dietary data from 2003-2008 national NHANES surveys to examine the impact of school lunch participation on the diets of 2376 children nationwide aged 6-17 years. After adjusting for weekend intake, they found that children who participated in school lunch had higher weekday

diet quality scores than non-participants, owing to the fact that they consumed more milk, less saturated fat, and less sodium than children who did not participate in school lunch.⁵ In 2011, Gosliner et al collected dietary data on 5365 low-income 7th and 9th graders in California and found that school lunch participants were more than twice as likely to consume fruits and vegetables (FV) at lunch than non-participants.²⁰ Though the Gosliner study does not involve a nationally representative sample, the sample size coupled with dietary data makes a compelling case for the association between school lunch and FV consumption.

In 2009, two additional studies used nationally representative data from the third School Nutrition Dietary Assessment study (SNDA III) and found mixed effects of school lunch participation on student diet. Briefel et al found that while school lunch participants consumed less energy dense meals and fewer calories from sugar sweetened beverages than non-participants, school lunch participants' consumption of low-nutrient, energy dense foods such as french fries and baked goods was higher than that of non-participants.²¹ Likewise, Clark et al found that while school lunch participation was associated with reduced dietary inadequacy, school lunch participation was also associated with higher intakes of fat and sodium relative to non-participants.²² However, these studies were conducted before the implementation of the new school lunch standards.

To our knowledge, since 2009, only two studies using nationally representative datasets have estimated entirely negative associations between NSLP participation: Schanzenbach (2009) and Millimet et al (2009) both used a nationally representative dataset from the Early Childhood Longitudinal Study-Kindergarten cohort (ECLS-K) and found that participation in school lunch during kindergarten was associated with a higher likelihood of being overweight or obese in third grade.^{23,24} However, as pointed out by Gundersen et al, both the Schanzenbach and Millimet studies both employ regression discontinuity designs, which enforce sharp income-based cutoffs between participants and nonparticipants for the sake of comparison, an approach that creates artificial counterfactuals and which does not account for classification

error or for the nonrandom selection into NSLP participation.²⁵ In short, the Schanzenbach and Millimet studies do not adequately account for the fact that the low-income students are more likely to self-select to participate in school lunch programs and also far more likely than their higher-income peers to be obese in general.^{26,27} Additionally, it is important to note that each of these studies (Schanzenbach et al and Millimet et al) examined the association between school lunch participation and weight status, rather than participation and dietary quality. However, dietary quality is likely more proximally impacted by school lunch participation than is weight status, as weight status is influenced by myriad factors which go unmeasured in both studies.

2.2. School lunch more important for lower income students

Research suggests that the positive contribution of school lunch toward diet quality is even more important for low-income students, who are at higher risk of diet related diseases.²⁶ For instance, Robinson-O'Brien et al found that low-income children with low daily fruit and vegetable (FV) intake consumed a higher proportion of their daily FV at school by participating in school lunch, suggesting that school lunch is an important opportunity for students who may not either have access to or be consuming these foods at home.¹² Similarly, Hanson et al (2013) used data from the 2003-2008 NHANES studies to examine the relationship between diet quality and school lunch participation, finding that low-income students who consumed school lunch had higher diet quality indices than low-income non-participants.⁵ Likewise, Gundersen et al used data from 2001-2004 NHANES studies to examine the effect of receipt of free and reduced price school lunches on food insecurity, poor health, and obesity and found that school lunch participation among low-income children was associated with improved health outcomes relative to low-income non-participants.²⁵

2.3. New regulations ensure healthier lunches

Importantly, each of the studies referenced previously was conducted before the Healthy Hunger Free Kids Act was passed in 2010 and enacted in 2012. The Healthy, Hunger Free

Kids Act improved nutritional standards for school lunch by mandating increased portions of fruits, vegetables, and whole grains, mandating lower-fat dairy offerings and imposing restrictions on total calories and sodium. Limited recent research demonstrates that these standards have already improved both the diet quality and weight status of school lunch participants. For instance, in 2013, Dan Taber and colleagues used a nationally representative sample of 4870 8th grade students from 40 states and found that in states with nutritional standards for school lunch that met or exceeded the new USDA standards, the disparity in obesity rates between low-income student participants in school lunch and higher-income non-participants was 12 percentage points smaller than in states that did not have regulations similar to the new standards in place. Importantly, the study also found “little evidence” that students responded to the new regulations by buying more competitive foods.³ In a similar study published in 2013, Taber also found that nutritional standards that met or exceeded the new USDA regulations were associated with higher FV intake among school lunch participants, and that the relationship was strongest among students with the least home access to FV, suggesting again that school lunch is an important opportunity to provide access to healthy foods, since participants are willing to eat healthy foods at school even if they do not have regular access to those foods at home. Additionally, Cohen et al (2014) measured school lunch selection, consumption, and plate waste before and after implementation of the new standards in 4 urban, low-income elementary schools and found that fruit selection increased by 23% and vegetable consumption increased by 16.2% after the new standards were implemented, suggesting that the standards may influence both the selection and consumption of healthy foods at lunch.²⁸

2.4. School lunch healthier than meals brought from home

Indeed, a limited but growing body of research suggests that school lunch is often healthier even than lunches brought from home. Before the implementation of the HHFKA, Hur

et al conducted parent-assisted dietary recalls on 129 elementary school children in suburban Minneapolis and found that the children who regularly ate school lunch had higher intakes of protein, calcium, and vitamins A, D and K and lower intakes of energy, fat, carbohydrate, vitamin E and sugar than students who regularly brought lunches from home.⁸ In 2012, Johnston and colleagues observed the lunch choices of 2107 2nd graders from 7 different elementary schools in Texas and found that packed lunches contained far more sugar in the form of sugar sweetened beverages and desserts than school lunch.⁷ This finding is similar to that of Dr. Kiya Duffey and colleagues who conducted 1314 lunch observations among pre-K and Kindergarten students in 3 schools over a consecutive 5-day period and found that among the 561 packed lunches they analyzed, 41.7% contained no fruits or vegetables, 41.2% contained a sugar sweetened beverage, and 61.1% contained a sugary dessert.¹¹ In a related study, Duffey et al report that packed lunches from the same observations contained significantly more total energy, fat, saturated fat, sugar, Vitamin C and iron and less protein, sodium, fiber, Vitamin A and Calcium than packed lunches.¹⁰ Likewise, in 2015, Caruso and Cullen observed packed lunches from elementary and middle school children from 12 different schools in Texas and found that 90% of the packed lunches in their sample contained sugar sweetened beverages, sugary desserts, or snack chips and that overall, packed lunches contained more sodium and fewer fruits, vegetables, and milk than school lunch.

It is important to note that all of the research on the nutritional profile of packed lunches that is discussed here was conducted among preK-8 students rather than high school students.

Though school lunch participation declines as students age and is particularly low at the high school level, there are not, to our knowledge, any studies that compare the nutritional profiles of school lunch to packed lunches among high school students, nor are there any studies that systematically investigate what high school students choose to eat for lunch if they do not eat school lunch. If high school students bring lunch from home as an alternative to school lunch, it is unclear who assembles those lunches: the students or their parents. If parents are packing

high school students' lunches, then there is no reason to assume that parent-packed lunches for high school students are any more nutritious than the lunches that parents are packing for younger children. If students are packing their own lunches, then we feel that there is even less reason to assume that those lunches are nutritionally comparable to a healthy school lunch, as many studies that have investigated the longitudinal diet quality of children have found that overall diet quality decreases with age^{29,30}, a fact that is often attributed to children expressing more autonomy over their dietary choices and perhaps failing to choose foods that are as healthy as their parents used to choose for them. Additionally, as high school students exercise more autonomy than younger students in the forms of increased spending money and transportation, it is hypothesized that the alternatives to school lunch include not only lunches brought from home, but fast food, convenience store fare, vending machine products, or meal skipping – none of which are likely to compare favorably with a healthy school lunch.

2.5. The Challenge: Low School lunch participation

National school lunch participation has been declining, and is especially low at the high school level.^{15,31} As of 2009, national high school lunch participation was 38.6%.³¹ However, at the high schools involved in this pilot study, school lunch participation rates are especially low. As of Fall 2013, the overall lunch participation rates at the intervention and delayed control schools were 17.5% and 19.8%, respectively.

Low school lunch participation among high school students means that students are missing an important contribution to a healthy diet. As previously mentioned, this contribution is especially important for low-income students, who may have less access to healthy foods outside of school.^{2,12} Some investigators have suggested that low school lunch participation rates may also increase any social stigma surrounding school lunch participation, such that even students who receive subsidized lunches do not participate in school lunch for fear of being identified as low income.^{17,18,32,33} In a media interview given in April 2014, a spokeswoman

for the School Nutrition Association, an organization representing more than 55,000 school food service personnel nationwide, was quoted saying, "A concern that our [school food personnel] members have when you look at declining participation in the school meal program is the possibility that there are going to be kids who feel like they don't want to go to the cafeteria because only the poor kids go to get their lunches there."¹³

Lastly, low school lunch participation is a significant challenge for food service programs that must meet the costly new nutritional standards despite having fewer customers. After many of the new regulations were implemented in the Fall of 2012, the Government Accountability Office (GAO) surveyed and visited school food operations nationwide to gauge how well the school food operators were able to implement the new regulations. The result of this effort is a report issued in January 2014 stating that school food operators cited "many challenges" to complying with the new regulations, chief among them being "managing food costs".¹⁶ In April 2014, the head of The School Superintendents Association, a national organization representing over 10,000 school districts nationwide, sent an open letter to the USDA expressing growing concern that the standards mandated by the Healthy Hunger Free Kids Act, "place(s) ever-increasing strain on school district budgets."³⁴ The GAO report also finds that in the school year during which the regulations were first implemented (2012-13), school lunch participation declined drastically nationwide, driven by the fact that 1.6 million full-price paying students ceased participating in school lunch that year. The report cites the new regulations as directly responsible for the observed decrease in NSLP participation, which is the sharpest single-year decrease in the program's history.¹⁶ Some school food operators have responded to the new regulations by opting out of the NSLP altogether.³⁵⁻³⁷ While the USDA reports that only 524 of 100,000 all participating schools nationwide have actually opted out of the NSLP as of the 2013-14 school year³⁸, a school opting out of the federal NSLP is a problem to be avoided at all costs. When schools opt out of the NSLP, they are under no legal obligation to maintain any sort of nutritional standards for any of the meals they serve, they may charge whatever price they

choose for meals, and they are no longer obligated to make provisions for low-income students who may be unable to pay for school lunch. Clearly, there is a need for interventions to help maintain or increase school lunch participation at the high school level so that school food operators who serve federally compliant meals do not do so at financial risk.

2.6. Factors affecting school lunch participation

It is likely that factors related to school lunch participation are different for high school students, who have more autonomy and more non-school food lunch options are different than those of elementary and middle school students.³⁹ Still, very little research has been conducted to investigate why so few high school students participate in school lunch. To our knowledge, the only national-scale investigation of school food perceptions at the high school level is a 2010 study published by the Asperin et al, which used focus groups from all USDA regions in the country to develop a survey for high school students that measures the degree of satisfaction with school food service and the barriers to and motivations for participating in high school lunch. Their investigation found that, in general, there are two types of school food participants at the high school level: those who participate frequently (3 times per week or more) and those who participate rarely (8 times per month or fewer). The survey that Asperin et al developed and validated to investigate why high school students do not participate in school lunch found that students who do not currently participate in school lunch would be encouraged to participate if they saw improvements in “overall quality of the food, variety of menu items from day to day, and time spent waiting in line.”^{14,15} Similarly, more than 80% of school lunch principals nationwide who were surveyed as part of the SNDA III study cited “long lunch lines” as a challenge to school lunch participation at their school. Long high school lunch lines make school food especially inconvenient for a population that highly values convenience. One study conducted by the National Food Service Management Institute at the University of Mississippi surveyed over 800 high school students from 6 different schools located Minnesota and Iowa.

The study sample included schools with both relatively high and relatively low overall lunch participation rates. Importantly, the study found that students cited convenience of school lunch as the primary motivator for or barrier to participating in school lunch, and that this was the case whether or not the students attended a high participation school or a low participation school.¹⁹ Informal interviews, anecdotal data, and observations of local high school lunch periods suggest that time spent in line is likely a key barrier to school lunch participation for local high school students. In each of the two local high schools involved in this pilot study, the entire student body eats lunch during a single lunch period. This means that 900 – 1500 students all eat lunch during a 45-minute period. This creates very long cafeteria lines. Indeed, preliminary observations of the lunch period at the intervention school in the Spring of 2014 found that some cafeteria lines still persisted halfway into the lunch period, which left students with fewer than 25 minutes to eat lunch. Long lunch lines during limited lunch periods are more than inconvenient. Long cafeteria lines during short lunch periods mean that students who do receive school lunch have limited time to eat it, which may contribute to overconsumption.⁴⁰ One working paper by economists at Georgia State University suggests that not having enough time to eat lunch may be an issue for students. Using data from the national SNDA III study, they found that every 10-minute increase in a school lunch period was associated with a 1.86 percentage point drop in the likelihood of being overweight and a 0.194 reduction in BMI, suggesting that having more time to eat at lunch is healthier for students.⁴¹

CHAPTER 3: HOW TASTE TEXTING WORKS

3.1. Program and study site overview.

Taste Texting is a web based mobile health program that allows students to pre-order school lunch from their cellphones or computers and retrieve pre-ordered lunches from kiosks located apart from the cafeteria, thereby skipping long lunch lines. In this study, we used a multiple baselines study design to evaluate the impact of the Taste Texting program participation on student-level school lunch participation in two public high schools in North Carolina. The two high schools involved in this pilot study are located in the same school district, share the same school food vendor, and have identical daily school lunch menus. As of October 2014, School 1 had an average daily attendance of 1489 students, School 2 had an average daily attendance of 874 students. Research that has explored the factors affecting lunch participation in younger students have found that qualifying for free or reduced price lunch significantly influences lunch participation, and we hypothesize that the same is true for high school students. As such, it is important to note that as each of the schools in this study, 18% of the student body qualified for free or reduced price lunch, which is far lower than both the national average (38%) and the statewide average for North Carolina (41%).⁴²

3.2. Study schedule overview.

The focus groups and surveys that comprised the data collection effort for AIM 1 were conducted during the Fall 2014 semester. Specifically, all focus groups were completed in September – October 2014 and all surveys were administered in October – November 2014. In the Spring of 2015, the Taste Texting program followed a staggered start schedule as per a

multiple baselines study design. Beginning in February 2015, the program start dates were as follows:

1. FEB 4, 2015: Program begins for 11th and 12th grade students at School 1 (group 1)
2. MAR 2, 2015: Program begins for 9th and 10th grade students at School 1 (group 2)
3. MAR 4, 2015: Program begins for 11th and 12th grade students at School 2 (group 3)
4. MAR 25, 2015: Program begins for 9th and 10th grade students at School 2 (group 4)

This staggered start was necessary from an analytical perspective, but it was also useful in preventing the school food service staff from becoming overwhelmed once the program launched at their site. The program ended at both sites on May 22, 2015, such that the total program run time at School 1 was 12 weeks (with some students being eligible to use the program for 10 weeks) and 10 weeks at School 2 (where half of the student body was eligible to use the program for 8 weeks).

3.3. Study Partners

This pilot study was conducted as part of a partnership with the local school district, Chapel Hill Carrboro City Schools (CHCCS), UNC Chapel Hill, and Chartwells, a corporate school food vendor that handles food service for the entire school district. Both Chartwells and CHCCS provided student-level data for this study.

The Institutional Review Board (IRB) at the University of North Carolina at Chapel Hill, reviewed and approved all of the methods and materials for this project and the project and supervised all project operations conducted by both UNC and RTI project personnel. In addition to UNC IRB approval, the school district conducted its own review of the project methods and materials and issued an independent approval.

3.4. Spring 2013 Proof-of-concept study

In the 2011-12 school year, a prototype of the Taste Texting technology was tested in a limited proof-of-concept study in one public high school in Chapel Hill. This small trial lasted 48

days, during which 59 high school students used Taste Texting to order 269 school lunches, with only 2 reported lunch order errors (error rate < 1%). On post-program surveys, half of the respondents reported that Taste Texting was easy to use and that the program heavily influenced their decision whether to eat school lunch on any given day. These limited data are encouraging but insufficient to estimate the larger and longer-term impact of Taste Texting on school lunch participation or the feasibility of scaling the program from a food service perspective. The current study is a larger pilot test of the Taste Texting program in two local high schools (~2300 students) with identical menus. This study will transition the technological infrastructure of the Taste Texting platform from a text message-based platform to a web-based platform that allows many more users to use the system simultaneously and will allow us to examine the impact of this scaled up program on individual-level school lunch participation.

3.5. User registration and informed consent

For the updated pilot study of the Taste Texting program reported here, program registration was free and voluntary. Efforts to incentivize user registration are explained in Chapter 6 below. Program registration consisted of establishing an account with an email address and password, along with optionally providing one's gender and grade level. Upon registration, students agreed to receive email updates to the email address that is associated with their Taste Texting account, but permission to text information to students' cell phones had to be obtained separately, per federal law. If a student consented to receiving text messages about the program, they had to check a box and provide a cell phone number. Per the UNC IRB referenced above, Taste Texting program registration did not require specific, informed consent on the part of the student as long as the data resulting from the student's interaction with the program was analyzed using de-identified project ID numbers in place of student ID numbers. The local school district echoed this preference and as such, all the data that follows were analyzed using nonsense project ID numbers that were installed by the school district

rather than actual student ID numbers. The school district is the sole custodian of the key which links project IDs to actual student ID numbers, and none of the UNC or RTI personnel associated with this project have access to that key.

3.6. Messaging, ordering, and payment procedures

Once a student registered an account with Taste Texting and the program launched for their grade level in their school, they began to receive daily messages that prompted them to use the program to order lunch. More detail about the content and frequency of messages is included in Chapter 6 below, but generally, email messages were sent in the evening to prompt students to pre-order lunch for the following school day and text messages were sent in the morning to prompt students to pre-order lunch for that school day. The messages – both email and text – prompted students to visit the Taste Texting website, which was branded as “Lunch101” in the schools, to place their order. Each school in the study had their own specific Lunch 101 website (Screenshots of the program are available in APPENDIX 4), and students had to sign in using the email address and password that they used to establish their account.

Pre-ordering was only offered one day at a time, and pre-orders for lunch had to be received by 10am on the day of lunch. Only federally reimbursable lunches, which consist of an entrée and mandatory fruit and vegetable side items, were offered for purchase via Taste Texting. The entire school lunch menu was available for pre-order, and there were no items that were only available via Taste Texting or on the usual line. Once a student’s Taste Texting order was complete, the student received a confirmation message on-screen, but not via email or text message, since student feedback from the earlier proof-of-concept study indicated that fewer messages were strongly preferred.

Lunches ordered via Taste Texting were retrieved from kiosks located apart from the cafeteria. To minimize logistical confusion, each site began with one kiosk each, and, as explained in

Chapter 6 below, program adoption was such that one kiosk per site was sufficient for the duration of the program.

The student did not pay for the meal until the meal is retrieved from the kiosk, due to federal regulations that stipulate that a food service staff person must “lay eyes” on the student and the meal in order to charge for the meal and for the meal to count as a reimbursable lunch. All Taste Texting transactions were conducted using student IDs and the same electronic point-of-sale (POS) system used to receive and record payment for the rest of each cafeteria’s transactions, such that every meal sold using Taste Texting was tracked via student ID numbers in the same manner as the rest of the school’s cafeteria transactions. Technically, it was possible for student to preorder a lunch and then fail to retrieve and pay for it. However, this issue only happened twice during the entire duration of the program, and in the 2012 proof-of-concept study, we did not find that this was a common problem.

Additionally, each of the schools included in this study have campus-wide wireless internet that is free for all students, and both students, staff and administrators at both schools report that students are allowed to use their cellphones while at school.

3.7. Back-end operations

Taste Texting is a responsively designed web-based program. Due to its responsive design, the program’s website renders the same whether the site is being accessed via a smartphone, tablet, or computer and is browser-agnostic. Because it is web-based, operating system-specific capabilities were not a concern (i.e. the site would render the same whether it was accessed via an Apple or an Android device) and any operating system updates that may have been scheduled during the study period would not have affected program operations. Chartwells, the school food vendor for both schools involved in this study, designed the lunch menu on a monthly basis. As previously stated, the two schools in this study have identical daily lunch menus, but each school had its own Taste Texting website and students were

directed to visit the site for their school. All Taste Texting menus were loaded into the program's website on a weekly to monthly basis by the site's developer, Area101, Inc. Each Taste Texting order consisted of a federally reimbursable lunch, which includes an entrée plus a minimum of 1 fruit or vegetable side item and milk. If a student attempted to place an order without the required components, the system would register an error message that identified the specific problem and directed the student to remedy it. On each school day that the program ran, once the 10am ordering deadline was met, the school food service personnel at each site retrieved a report of all of the Taste Texting orders for that day, sorted by entrée. The school food service then prepared the meals and stored them at the kiosk for pickup. The Taste Texting kiosks were outfitted with climate control equipment that kept hot food hot and cold food cold and a POS-outfitted cash register to accept payment. At each site, the Taste Texting kiosk was staffed by a single food service operator.

3.8. Laptop and cell phone ownership among high school students

Taste Texting is a web-based program that is accessible by all internet-enabled devices, including smartphones, tablets, and computers. Research demonstrates that the majority of American teenagers have access to one or more of such devices. For instance, a recent Pew report on Teenage internet use found that 76% of high school students nationwide own an internet-capable smartphone, and that 90% of US high school students own or have access to a desktop or a laptop, and 56% have access to a tablet.⁴³ Importantly, though there is some variation in ownership by income level, Pew research shows that a majority of the high school students (61%) in the lowest income bracket own smartphones and 78% have regular access to an internet-enabled laptop or desktop computer. This suggests that that web-based nature of the Taste Texting does not preclude low-income or minority students from participating in the program.

However, there may be other mitigating factors such as internet access at home or school, and while Taste Texting is accessible by any internet-capable device, we expect that most users will access the site via a smartphone while at school. As such, we verified with administrative officials at both schools that a) each site has a wireless internet connection that students are able to use during the school day, b) students are allowed to bring and use their cellphones on campus during the school day, and c) our formative research for this project inquired directly about smartphone ownership and internet use among students and found that over 90% of the survey respondents at both of the schools represented in this study reported owning a smartphone that they use to access the internet daily while at school (see Chapter 4 below)

3.9. Theoretical framework: Behavioral economics

Researchers have been calling for an increase in the use of behavioral economic principles to inform nutrition related interventions^{43, 44} owing in part to the fact that behavioral economics principles are often operationally inexpensive and easily evaluated. The development of Taste Texting is informed by 4 main principles of behavioral economics: pre-commitment, active choice/customization, incentivizing behavior change with convenience, and exerting implicit rather than explicit influence over the target behavior.

3.9.1. Pre-commitment

Behavioral economics posits that individuals make less healthy choices when confronted with sensory, visceral cues and a stressful, distracted environment in which to make decisions⁴⁵ and suggests the use of pre-commitment strategies as a means to shift the timing of decisions to less stressful and less sensory circumstances. For instance, in a study to be detailed in a forthcoming article, Hanks et al (2012) found that students who preordered their lunch entrees were 92% more likely to select a healthier entrée and 12.3% less likely to consume unhealthy snacks than students who did not preorder their lunch entrees.⁴⁶ Behavioral economics also

posits that self-control is an exhaustible resource that diminishes as individuals perform cognitively demanding tasks. For instance, in a 1999 experiment conducted by Shiv and Fedorikhin, adult subjects were randomized into two groups: one group that was given a cognitive task and another that was not given a cognitive task. Both groups were given a choice between fruit salad or chocolate cake as a snack. The adults who had been subjected to the cognitive task were significantly more likely to choose the cake than their less cognitively depleted peers, and the authors suggest that these results are due to the affect that cognitive exertion makes subsequent decisions less rational and more impulsive.⁴⁷ This is an important consideration for school lunch as students are often making lunch decisions in a crowded lunchroom after a full morning of class. Taste Texting utilizes a pre-commitment strategy by prompting the user to pre-order school lunch early in the school day and apart from sensory stimuli such as sights and smells of energy dense competitive or ala carte foods during a time of the day that is likely less stressful than a crowded lunchroom.

3.9.2. Active Choice

Behavioral economics asserts that whether and how a choice is presented can influence decision.⁴⁸ This phenomenon is known as active choice, choice framing, or choice architecture. Research has shown that prompting students while they are making lunch decisions is a simple but powerful tool to influence not only the selection but the subsequent consumption of healthy foods. For instance, a pilot study published in 2007 studied the effect of a verbal prompt on elementary school students' selection and consumption of fruit. In the intervention school, the cafeteria workers prompted students with a choice question: "would you like fruit or juice with your lunch?" In the control school, the same fruit and juice options were available, but no prompt was given. In the intervention school, 90% of the students eating lunch selected a fruit with their lunch, while only 60% of the unprompted students selected a fruit with lunch. The consumption rate was the same at both schools, where 80% of the students who selected the

fruit with lunch consumed it.⁴⁹ In a similar experiment conducted by Just and Wansink, middle school students attending a summer camp were randomized into two groups: one group of 120 students was told that they must select carrots with their lunches while a second group of 120 student were asked if they wanted carrots or celery with their lunches. In the group in which carrots were mandated, only 69% consumed any of the carrots, whereas in the group that was given a choice, 91% of them consumed the carrots that they chose.⁴⁴ Likewise, Hakim and Meissen (2013) found that forcing an active choice resulted in a 15% increase in consumption of both fruits and vegetables in elementary and middle school students' lunches.⁵⁰ The proposed mechanism for the association between choice and action is that increases awareness of present options and supports autonomy by giving individuals a sense of ownership surrounding their decisions. Several investigators have suggested that this autonomy becomes more important to older students who want to exert more control over their decisions.³² Taste Texting utilizes active choice by prompting students to customize their entrees using a set of pre-determined options, ensuring that each student has as much control as possible over determining the makeup of their lunch entrée.

3.9.3. Convenience

Behavioral economic theory also asserts that even relatively small changes in convenience can precipitate significant changes in behavior.⁵¹ Researchers have tested the effects of this principle in school lunchrooms by slightly rearranging the items offered on a school lunch line⁴⁴, or by creating express lunch lines exclusively for health options.⁵² An example of the latter, Hanks et al (2012) formed an express lunch lane explicitly for healthy grab and go items one public high school cafeteria and found that this alone increased sales of healthier foods by 18% and decreased grams of less healthy foods consumed by 28%.⁵² The proposed mechanism by which convenience is said to motivate behavior is by exploiting an individual's present-bias, also known as hyperbolic discounting or future discounting, which

places a disproportionate amount of value on things that benefit one now versus in the future.⁵³ According to this theoretical construct, convenience is a powerful motivator for behavior change by creating immediate benefits for healthy behaviors that usually have longer-term benefits. Taste Texting utilizes convenience to encourage school lunch participation by allowing students to skip long cafeteria lines to retrieve preordered lunches from kiosks located just outside the cafeteria. In this way, Taste Texting mitigates the most inconvenient factor associated with school lunch participation.

3.9.4. Choice framing

Behavioral economic theory also asserts that exerting an implicit influence on target behaviors or decisions is often more effective than exerting explicit influence on those same behaviors or decisions.⁵⁴ This principle, sometimes called libertarian paternalism, preserves an individual's ability to choose a less desirable behavior while incentivizing more desirable behaviors and/or de-incentivizing less desirable behaviors. This is an important principle as many individuals equate choice with freedom and react negatively to explicit restrictions on choice. A good example of this negative reactance is student response to chocolate milk bans in schools. Researchers recently evaluated the effects of a similar chocolate milk ban in 11 public elementary schools in Oregon, finding that the ban was associated with a 10% decrease in total milk sales, a 6.8% decrease in the proportion of students participating in school lunch altogether, and an increased milk waste rate as 29.4% of the white milk cartons selected during lunch were thrown away untouched.⁵⁵ In contrast, Smith et al in 2011 sought to increase selection of white milk among students by simply rearranging the order of the available milk options in one school: placing skim milk first in line, placing the 1% milk next, and then placing chocolate milk last in line. This small pilot had moderate success, increasing skim milk sales by 20%⁵⁶, suggesting that more subtle measures such as making less healthy choices harder to locate in a cafeteria might be more palatable and successful in changing behavior than banning

certain options altogether. Taste Texting incorporates this principle of liberal paternalism by making only school entrees, not competitive or ala carte foods, available for pre-order via Taste Texting. In this way, Taste Texting does not forbid the purchase of competitive or ala carte foods, but it does implicitly incentivize healthier choices by limiting options to those whose nutritional standards are regulated (i.e. lunch entrees).

CHAPTER 4: PERCEPTIONS OF SCHOOL LUNCH AND BARRIERS TO PARTICIPATION

4.1. Introduction

To identify perceptions of school lunch and perceived barriers to school lunch participation among students at two public high schools in North Carolina. We conducted 8 focus group discussions with 60 students at two public high schools. Focus group findings were used to design a survey that was completed by 398 students, or approximately 20% of the student body at each school. When asked about the food and the non-food aspects of the school lunch experience, students expressed strongest feelings about school lunch food. Student perceptions of school food are largely negative and include the perceptions that the food is foreign, of poor quality, lacking in variety, and worth neither the time nor the money required to obtain it. Of the non-food aspects that were investigated, time spent waiting in line was the most significantly perceived barrier to participation, but more for students in one of the two schools. Students' collective perception that school lunch food is undesirable is the most significant barrier to school lunch participation among public high school students in this sample.

4.2. Background

Due to new federal regulations, school lunch is healthier than ever. Indeed, limited research suggests that school lunch is often healthier even than lunches brought from home^{7,8} and is thought to be healthier than the hypothesized alternatives to school lunch at the high school level, which include fast food, vending machines, lunches bought from gas stations, and meal skipping.^{44,13} School lunch participation has been declining and is particularly low at the high school level, and emerging evidence suggests that the while the new healthy school lunch

standards may be improving student nutrition^{2,3}, they may also be exacerbating the downward trend in participation as students demonstrate less preference for healthier foods.^{16,45,46} This downward trend is particularly problematic as healthier lunches are more expensive to produce, placing an additional burden on school lunch providers who were already struggling to remain solvent while serving federally compliant meals to a declining customer base. Citing their inability to remain solvent while serving meals that meet the new healthy school lunch standards, a small but growing number of school food vendors have opted out of the federal program altogether.^{34,35,47} Opting out of the federal lunch program means a lack of regulation – school lunch program that opt out of the federal lunch program can serve whatever they choose, charge whatever they want, and are under no obligation to make provisions for low-income students. Thus, an understanding of the barriers and facilitators to school lunch participation among high school students is critical, yet little is known about high school students' perceptions of school lunch or their usual lunchtime behaviors.

4.3. Methods

4.3.1. Overview of study methods

The present study is an exploratory mixed methods⁴⁸ investigation into the factors which affect school lunch participation among students in two public high schools in North Carolina. This study is a collaboration between public health investigators at an academic institution (UNC Chapel Hill), a contract research organization (RTI International), and a corporate school food vendor. The results of this study informed the implementation of Taste Texting, a web-based behavioral economics-informed school lunch intervention that aimed to increase school lunch participation by allowing high school students to pre-order lunch from their cell phones or computers.⁴⁹ The present pilot study was conducted in two public high schools in North Carolina that share the same school food vendor, have identical daily lunch menus, and similar overall lunch participation rates prior to the start of this research.⁵⁰ One school (n ~ 1500

students) served as the intervention school (School 1) while the second high school (School 2, n ~ 850 students) served as the delayed control school.

The present study used a series of focus groups and a pen-and-paper survey to address 4 formative research questions: 1) What are students' current perceptions of school lunch (both the food and non-food aspects), including barriers to and facilitators of participation? 2) What are students' usual lunch behaviors, including what students normally eat for lunch and how they usually spend their lunch hour? 3) What are students' suggestions for improving the lunch experience in their school, including improvements to both the food and non-food aspects of school lunch? 4) What are students' initial reactions to the concept of a web-based system for pre-ordering school lunch? Focus groups were conducted prior to finalizing the pen-and-paper survey, such that the results of focus group discussions were used to refine survey questions and response options.

4.3.2. Focus group methods

4.3.2.1. Recruitment, scheduling, and participation incentives

Researchers visited the schools to recruit focus group participants during the lunch hour (at School 1) or by visiting English classes (at School 2). Potential focus group participants completed a focus group interest form that included a brief prescreening survey assessing each student's grade, gender, how many times per week they usually bought school lunch (Never, 1-2 days/week, 3-4 days/week, or Everyday), and their preferred method of contact (either text message or email). The purpose of this prescreening tool was to segregate focus group participants by self-reported participation status: those who reported buying school lunch with some frequency were considered "usual participants" and were therefore eligible to participate only in focus group discussions with other usual school lunch participants, while those who reported never buying school lunch were eligible to participate only in focus group discussions with other usual non-participants. This distinction was not disclosed to focus group participants,

but was enforced to minimize any potential discomfort that may be experienced by students who were usual participants in school lunch in case school lunch participation was stigmatized in their school. Tenth and 11th grade students were prioritized for focus group participation because focus group discussions were held in the Fall shortly after 9th grade students would have arrived and because 12th grade students were allowed to travel off campus for lunch. The target participation was 5 to 10 students per group, and students were contacted a few at a time by email or text message (depending on their indicated preference) until focus groups were scheduled to capacity. Focus group participants were given a \$10 restaurant gift card and a lunch of pizza and drinks provided by the school cafeteria during the focus group.

4.3.2.2. Focus group content

A total of eight focus groups were planned: 4 per school (2 groups with usual school lunch participants, 2 with usual school lunch non-participants). All focus groups were conducted on each school's campus during the lunch hour in the Fall of 2014 and led by the same facilitator (Smith). The focus group guide was written to address the following research questions: 1) What are students' perceptions of school lunch? (both the food and the non-food aspects of school lunch were of interest) 2) What are students' usual lunch behaviors? (both what they normally eat for lunch and how they spend their lunch hour) 3) What are students suggestions for improving school lunch (both the food and the non-food aspects of school lunch) and 4) what are students initial reactions to the pre-ordering concept? To investigate this last research question, at the very end of each focus group, the Facilitator mentioned that the school was preparing to implement a new program that would allow students to pre-order school lunches online which would allow students to bypass cafeteria lines to pick up school lunch. The Facilitator did not mention the name of the program or the anticipated start date, but did openly solicit group feedback on the concept of the program, asking for suggestions that the

students had for implementing the program, and asking for suggestions for potential marketing avenues for advertising the program.

Additionally, each group was asked the questions 1) “how do you normally hear about things happening at school?” and 2) “If you were in charge of the school lunch program here and you had improved school lunch and wanted people to try the new, improved school lunch, how would you get people to try it?” (the focus group guide used for this study can be found in APPENDIX 1)

4.3.2.3. Analysis of focus group data

Focus group discussions were audio recorded and then transcribed verbatim. Very little formal research has been conducted to examine high school students’ perceptions of school lunch food and their perceived barriers to school lunch participation. As such, there are very few hypotheses to govern the focus group data collection effort and therefore all of the focus group coding was inductive rather than deductive. After reading through all of the focus group transcripts, the facilitator drafted an initial codebook. Two coders then independently applied the codes to the same set of transcripts (1/4 of all transcripts) and met weekly to discuss code applications, resolve discrepancies, and to revise the codebook until target agreement was met. Inter-rater code application agreement was determined by calculating Cohen’s kappa statistic and a Pooled Kappa according to the method outlined in Vries et al (2008), where acceptable agreement is achieved at pooled Kappa ≥ 0.61 ,⁵¹ though the target agreement for this study was set at Pooled Kappa = 0.7. Once target agreement was reached, the coders independently analyzed the remaining focus group transcripts. Two investigators then read the coded transcripts independently to identify themes and observations which address each of the 4 research questions, as well as any themes and observations that may not have been anticipated by the research questions. The results of these independent readings/theme identifications were synthesized in a series of meetings until a consensus results were

identified. All focus group data were analyzed using Dedoose (version 6.0.21, Los Angeles, CA)

4.3.3. Survey methods

Focus group results were used to refine questions and response options for a paper-based survey that was designed to assess perceptions of school lunch, usual lunchtime behaviors, student opinion about the planned pre-ordering program and information thought to be important for guiding the implementation of the preordering program at each school. Immediately after participating in the focus group, focus group participants completed an early prototype of the survey and offered feedback on both the questions and response options. The final paper survey was 24 questions long, though a few questions had several subparts. The survey was to be completed independently by students during their lunch period and was designed to require 15 or fewer minutes to complete. The survey included demographic questions (3 items), questions that assess perceptions of school lunch (5 items), usual lunchtime food and activities (3 items), the respondent's current relationship to the school lunch program and preference for a pre-ordering system (3 items), how students receive information about school events (2 items), cell phone ownership/use (3 items) and social media preferences and interaction with school on social media (5 items). The survey also included one optional open-ended question that solicited any additional thoughts on school lunch that the respondent may have that would not have been covered by the other questions, including any suggested improvements they may have.

The survey assessed current grade level and gender and asked how often, during any given week of the school year, they normally buy school lunch; response options included: everyday, 3-4 times per week, 1-2 times per week, or never. Students were classified as participators in school lunch if they reported normally buying lunch 1 or more times per week

and as non-participants if they reported never buying school lunch, and all survey responses were analyzed by school and participation status.

The survey asked students to use a 5-point Likert scale to quantify how important each of the following 8 aspects of school lunch is to them: the healthfulness of the food, the taste of the food, the appearance of the food, the variety of the food offered, time spent waiting in line, the price of the food, the friendliness of the school lunch staff, and the atmosphere in the cafeteria. The response options included: “5 = very important”, “4 = somewhat important”, “3 = neither important nor unimportant”, “2 = somewhat unimportant”, and “1 = not important at all”. These aspects of school lunch were included because they were mentioned during the focus group discussions. Respondents were then asked students to rate the current state of their school’s lunch on each of those aspects using the following Likert-type response options: “5 = excellent”, “4 = good”, “3 = average”, “2 = below average”, and “1 = poor”.

Students’ usual lunch food was assessed by asking respondents to indicate how often they did each of the following 8 things for lunch while at school: “I buy school lunch”, “I get lunch from the vending machines”, “I go off campus for lunch”, “I bring lunch from home”, “My parents drop lunch off to me at school”, “Seniors bring me food from off campus”, “I don’t eat lunch”, “I snack during classes rather than eating lunch”, using response options 1 = “Often”, 2 = “Sometimes”, 3 = “Rarely”, 4 = “Never”.

Additionally, the survey asked students how often they spent their lunch period on each of the following 4 activities: “I spend my lunch period socializing with my friends”, “I spend my lunch period doing schoolwork”, “I spend my lunch period attending club meetings”, and “I really don’t do anything else with my lunch period besides eat”. The response options for each of these activities were “1 = Often” “2 = Sometimes” “3 = Rarely” and “4 = Never”. Likewise, since many focus group participants mentioned feeling like their short lunch periods and busy schedules sometimes made eating lunch difficult (especially school lunch with its perceived

additional time cost), a survey question was added to assess whether this was an issue for a larger proportion of the student body at each school.

The survey also briefly assessed each student's relationship with the school lunch program by asking whether the student knows who to approach with specific complaints or suggestions about school lunch, and since we were assuming that most students who use the program will access it from their phones, the survey used 3 questions to assess cell phone ownership and usage. For survey items with Likert scale responses we calculated mean response values, 95% confidence intervals and used Wilcoxon rank sum tests to determine whether any of the observed differences in survey responses by school or participation were statistically significant at an alpha equal to 0.05.

At both schools, the finalized paper survey was distributed by researchers during the school lunch period. Survey completion was incentivized by a drawing to win one of ten \$25 Amazon gift cards. Survey data were analyzed using Stata (version 11.2, College Station, TX)

4.4. Results

4.4.1. Focus Group Results: Demographics of Study Participants

At School 1, researchers were only permitted to recruit potential focus group participants during the lunch period, whereas in School 2, researchers were permitted to visit each 10th and 11th grade English class in the school to recruit focus group participants. At School 1, 139 students completed a focus group interest form, or approximately 10% of the student body. At School 2, 205 students (25% of student body) completed focus group interest forms. Interested participants were contacted randomly until focus groups were scheduled to capacity. At School 1, 100 students were contacted to schedule participation: 2 students declined participation, 60 students did not reply, 38 students replied and were scheduled, and 27 students attended one of the focus group discussions (19% of all interested students, 27% of all contacted students). At School 2, 71 students were contacted: 3 students declined participation, 24 students did not

reply, 44 students scheduled participation and 33 students attended one of four focus group discussions (16% of those interested, 46% of all contacted students). Focus group discussion size ranged from 5 to 10 students per group with an average of 7 students per group. Table 1 summarizes the demographic information for all focus group participants.

A total of 8 focus group discussions were completed in the Fall of 2014, including 4 groups at each school. At each school, half of the 4 focus group discussions were comprised of usual school lunch participants, and half were comprised of people who reported never buying school lunch. A total of 60 students participated in the focus group discussions, including 27 total participants from School 1 and 33 total participants from School 2. Focus group discussion size ranged from 5 to 10 students per group. Focus group participants were more likely to be female than male, and the focus group discussions at both schools contained mostly 10th and 11th graders, though a few 9th and 12th graders were involved in focus group discussions at School 1 (Table 1).

Table 1. Focus group participant characteristics by school

Demographic Characteristics of Focus Group Participants, by School	SCHOOL 1 N (%)	SCHOOL 2 N (%)
GENDER		
Female	19 (70%)	18 (55%)
Male	8 (30%)	15 (45%)
GRADE		
9	6 (22%)	0 (0%)
10	8 (30%)	16 (48%)
11	11 (41%)	17 (52%)
12	2 (7%)	0 (0%)
LUNCH PARTICIPATION STATUS*		
Participant	15 (56%)	15 (45%)
Non-participant	12 (44%)	15 (56%)
TOTAL	27 (45%)	33 (55%)

*Students were classified as participators if they reported usually buying lunch 1 or more times per week; non-participators were those who reported never buying school lunch

At both schools, all focus group discussions occurred during the lunch period, which was approximately 50 minutes long. Initial focus group discussions averaged approximately 45 minutes in duration, which meant that the discussions spilled over into the class period immediately after the lunch period, at which point the School 1 administration requested that researchers limit focus group duration to just the lunch period. Thus, subsequent groups were conducted more quickly, such that overall focus group duration was approximately 32 minutes across both schools.

A final codebook and target agreement were achieved after coders independently analyzed 4 transcripts, resulting in double coding of half of all the transcripts. The final calculated inter-rater reliability for code application across all transcripts was 0.75. Coded

transcripts were independently read for themes, and consensus themes are matched to the study's research questions.

4.4.1.1. Focus Group Results: Themes in Students' Baseline Perceptions of School Lunch

Though the opinions on both the food and non-food aspects of school lunch were common across participation status and school, the students' opinions about school lunch were overall the most frequently and strongly stated. There was very little disagreement in focus group discussions and no differences in focus group results were noticed between participation status or by school.

4.4.1.2. Themes: Students' Perceptions of School Lunch food

Students' thoughts about school lunch food were overwhelmingly negative. Key themes that emerged included the perceptions that school lunch food is: 1) Foreign or mysterious, looking and smelling unappealing 2) Of poor quality rather than "real" or fresh 3) Of inadequate variety, containing the same menu items day after day, and 4) Not worth either the time or the money required to obtain it. In relation to themes 1 and 4, students often made direct comparisons between school lunch food and restaurant food, in which restaurant food was perceived to be preferable to school lunch food.

The most prominent theme arising in this particular study is the students' common description of school lunch food as foreign, mysterious, or "not real", often suggesting that one was unable to discern what a school lunch entrée was just by looking at it or that the entrée did not look or smell familiar or appealing:

One thing, the cafeteria does not always smell very good. So it's not very enticing to want to come and buy food if it smells really kind of gross. - (School 1, Group 1, Non-participant)

--

When you think about exactly what you're eating and then you don't know what it is, because it really does not look like what you think it is, like if you look at the chicken strips on the like little salad bar, it don't look, it does not look like chicken. It looks like cat tail or something weird."

(School 1, Group 2, Participator)

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I agree with [participant] number 9...a lot of times you don't even know what you're eating."

(School 2, Group 7, Non-participator)

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I mean, none of the meat is real at all. I wouldn't be surprised if it was cardboard or human or whatever [Laughter] - (School 2, Group 6, Participator)

--

Another related perception is that school lunch entrees are poor quality, originating from pre-processed frozen or canned ingredients that are haphazardly reheated in microwaves, all of which the students consider to be negative. Additionally, many students perceived that school food ingredients are often recycled or reused, such that each day's unsold food is repackaged and offered on several subsequent days before it is finally discarded. This perceived recycling/reusing of food is seen as something that affects both food quality and safety:

Participant 1: And I think they should make real food because I feel like this is like coming straight out the freezer, like microwaveable food.

P2: It's barely even heated up sometimes.

P1: Yeah.

P3: Right. (School 1, Group 4, Participators)

--

I feel like a lot of, like the pizza. I feel like they just took it out of the freezer and like heated it up and so that's why it's like rubbery" - (School 2, Group 5, Non-participator)

--

Everything is frozen and heated up. It's not real meat. It's just a mess. - (School 1, Group 1, Non-participator)

--

P1: Like, for instance, you have chicken patties, like chicken sandwiches and then the next day, we have chicken parmesan. [Laughter]

P2: It's chicken parmesan...

P3: ...and the chicken parmesan is the same chicken that I ate yesterday on that sandwich with that stale bread. So it's kind of like I seen that meat yesterday but you're going to try to fool me by putting cheese [Laughter] and some sauce and it has hardened already — (School 1, Group 2, Participators)

--

Another theme in the students' perception of school lunch food was the perception that school lunch offered the same menu options day after day and that those options grew more unappealing as the students progressed in grade level:

So I think that should just tell the cafeteria people a lot like, you know, the longer you've been here, the food gets nastier and nastier.

(School 1, Group 1, Non-participator)

--

Like Freshmen year, the food wasn't that bad. It was okay and now it's just horrible. - (School 2, Group 7, Non-participator)

--

This year, every time I walk on the line, it's like the same taco meat or the same chicken. It looks just mashed and the first week of school looked good but then now it's just nasty. (School 1, Group 4, Non-participator)

Another theme in the students' perception of school lunch food is that many students perceive that school lunch food is worth neither the price that is being charged for it, nor the time that is required to wait in line for it:

Oh, the process of getting school food is long...long and it's just, it's not worth the wait because the food is not that good. - (School 1, Group 1, Non-participator)

--

And I, when I like first like bought lunch my Freshmen year, it was like \$3.00 for like a slice a pizza and I was like, "That's not worth it," so I, I stopped buying lunch. - (School 1, Group 4, Non-participator)

--

I mean, it's super-pricey for what it is. Like if you don't have discounted lunch, it's like \$4.00 for a lunch, so I think that's like way overpriced for what we get. - (School 2, Group 6, Participator)

--

P1: Also, not to repeat what [participant] number 2 said earlier, it's not like, even if you are really hungry and you want to like wait in line and stuff, by the time you get there, it's not worth all the time...depending on the lines, it can take like almost the whole lunch period just waiting.

P2: Yeah.

P3: Especially the sandwich line. - (School 1, Group 1, Non-participators)

--

And I think because, well, some stuff they may think it's not worth their money. - (School 2, Group 5, Non-Participator, In response to the question "what is one reason why someone may not eat school lunch")

--

The themes of school lunch being mysterious and not worth the time nor the price required to obtain it were contrasted directly by a positive familiarity with restaurant food and students' willingness to both pay more money and wait in line for restaurant food that is familiar to them.

At any point in the discussions when restaurants were mentioned, the examples of desired restaurants were always national, branded chain restaurants such as Subway, Panera, and Chick-Fil-A. At any time when a participant discussed restaurant food, they seemed to assume that their positive opinion is one that most of their peers share, and many participants expressed strong agreement with positive perceptions of restaurant food:

I honestly don't think that kids are ever going to like school lunch just because of all the things that we've said, like it's just straight up not good. So I think that if it were possible to have a day, like one day a week where we had Chick-Fil-A bring in sandwiches or something where a student had to pay for it, like maybe the price would be raised a little bit but honestly, because people like I mean, everybody likes restaurants, so I think that that would appeal to students more. (School 2, Group 5, Non-participant)

--

if they [kids at school] see something like a brand like Subway, okay, you know, or Chick-Fil-A, you know it's going to be good. (School 1, Group 3, Non-participant)

--

P1: Well, my cousin...when she was here, they had a Subway in the lunch, like in the cafeteria and so I think that by like putting something that like people know and people like—because, you know, like I know I like Subway. So that way people like will say, “I know I’ll like it, so I’ll wait in line for it,” instead of just like going to get like the mystery meat.

P2: And also, the school will make a profit off that, everybody would buy Subway. That line would be ridiculous.

P3: Uh-huh [yes] (School 1, Group 1, Non-participants)

--

“like if you had let’s say Panera, I think people would wait in line. I don’t think they would mind that much.” (School 1, Group 1, Non-participant)

4.4.1.3. Themes: Students' perceptions of non-food aspects of school lunch

Students' shared perceptions on the non-food aspects of school lunch comprised only a fraction of the discussion, and were likewise mostly negative. About the non-food aspects of school lunch, two common themes emerged: 1) a shared perception that the cafeteria lines were long and that the cafeteria was crowded such that the logistics of obtaining school lunch are complicated and burdensome 2) a perception of school lunch staff as antagonistic. These negative, shared perceptions of the non-food aspects seemed to reinforce other negative perceptions of the school lunch experience:

And I think that sometimes the lines are really long and people have things to do during lunch, so they don't want to wait around as long to get their food. (School 1, Group 2, Participator)

--

It's also not a very enjoyable experience, like there's a lot of shouting, there's a lot of playing, just not like enjoyable stuff going on" (School 2, Group 8, Participator, talking about the atmosphere in the cafeteria and the lunch lines during the lunch period)

--

P1: I think that the atmosphere in the cafeteria would improve if they had nicer cafeteria ladies. Well, I mean, that's just my opinion. I had a issue with a cafeteria lady, well, like she's like a register lady, like she was yelling at me and I was like, because she's like, like not all of them are rude. There is one that likes me.

P2: There's some nice ones but, but the rest of them are very stingy and rude.

Several Participants: Yeah. (School 1, Group 4, Participators)

--

And the lunch ladies are really mean. They like snap at you. (School 2, Group 7, Non-participator)

--

When I've walked by the lines or anything, the people attending the lines are not always very nice and sometimes they yell at you, even if you're not in line. (School 1, Group 1, Non-participator)

4.4.1.4. Themes: Students' usual lunchtime behaviors

Despite the fact that half of the focus groups at each of the schools were comprised of students who self-reported eating school lunch with some regularity (i.e. usual participants), not many students admitted to eating school lunch, or if they did mention eating school lunch, admitted to buying school lunch only because they felt that they didn't have any other choice.

Most people still tend to eat it because they have nothing else to eat. (School 1, Group 3, Non-participator)

--

When I think about school lunch I just automatically think like it's nasty and I mean I can only force myself to eat it when I'm like on the verge of starving. (School 1, Group 1, Non-participator)

When asked what students eat for lunch if they do not eat school lunch, most participants stated that students often bring their own lunches from home. The most common reasons cited for this were increased control/choice over what they eat, better quality and variety, and the ability to "know" what they're eating, and more freedom during the lunch hour to snack on one's lunch throughout the day. Less common reasons cited for bringing lunch from home were larger portion sizes and the perception that lunch brought from home is cheaper than school lunch. At both schools in this study, seniors are allowed to travel off campus during lunch, a fact that was mentioned in many of the focus group discussions. Other mentioned alternatives to school lunch included: 9th through 11th grade students giving seniors money to bring food back to campus for them, using the vending machines (either exclusively or to supplement school lunch or lunch brought from home), parents dropping off food (usually

restaurant food), sharing other peoples' food, not eating at all, or sneaking off campus even though one is not a senior. Students in all groups said that their lunch period is very short, and that there are competing demands on their time that sometimes made eating lunch at all challenging, but which made eating school lunch especially challenging because obtaining school lunch requires so much time spent in line. When asked how they and their friends spend their lunch period, the first response was usually that they used the lunch period for schoolwork; either homework, studying for a test, or getting extra help from teachers. Students also mentioned socializing with friends and going to club meetings:

At least my friends, we usually eat for the first half of lunch and then the second half, we like go in the library and talk or do work that we need to get done. (School 2, Group 8, Participator)

--

I feel like it takes a really long time to get your food and say like, I know a lot of times like I'm really busy and I'll have to go to the library and do some homework, so if I want to like eat really quickly and I feel like if I did buy school lunch, I wouldn't have time to do that. So also, like I do like to eat throughout the day so I feel like just bringing snacks for myself is easier and I feel like with the school lunch I wouldn't be able to do that, so. (School 1, Group 1, Non-participator)

When asked what improvements to the school lunch experience they would make if they had power, participants overwhelmingly suggested improvements to the school lunch food, either the quality or variety of menu offerings. Specifically, many students requested fresher food, which seemed to include food that has been cooked from scratch rather than frozen and reheated. Some students suggested hiring chefs in order to achieve their vision of fresher food prepared on a daily basis. Many students, like others quoted above, also requested that restaurants be allowed to cater school lunch:

P1: *Like it depends like when you walk by in the morning, like there's the kitchen door open and to me, it looks like they have like a pretty like nice, good size kitchen and I think that they should like use it instead of just doing whatever they do with the chicken and stuff like that.*

P2: *Unfreezing it.* (School 1, Group 2, Participators)

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And I think like, at least like maybe one or two days out of the week, we should have like other, like outside companies like Chick-Fil-A or something, like just have catered food like for one or two days a week. I think that would like and have, just like have students pay for it because I'm sure they'd be willing to pay for that, if it was like good food. (School 2, Group 7, Non-participator)

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I was going to say that it'd probably help a lot if we got real chefs in the school. Like I don't know, maybe these people are real chefs but to me, it just kind of seems like 24-hour social hour and then talking and just kind of throwing things together because I bet you half the kids in the school could honestly cook lunch better than them. (School 2, Group 7, Non-participator)

When prompted, focus group participants offered brief suggestions to improve the non-food aspects of school lunch, including opening more lunch lines so that the existing lines would not be as long and allowing both juniors and seniors (or anyone with a car) to go off campus for lunch.

4.4.1.5. Themes: Students' initial reactions to the concept of a pre-ordering system for school lunch

The students' first reactions to the concept of a pre-ordering system were largely negative. The negative reactions centered on 4 main shared beliefs that 1) The program wouldn't work due to technological and logistical challenges which the school lunch staff would

not be skilled enough to navigate 2) The program wouldn't work due to students maliciously messing with the system either by not retrieving ordered lunches or by stealing someone else's pre-ordered lunch and 3) Even if the program did "work" (technically and logistically), widespread use of the program would simply relocate the lines from the cafeteria to the pickup kiosks such that any time savings would be lost, and 4) Students would not "care about" or use a school lunch pre-ordering program if that pre-ordering program did not also coincide with a dramatic improvement in school lunch:

I don't see that being successful, honestly. (School 2, Group 5, Non-participant)

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P1: I think people would completely ignore that.

P2: Yeah. (School 2, Group 7, Non-participant)

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P1: *I think that people would just screw with the system, like, just like—*

P2: *Oh, yeah.*

P1: *—get online and then like order stuff and then just not pick it up or like just screw with people.*

P3: *They'd get orders for like 50 hamburgers.*

P4: *Yeah.* (School 2, Group 7, Participants)

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[P]eople's lunches could easily be stolen or switched and then we'd be without a lunch. So you would need a lot of people like looking over it to make sure that everyone's getting the right lunch. So it might be a hassle. (School 2, Group 8, Participant)

--

[A]nd like even if that system does work, I feel like maybe the lines will still be really long.
(School 1, Group 2, Participants)

--

If they do put it out, no one's going to order it, they're just going to take somebody's order and not care and if they do, make sure that the one who ordered it that would be really inefficient and a waste of time and (School 2, Group 7, Non-participator)

--

P1: Yeah, and so also, I feel like now everybody's going to try to order food and then like it's just going to be crazy like trying to pick it up—

P2: Uh-huh [yes].

P1: —just like the fact that you still have to stand in line and still like wait for it, will be also another hassle.

P3: I agree. I think that also it could be like you sent it and they didn't get it or something and then you go all the way up there but then you don't actually get the food. I mean, it would just cause a lot of problems. (School 1, Group 1, Non-participators)

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P1: So I think that would be such a trash idea because you could like—

P2 Boom.

P1: —you could send, like someone could find out your student ID and then they could send in an order, then you can go into the line expecting to get food and then they'd be like, "Oh, no, that's \$3.50. You already got a lunch today." And so like you could easily just completely mess that up and someone could easily come up and pick food off the table and you would still have to type in your student number and it would take just as long. So I think it's just making it more complicated. (School 2, Group 6, Participators)

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I don't think that would be very practical because personally I am very lazy. I don't think I would go every day, like go on my cell phone every day and preorder a lunch. I think I would forget and then end up having to go through the line, anyway. So I don't think that's very practical.

(School 2, Group 6, Participator)

Additionally, the consensus seemed to be that if the pre-ordering program were to be used to sell the existing school lunch food, the students would not be interested in using the program. Indeed, some students even seemed irritated that the school lunch program would be investing resources into a pre-ordering program instead of investing resources in improving the quality of the school lunch food:

So I don't think the problem, I feel like the problem, there is a problem with the order [process] but I think the main problem is the actual food. (School 1, Group 1, Non-participator)

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I don't think that it would be very successful because a lot of kids don't, are not going to do that if it's going to be the same food. (School 1, Group 4, Participator)

--

I think that like the lunch program needs to focus on like making food that's worth waiting in line for and not eliminating the line for food that's not that good. (School 2, Group 5, Non-participator)

--

If they're not going to change the food then I think it would just be a waste of like their resources trying to do it because honestly the line is a big part of it but I think people would just rather have food that they know is going to taste good. (School 1, Group 1, Non-participator)

A few students expressed some enthusiasm for the pre-ordering concept, mostly due to perceived time savings that the program might provide by allowing students to skip the cafeteria lines:

P1: Just because they don't want to wait in the line, so if you can order anything and people might do it so they don't have to stand in the lines.

P2: Yeah, I would do that. (School 1, Group 4, Participators)

--

I think...being able to order your food before lunch starts is a really good idea because often times when I'm eating lunch with my friends, it'll take them 10-15 minutes to get to our table with their school lunch and by that time, we're almost ready to go into the library and do work or something. So it can really, having this new feature will really increase productivity of students during lunch and also just give them more of a break from doing work and not have that stress of waiting in line. (School 2, Group 8, Participant)

When prompted, the students offered brief advice for implementing the program, which included the suggestion to be certain that the technology worked before deploying the program, starting small by limiting the total number of allowed pre-ordered lunches each day, and specific suggestions for pick up kiosk locations around the school.

In all groups, participants indicated that most people heard of school events via the school announcements, which are either read daily at the intervention School and posted silently on display screens at both schools. Secondly, students mentioned that they hear about events at school from their friends or teachers. When probed about whether or not they hear about happenings at school via social media, the quick, consensus response was that the students do not follow their schools' official accounts on social media, with few exceptions.

P1: [School 1] doesn't have such a great reputation of social media [inaudible] and stuff, so probably won't do that but the announcements is a great way

P2: Yeah.

P3: Uh-huh [yes].

(School 1, Group 2, Participants, discussing the best avenues for advertising the school lunch program)

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Moderator: What about social media?

P1: No.

P2: They tried to have a Twitter and all these teachers are like, "Follow me on Twitter," and—

P3: It failed.

P1: —everybody's like, "No, I won't follow you on Twitter" (School 2, Group 6, Participators)

Additionally, students expressed distaste for any game or contest-style marketing. Instead, the majority suggestion was to offer free samples to entice students who do not normally buy school lunch to try it:

P1: I'd do anything for free food, so—

Several Participants: Yeah. (School 2, Group 7, Non-participators)

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Maybe announcing the like free samples over the announcements, which is the period right before lunch, so it'd be like fresh in people's brains (School 1, Group 2, Participator)

4.4.2. Survey Results

At School 1, 253 surveys were completed, approximately 19 percent of the school's average total daily attendance. At School 2, 193 surveys were completed, or approximately 23 percent of that school's average total daily attendance. See Table 2 for demographic information on survey respondents at both schools.

Table 2. Demographic characteristics of survey respondents by School.

Demographic Characteristics of Survey Respondents, by School	SCHOOL 1 N (%)	SCHOOL 2 N (%)
GENDER		
Female	123 (49)	93 (48)
Male	129 (51)	99 (51)
Missing	1 (0.4)	1 (0.5)
GRADE		
9	96 (37)	38 (20)
10	77 (30)	53 (27)
11	55 (22)	77 (40)
12	25 (10)	24 (12)
Missing	1 (0.4)	1 (0.5)
LUNCH PARTICIPATION STATUS*		
Participator	110 (43)	63 (33)
Non-participator	141 (56)	129 (67)
Missing	2 (0.8)	1 (0.5)
TOTAL	253	193

*Students were classified as participators if they reported usually buying lunch 1 or more times per week; non-participators were those who reported never buying school lunch

4.4.2.1. Survey results: Students' current perception of school lunch experience

Table 3 below displays the mean responses for each survey item by school and the p value for Wilcoxon rank sum tests that were applied to determine whether any observed between schools differences are statistically significant at an alpha of 0.05. Each of the 8 aspects of school lunch were ranked according to mean response – the aspect rated the highest in importance was deemed most important to the group overall.

Table 3. Responses to: “When you think about school lunch, how important are each of the following aspects to you?”*

Aspect of School Lunch Experience	SCHOOL 1				SCHOOL 2				Between Schools diff p value**
	mean	95% CI	std dev	RANK [#]	mean	95% CI	std dev	RANK [#]	
Taste of the Food	4.60	4.5, 4.7	0.8	1	4.65	4.5, 4.8	0.8	1	0.33
Appearance of the Food	4.10	4.0, 4.2	0.8	2	4.02	3.9, 4.2	1.1	2	0.99
Healthfulness of food	3.83	3.7, 4.0	1.1	4	3.78	3.6, 3.9	1.2	3	0.64
Variety of Food	3.82	3.7, 3.9	1.0	5	3.76	3.6, 3.9	1.0	4	0.67
Price of the Food	3.57	3.4, 3.7	1.3	7	3.73	3.6, 3.9	1.2	5	0.22
Time Spent Waiting in Line	4.00	3.9, 4.1	1.2	3	3.63	3.4, 3.8	1.3	6	0.001
Friendliness of School Lunch Staff	3.71	3.6, 3.9	1.2	6	3.48	3.3, 3.7	1.3	7	0.08
Atmosphere in the cafeteria	3.35	3.2, 3.5	1.3	8	3.28	3.1, 3.5	1.3	8	0.51

* Response options: 1 – 5 scale: 5 = “Very important”, 4 = “Somewhat Important”, 3 = “Neither Important nor Unimportant”, 2 = “Somewhat unimportant”, 1 = “Not important at all”

Each aspect of school lunch ranked in order of mean importance (1 = rated most important; 8 = rated least important)

** According to Wilcoxon Rank Sum test, at significance ≤ 0.05

The highest (higher = more important) mean response and smallest standard deviation was observed for the taste of the food aspect at both schools. Each school rated “taste of the food” and “appearance of the food” to be of highest importance, and “atmosphere in the cafeteria” to be of least importance, relative to the other aspects. The only statistically significant between-schools differences were observed for “friendliness of the school lunch staff” and the “time spent waiting in line” aspects, both of which were rated as more important by the respondents at School 1 relative to School 2. When students were asked to indicate which aspect of school lunch was most important to them, over 60% of the respondents at both schools indicated that “taste of the food” is most important, relative to all the other listed aspects.

Respondents at both schools indicated their highest level of satisfaction was with the “friendliness of school lunch staff”, relative to other aspects (see Table 4 below). All aspects had mean ratings and confidence intervals at 3.5 or below, indicating that respondents at both schools perceive their school lunch programs to be largely of average or less-than-average performance on the included aspects. Statistically significant between-schools differences were

observed for half of the aspects: the appearance of the food, the healthfulness of the food, the time spent waiting in line, and the variety of the food. For each of these between schools differences, the respondents at School 2 ranked their school's performance lower than those at School 1 – except for “time spent waiting in line” which was ranked lower at School 1 than at School 2.

Table 4. Responses to: “Please rate the current state of school lunch at your school in each of the following areas”*

Aspect of School Lunch Experience	SCHOOL 1				SCHOOL 2				Between Schools diff p value**
	mean	95% CI	std dev	RANK [#]	mean	95% CI	std dev	RANK [#]	
Friendliness of lunch staff	3.5	3.4, 3.7	1.1	1	3.3	3.2, 3.5	1.2	1	0.06
Atmosphere in cafeteria	3.4	3.3, 3.5	1.0	2	3.3	3.1, 3.4	1.0	2	0.16
Price of the food	3.2	3.1, 3.3	1.1	4	3.1	3.0, 3.3	1.0	3	0.62
Variety of the food	3.2	3.1, 3.3	1.1	3	3.0	2.8, 3.1	1.0	4	0.02
Healthfulness of the food	3.1	3.0, 3.2	1.0	5	2.9	2.8, 3.1	1.0	5	0.02
Time spent waiting in line	2.5	2.3, 2.7	1.4	8	2.8	2.6, 2.9	1.1	6	0.004
Taste of the food	2.9	2.7, 3.0	1.3	6	2.7	2.5, 2.9	1.2	7	0.11
Appearance of the food	2.8	2.6, 2.9	1.2	7	2.5	2.4, 2.7	1.1	8	0.03

* Response options were on a 1 to 5 scale, where: 5 = “Excellent”, 4 = “Good”, 3 = “Average”, 2 = “Below Average”, 1 = “Poor”

Each aspect of school lunch ranked in order of mean importance (1 = rated most important; 8 = rated least important)

** According to Wilcoxon Rank Sum test, at significance ≤ 0.05

4.4.2.2. Differences in survey responses by school lunch participation status

As survey respondents indicated how important each of the 8 aspects of school lunch experience are to them, we noted several significant differences by school lunch participation status (see Table 5 below). All of the observed statistically significant differences, whether they were differences shared by both schools or limited to single school, were due to non-participants rating the aspects to be of higher importance to them relative to the participants.

Table 5. Responses to: "When you think about school lunch, how important are each of the following aspects to you?"*

Aspect of School Lunch Experience	SCHOOL 1			SCHOOL 2		
	mean	std dev	p value**	mean	std dev	p value**
Appearance of the Food	Total	4.10	0.8	4.02	1.1	
	Participators	3.95	0.9	3.67	1.3	
	Non-participators	4.21	0.8	0.02	4.18	0.9	0.02
Atmosphere in the cafeteria	Total	3.35	1.3	3.28	1.3	
	Participators	3.30	1.3	3.05	1.4	
	Non-participators	3.38	1.2	0.75	3.40	1.2	0.11
Friendliness of School Lunch Staff	Total	3.71	1.2	3.48	1.3	
	Participators	3.75	1.2	3.29	1.4	
	Non-participators	3.67	1.1	0.49	3.58	1.3	0.19
Healthfulness of food	Total	3.83	1.1	3.78	1.2	
	Participators	3.61	1.2	3.22	1.3	
	Non-participators	3.99	1.0	0.02	4.05	1.0	0.000
Price of the Food	Total	3.57	1.3	3.73	1.2	
	Participators	3.56	1.4	3.75	1.2	
	Non-participators	3.55	1.2	0.79	3.75	1.1	0.85
Taste of the Food	Total	4.60	0.8	4.65	0.8	
	Participators	4.44	0.9	4.40	1.1	
	Non-participators	4.71	0.7	0.005	4.78	0.6	0.01
Time Spent Waiting in Line	Total	4.00	1.2	3.63	1.3	
	Participators	3.81	1.3	3.51	1.4	
	Non-participators	4.15	1.1	0.05	3.68	1.2	0.47
Variety of Food	Total	3.82	1.0	3.76	1.0	
	Participators	3.79	1.06	3.49	1.24	
	Non-participators	3.83	0.97	0.84	3.89	0.89	0.05

#Students were classified as participators if they reported usually buying lunch 1 or more times per week; non-participators were those who reported never buying school lunch

*Response options: 1 – 5 scale: 5 = "Very important", 4 = "Somewhat Important", 3 = "Neither Important nor Unimportant", 2 = "Somewhat unimportant", 1 = "Not important at all"

**p value listed is for Wilcoxon rank sum tests of mean ratings by participation status within each school

At School 1, usual school lunch participants expressed higher rates of satisfaction with each of the 8 aspects of school lunch, with the exception of the price of the food. For price of the food, usual participants at School 1 rated it slightly lower than the usual non-participants did, though the observed difference was not statistically significant. The observed differences

between participants and non-participants which were statistically significant included: appearance of the food, healthfulness of the food, taste of the food, and variety of the food. The largest observed difference in responses between participants and non-participants was for the taste of the food aspect of school lunch. At School 2, the observed differences in responses between participants and non-participants is smaller than those observed among respondents at School 1. The appearance of the food, the friendliness of the school lunch staff, and the time spent waiting in line are all rated higher by the participants than non-participants. As at School 1, the usual lunch participants at School 2 expressed a lower satisfaction with the price of the food than non-participants, and this observed difference (at School 2) was statistically significant at $p \leq 0.5$. The only other statistically significant difference among School 2 respondents was observed for time spent waiting in line, which the participants rated higher than non-participants. The largest observed difference between participants and non-participants was observed for “price of the food” aspect of school lunch.

Table 6. Responses to: "Please rate the current state of school lunch in each of the following areas"*

Aspect of School Lunch Experience	SCHOOL 1			SCHOOL 2		
	mean	std dev	p value**	mean	std dev	p value**
Appearance of the Food	Total	2.54	1.1	2.54	1.1	
	Participators	3.14	1.1	2.69	1.1	
	Non-participators	2.52	1.2	0.000	2.46	1.1	0.19
Atmosphere in the cafeteria	Total	3.26	1.0	3.26	1.0	
	Participators	3.46	1.0	3.10	1.0	
	Non-participators	3.36	1.0	0.42	3.35	1.1	0.08
Friendliness of School Lunch Staff	Total	3.32	1.2	3.32	1.2	
	Participators	3.57	1.1	3.37	1.3	
	Non-participators	3.51	1.1	0.70	3.29	1.1	0.48
Healthfulness of food	Total	2.92	1.0	2.92	1.0	
	Participators	3.32	1.1	2.90	1.1	
	Non-participators	2.98	1.0	0.002	2.93	0.9	1.00
Price of the Food	Total	3.14	1.0	3.14	1.0	
	Participators	3.09	1.1	2.86	1.1	
	Non-participators	3.29	1.0	0.14	3.27	1.0	0.01
Taste of the Food	Total	2.70	1.2	2.70	1.15	
	Participators	3.33	1.3	2.71	1.1	
	Non-participators	2.56	1.2	0.000	2.69	1.2	0.95
Time Spent Waiting in Line	Total	2.77	1.1	2.77	1.11	
	Participators	2.61	1.5	3.02	1.2	
	Non-participators	2.42	1.3	0.46	2.65	1.0	0.03
Variety of Food	Total	2.99	1.0	2.99	1.0	
	Participators	3.41	1.01	3.00	1.09	
	Non-participators	3.05	1.05	0.009	2.99	0.98	0.88

* Response options were on a 1 to 5 scale where 5 = "Excellent", 4 = "Good", 3 = "Average", 2 = "Below average", and 1 = "Poor".

Students were classified as participators if they reported usually buying lunch 1 or more times per week; non-participators were those who reported never buying school lunch

** p value listed is for Wilcoxon rank sum tests of mean ratings by participation status within each school

4.4.2.3. Survey results: Usual school lunch food and activities

At each school, respondents indicated that they most often brought lunch from home and that they travel off campus for lunch least often. Though there were a few statistically significant between-schools differences in mean responses, the within-school rankings of each item were similar enough that we conclude that there are no important differences between schools in regard to usual lunchtime food sources.

Table 7. Responses to: "What do you normally eat for lunch when you are at school?"* by school.

Alternatives to School Lunch	SCHOOL 1			SCHOOL 2			Between Schools diff p value**
	mean	std dev	RANK#	mean	std dev	RANK#	
I bring lunch from home	1.8	1.2	1	1.6	1.1	1	0.01
ck during class rather than eat during lunch	2.8	1.0	2	2.7	1.0	2	0.22
I buy school lunch	3.0	1.2	3	3.2	1.1	4	0.26
I get lunch from the vending machines	3.2	1.0	4	3.1	1.0	3	0.08
I don't eat lunch	3.4	0.9	5	3.3	1.0	5	0.55
Seniors bring me food from off campus	3.5	0.9	6	3.3	0.9	6	0.003
My parents drop lunch off to me at school	3.5	0.8	7	3.4	0.9	7	0.16
I go off campus for lunch	3.6	0.8	8	3.4	0.9	8	0.01

*Response options were 1 = "Often", 2 = "Sometimes", 3 = "Rarely", 4 = "Never"

#Ranked in ascending order mean, such that 1 = most commonly reported lunch option and 8 = least common lunch option

Though respondents at School 2 reported socializing with friends somewhat more often than respondents at School 1, no significant between schools differences were noted in how the survey respondents spend their lunch period. Likewise, respondents at both schools indicated that missing lunch due to pressing obligations was relatively rare (see Table 8 below

Table 8. Responses to: "How do you normally spend your lunch period?"*

Lunchtime Activities	SCHOOL 1		SCHOOL 2		p value**
	mean	std dev	mean	std dev	
Socializing with my friends	2.3	0.8	1.3	0.7	0.6
Doing Schoolwork	2.3	0.8	2.1	0.7	0.1
Attending club meetings	2.7	0.9	2.7	0.9	1.0
I only eat during lunch	3.1	1.0	3.1	1.0	0.8
Obligations make it difficult for me to eat lunch	2.4	0.8	2.3	0.76	0.8

*Response options were 1 = "Often", 2 = "Sometimes", 3 = "Rarely", 4 = "Never"

** p value listed is for Wilcoxon rank sum tests compared means to determine if between-schools differences were statistically significant at $p \leq 0.5$

In an open-ended survey question, we asked respondents to identify the primary reason why they buy school lunch. At both schools, the majority of respondents indicated that they eat school lunch only because they, for one reason or another, do not bring their lunch from home. At School 1, 92 respondents (36%) answered the question, 42 of whom (46% of those who answered the question) indicated that they buy school lunch primarily because they "do not pack". The various reasons given for not packing a lunch from home were not wanting to spend the effort to pack, (33%), forgetting to pack (17%), having "no time" to pack (19%) and 1 respondent who indicated that they buy lunch primarily when their parents do not pack their lunch for them (2%). Of the 92 respondents who answered this question at School 1, 5 indicated that they eat school lunch because they qualify for free or reduced price lunch (5%), 4 answered "no choice" (4%), and 23 simply said that they eat school lunch because they are "hungry" (25%). A total of 20 respondents (22%) cited a positive aspect of school lunch as their primary reason for eating it. Eleven respondents (12%) answered that school lunch was more convenient than other options, and 8 respondents (9%) from School 1 indicated happily eating school lunch – 6 because they "enjoy the food" (7%) and 2 respondents (2%) indicating that they eat school lunch when their favorite item is on the menu. At School 2, 61 of 193 survey respondents (32%) answered the open-ended question that solicits a primary reason for eating school lunch. Similar to the respondents at School 1, the majority of responses to this question

(66%) indicated that food brought from home is the default option in many students' minds, such that they frame their choice to eat school lunch in terms of either a failure or an unwillingness to spend time/effort packing lunch from home. The responses to this open-ended survey question were remarkably similar between schools, the only notable difference being the fact that 2 respondents from School 2 indicated that they eat school lunch to supplement lunches brought from home.

In an additional open-ended survey question, respondents were asked to identify the primary reason why they do not choose to buy school lunch. Over half of the survey respondents at both schools answered this question, and responses to this open-ended survey question were similar between schools, with the one exception that 10% of the respondents at School 1 cited the length of the cafeteria lines as being the primary deterrent to eating school lunch, compared with just 2% of the respondents at School 2. At both schools, the most commonly cited reason for not eating school lunch at either school was that the students do not enjoy the food. The second most common reason given for not eating school lunch was that the students pack a lunch – again confirming that students often see their lunch choice as a decision between two options: eating school lunch or bringing lunch from home, and that they far prefer bringing lunch from home.

4.4.2.4. Additional Survey Results

When asked whether they know who to approach with comments, complaints, or suggestions about school lunch – 82% of respondents at School 1 answered “No” as did 79% of respondents at School 2.

Over 60% of the respondents at both schools indicated that they would be more willing to eat school lunch if they could pre-order it and pick it up without having to wait in line. At School 1, 51% of those who indicated such interest in the pre-ordering program were non-participants.

At School 2, 67% of the respondents who expressed positive interest in the pre-ordering were non-participants.

When asked to identify the primary method that they normally hear about things happening at school, respondents at both schools chose “Announcements” (read over the school’s public speaking system) as the top avenue of communication. When asked how often they interact with their school or school clubs on social media, 11% of respondents at both schools answered “often” while 40% answered “sometimes.” When asked if they would be willing to follow either their school or their school food vendor on social media if they received menu information and/or coupons/discounts by doing so, 39% of respondents in both schools answered “yes”. Though focus group participants indicated an aversion to following official School 1 accounts on social media, we asked a few questions about social media preferences to gauge whether this finding would be shared by a larger fraction of the student body. When asked which social network they use most, the top answer at both schools was Instagram – 37% at School 1 and 32% at School 2, followed by Facebook (22% at both schools). At School 2, the second-choice top social media network reported by respondents was tied between Facebook and Twitter (22% of respondents at School 2 reported that one of these was their preferred social media network) When asked whether photos, videos, ads, or articles catch their attention most on social media, 75% of the respondents who answered the question correctly at School 1 and 85% of the respondents at School 2 answered “photos” When asked whether they would be willing to follow the school lunch program (at their school) in exchange for coupons or discounts, 57% of respondents at School 1 and 55% of respondents at School 2 answered “No”.

When asked whether they own a cell phone, 92% of respondents at School 1 and 94% of respondents at School 2 said “Yes”. When asked if they use their cell phones to access the internet, 85% of respondents at School 2 said “yes”. When asked how often they use their cell

phones while at school, 79% of respondents at School 1 and 81% of respondents at School 2 answered “Everyday”.

4.5. Discussion

Nationally, school lunch participation has been declining and is particularly low at the high school level. Low school lunch participation is a problem for both students and the school food programs that serve them. If low school lunch participation is to be mitigated, it is important to identify the shared perceptions of school lunch and perceived barriers to school lunch participation in public high schools. To our knowledge, this is one of the most comprehensive investigations of high school student perceptions of school lunch, and their perceived barriers to school lunch participation. Both the focus group and survey findings from this study suggest that the taste of the food is the most significant perceived barrier to school lunch participation, as many students in this study share a very negative opinion of school lunch food. Additionally, our focus group results suggest that these students judge food primarily based on how it looks, and secondarily on how it smells, and our survey results indicate that these students are most active on image-based social media platforms like Instagram, where school food is unlikely to shine.

Both the focus group and survey results from this study indicate that students consider lunches brought from home to be the default lunch option for themselves and their peers such that they only participate in school lunch when they forget or otherwise do not choose to bring lunch from home. This is somewhat concerning, given the lack of research on the healthfulness of packed lunches for high school students and the reasonable suspicion that at the high school level, packed lunches are no more nutritious than the lunches that parents pack for their younger children, which often are nutritionally inferior to school lunch. Focus group results were more negative than survey results, particularly when student perceptions of the friendliness of school lunch staff, students’ willingness to interact with school

food program on social media, and the initial response to the preordering concept were measured. Additionally, the survey results highlighted more of a contrast between the schools about the issue of the lines being too long – during the focus groups, there seemed to be equal mention of the school lunch lines being long and a barrier to participation, but in the survey data, it seems like this was much more of a perceived issue at School 1 than School 2. These discrepancies between the focus group and survey findings suggest that even though we were deliberate about separating focus groups based on self-reported school lunch participation status, perhaps the group discussion nature of the focus groups creates an environment in which students are inclined to state their negative opinions about school lunch perhaps a little more strongly than they would if they were asked individually.

Additionally, we found that the vast majority of survey respondents at both schools indicated that they do not know who to talk to if they have comments, concerns, or suggestions about school lunch. This indicates that the students in this study do not know the face of school lunch at their school, and is concerning given that the problem of low school lunch participation is serious and pervasive enough that any potential solutions will need to involve an honest dialog between high school students and their school food service providers.

4.5.1. Strengths, Limitations, and Implications for future research

Though this is a small pilot study that uses a convenience sample in a relatively wealthy school district, these findings still have implications for future research. Specifically, school food programs in this district and beyond may need to consider interventions to make school lunch food more visually appealing to students via carefully produced image-based menus and/or improved cafeteria designs which present the food in visually appealing ways. Secondly, these results indicate that high school students are somewhat reluctant to interact with official school social media accounts, suggesting that school food programs should seek other means of engaging potential customers. Lastly, our findings suggest that students view lunches brought

from home as the default lunch option. Therefore, more research is needed to determine the agency that students have in packing their own lunches. Additionally, interventions that instruct parents and/or high school students on how to construct healthy packed lunches may be needed.

CHAPTER 5: SOCIODEMOGRAPHIC FACTORS ASSOCIATED WITH SCHOOL LUNCH PARTICIPATION

5.1. Introduction

This study uses longitudinal, student-ID linked cafeteria transaction to identify the student-level sociodemographic characteristics that are associated with school lunch participation among high school students from two public high schools in North Carolina. Using student-ID linked cafeteria transaction data on approximately 2300 public high school students followed for 20 weeks, we regressed weekly school lunch purchases on to student-level demographic variables such as grade, school, gender, and school lunch paying status. When all students are included in the model, qualifying for free or reduced price lunch is most strongly associated with lunch participation (OR = 14.6; 95% CI = 11.8 – 18.8), males are more likely to eat school lunch than females (OR = 2.2; 95% CI = 1.8 – 2.7) and students in higher grades were less likely to eat school lunch than those in lower grades (OR = 0.87; 95% CI = 0.78 – 0.95). When analysis is stratified by paying status, the effects of gender and grade on lunch participation hold for students who pay regular price, but not for those who qualify for free or reduced price lunch. Qualifying for free or reduced price lunch is the most important predictor of school lunch participation among students in this sample.

5.2. Methods

5.2.1. Constructing the dataset

The data used for this study are derived from two different sources: 1) electronic, student-ID linked cafeteria transaction data that is collected by the school food vendor at both schools, and 2) student-level demographic data that are collected by the school district.

The student-ID linked cafeteria transaction data are generated every school day by students who must either enter their student ID number on a keypad or else swipe their student ID card each time they make a purchase from the school cafeteria. The student demographic dataset is comprised of variables that the school district collects via student self-report at the time of initial enrollment.

The analyses presented in this current study focuses solely on the purchase of federally reimbursable lunches, which consist of an entrée plus mandatory fruit or vegetable side items. Though any student (F&R eligible or not) can purchase an unlimited number of entrees, side items, and ala carte items from the cafeteria each day, reimbursable lunch purchasing is limited to 1 reimbursable lunch per student per day. If a student bought a reimbursable lunch on a given school day, then the cafeteria transaction data set records a “1” for that student on that day. As such, the dataset containing student-ID linked cafeteria transaction data only includes data on those students (paying or not) who ever purchased a reimbursable lunch rather than every student in the school.

Demographic data on all students was supplied by the school district, which provided the following variables for all students in both schools: student ID numbers, gender, grade, and lunch paying status (free/reduced price lunch or full price), and total number of annual school days that each student in the dataset was absent from school.

Using the demographic data provided by the school district and the student ID number as the unique identifier, the cafeteria transaction dataset was merged with the demographic

dataset. While merging these two datasets, if a student was known to be enrolled in one of the two schools in this study but did not appear in that school's cafeteria transaction dataset for a given school day, it was assumed that the student was present in school that day but did not purchase any food from the cafeteria. As such, zeros for all unobserved school cafeteria transactions were imported into the final dataset, which then contained one observation for each student in both schools for every school day of the 2014-2015 school year.

To minimize the effect of student absences on the analyses in this study, students were categorized into deciles based on the number of school days they missed, and the students in the highest decile of absences in each school were excluded from analysis. To minimize the effect of any single school day on the analysis, school lunch transactions were aggregated at the week level such that the resulting dataset contracted from one observation per day per student to one observation per week per student. To minimize the effect of any idiosyncratic school weeks on the analyses presented in this study, any school weeks with fewer than 3 days ($n = 2$) were omitted from the analysis. The resulting dataset contained one observation per student per week for a total of 33 school weeks. However, because the present study is an investigation into baseline school lunch participation in advance of a planned school lunch intervention, the analyses presented here are restricted to the weeks of the school year in which the Taste Texting school lunch intervention had not yet been launched. Taste Texting was a multiple-baselines intervention that was initiated at different times during the school year for various subsets of the student body at both schools. As such, the number of school weeks that count as baseline differs from student to student, depending on when the intervention began for their group. At the very earliest, the intervention began during the 22nd week of school, so the analyses presented here are for school weeks 1-20, which represents a common baseline period for all students.

5.2.2. Analytical methods

To estimate any associations between student-level demographic variables and school lunch participation, an events-of-trials logistic regression model was built that regressed each student's weekly lunch participation for school weeks 1-20 on student-level demographic variables. For the dependent variable, the number of school days in any given school week as the number of "trials" and the number of times a student buys a reimbursable lunch that week as "events" such that the dependent variable is calculated as follows:

Dependent variable = *# of lunches bought during a school week / # of days in that school week*

The resulting dependent variable is a proportion, ranging from 0 to 1, that quantifies the percentage of each school week that each student buys lunch. Because the model is constructed from multiple observations on the same students, the model was adjusted for intra-individual correlation. All of the regression modeling for this study was performed in Stata (v13; College Station, TX) and sample code and output can be found in APPENDIX 3.

Since little is known about the demographic factors affecting school lunch participation at the high school level, there are few hypotheses to govern the model-building process for this analysis. However, in conjunction with the current study, we conducted an exploratory mixed methods formative research study in advance of the launch of the Taste Texting program (see Chapter 4 above). The findings from this work suggest that whether a student qualifies for free or reduced price is likely a strong predictor of school lunch participation⁵², which agrees with the findings in younger populations.³³ As such, a binary variable indicating lunch paying status (0 = regular price; 1 = free/reduced price) was added to the regression model. Additionally, we recognize that school lunch participation at each school maybe be impacted by various particular, unmeasured aspects of school culture, such that school was included as a covariate. Another finding from our formative research was the suggestion that grade level may be an important factor affecting school lunch participation, such that students in higher grades tend to participate less than students in lower grades⁵² and that overall lunch participation declines as

the school year progresses. As such, grade level and a variable that measured the school year by week were included in the regression model.

Beginning with an intercept-only model, the regression model was built by an iterative, forward selection process whereby variables were added to the model one at a time. The log pseudo-likelihood, Akaike's Information Criteria (AIC), and Bayesian Information Criteria (BIC) values were calculated for each model iteration, and variables remained in the model if their effect size was significant at an alpha of 0.05 and if they contributed to improvements in the AIC and BIC.

5.3. Results

5.3.1. Censoring the dataset

This analysis began with a dataset that consisted of 1489 students in School 1 and 874 students in School 2. Table 9 presents demographic characteristics for students in both schools. For students in school 1, the mean number of days that a student was absent from school was 7.7 and the median was 5 days. In School 2, the mean number of absences among the student population was 9.3 days while the median was 7. As previously mentioned, students in the highest decile of absences were excluded from analyses. At School 1, this meant that students with 18 or more yearly absences were excluded ($n = 146$, 9.8%). At School 2, those with 20 or more yearly absences were excluded ($n = 87$, 10%). Since the school year consists of 185 days, these numbers of yearly absences represent 10 and 11 percent of the total school year for schools 1 and 2, respectively.

Table 9. Demographic characteristics before excluding students from the dataset based on total yearly absences.

DEMOGRAPHIC VARIABLE	SCHOOL 1		SCHOOL 2		chi-square (p value)
	N	%	N	%	
GENDER					
Female	757	51	471	54	2.1 (0.15)
Male	732	49	403	46	
Missing	.	.	.	.
Total	1489	100	874	100	
GRADE					
9	391	26	224	26	1.5 (0.68)
10	378	25	210	24	
11	365	25	213	24	
12	355	24	227	26	
Missing	.	.	.	.
Total	1489	100	874	100	
SCHOOL LUNCH PAYING STATUS					
Free/Reduced Price	272	18	159	18	0.14 (0.71)
Regular Price	1103	74	672	77	
Missing	114	8	43	5	
Total	1489	100	874	100	

Table 10 summarizes the demographic information on students who were excluded from analysis. The students who were removed from the analyses were slightly more likely to be male at School 1 (56% male in the dropped dataset compared to 49% male in the original dataset). At both schools, the students missing the most number of school days were more likely to be seniors than those students in the lower deciles of absences, and students in the highest decile of total yearly absences were more likely to qualify for free or reduced price lunch than those who missed fewer days of school.

Table 10. Demographic characteristics of students excluded from analysis.*

DEMOGRAPHIC VARIABLE	SCHOOL 1		SCHOOL 2		chi-square (p value)
	N	%	N	%	
GENDER					
Female	64	44	46	53	1.8 (0.18)
Male	82	56	41	47	
GRADE					
9	23	16	21	24	4.98 (0.17)
10	23	16	19	22	
11	37	25	18	21	
12	63	43	29	33	
SCHOOL LUNCH PAYING STATUS					
Free/Reduced Price	86	59	59	68	1.91 (0.17)
Regular Price	49	34	22	25	
Missing	11	8	6	7	
Total	146	100	87	100	

*Students in School 1 were excluded from analysis if they missed 18 or more school days. Students in School 2 were excluded for missing 20 or more school days.)

After excluding students according to absences, the resulting dataset consisted of 1343 students at School 1 and 787 students at School 2, with 20 school weeks of data each. The distributions of gender, grade, and lunch paying status in the filtered dataset were similar to those in the original, unfiltered dataset (see Table 11 below).

Table 11. Demographic characteristics of students who remained in the dataset.*

DEMOGRAPHIC VARIABLE	SCHOOL 1		SCHOOL 2		chi-square (p value)
	N	%	N	%	
GENDER					
Female	668	50	357	45	3.8 (0.05)
Male	675	50	430	55	
Missing	.	.	.	.
Total	1343	100	787	100	
GRADE					
9	368	27	203	26	3.9 (0.27)
10	355	26	191	24	
11	328	24	195	25	
12	292	22	198	25	
Missing	.	.	.	.
Total	1343	100	787	100	
SCHOOL LUNCH PAYING STATUS					
Free/Reduced Price	223	17	137	17	0.03 (0.87)
Regular Price	1017	76	613	78	
Missing	103	8	37	5	
Total	1343	100	787	100	

*Students in School 1 were excluded from analysis if they missed 18 or more school days. Students in School 2 were excluded for missing 20 or more school days.)

5.3.2. Overview of school-wide lunch participation

At both schools, the total number of reimbursable lunches sold each day did not vary much during the baseline period, and student-level lunch participation patterns were remarkably similar at both schools. At School 1, the mean number of reimbursable lunches sold during the baseline period was 268 (sd = 16; range = 194 – 309), which equates to 18% of the student population eating school lunch on any average school day. At School 2, the mean number of reimbursable lunches sold per day during the baseline period was 158 lunches per day (sd = 11; range = 109 – 176), which also equates to 18% of the student body at School 2 eating school lunch on an average school day. At both schools, 55% of the student body never purchased reimbursable lunch during the baseline period. Among the students who bought at least one reimbursable lunch during the baseline period, the mean school lunch participation

during the baseline period was about 0.40 (standard deviation was 0.34 at both schools), which equates to each participating student eating school lunch on 2 out of 5 school days per week on average. At both schools, the median lunch participation was 0.3, with a minimum of 0.01 and a maximum of 0.99. Students who qualify for free or reduced price lunch had much higher mean lunch participation (mean lunch participation proportion = 0.67) than students who may full price (mean lunch participation proportion = 0.26). At both schools, 12% of the students who qualify for free or reduced price lunch did not choose a reimbursable lunch during the baseline period.

5.3.3. Student-level demographics associated with school lunch participation

Initially, it was planned to retain only those variables that were significantly associated with school lunch participation in the model. However, while fitting the model, retaining non-significant covariates in the model did not substantially affect the parameter estimates for the significant covariates and thus all covariates were retained.

Table 12. Parameter estimates for sociodemographic factors associated with baseline school lunch participation*

Covariate	Levels of Covariate (Values)	Referent	OR	95% CI	p value
School lunch paying status	2 (0/1)	Regular price	14.63	11.38, 18.81	0.00
School	2 (1/2)	School 1	0.99	0.80, 1.22	0.89
Grade Level	4 (9-12)	n/a	0.87	0.79, 0.95	0.00
Gender	2 (0/1)	Female	2.20	1.78, 2.71	0.00
School week	20 (1-20)	n/a	1.00	0.996, 1.01	0.73

*Among 2130 students at both School 1 and School 2 during the baseline period (20 wks) of 2014-15 school year, using events-of-trials logistic regression, adjusting for clustered residuals (by subject); Outcome = (# of lunches bought per week / # of school days per week); Federally reimbursable meals only

**n (total observations) = 42,600

Lunch paying status was the strongest predictor of school lunch participation during the measured baseline period (OR = 14.5, CI = 11.4 – 18.8, using full-price as referent). Grade level was significantly associated with school lunch participation such that participation decreased as grade level increased (OR = 0.9, CI = 0.8 – 0.95), which was expected and which agrees with the formative research findings associated with this project.⁵² Additionally, gender

was found to be associated with school lunch participation, such that males ate school lunch significantly more often than females during the baseline period in this sample (OR = 2.2, CI = 1.8 – 2.1, female gender used as referent). Being a student at one school relative to the other was not significantly associated with school lunch participation (OR = 0.99, CI = 0.80 – 1.22), which agrees with the school-level analysis presented previously in which the lunch participation patterns at both schools similar. Overall, school lunch participation did not seem to change over time during the baseline period, such that school week was not significantly associated with lunch participation.

5.3.3.1. Stratification by lunch paying status

Because the effect of school lunch paying status was so strongly associated with lunch participation in the overall regression model, it was decided to stratify the analysis by lunch paying status. Following the same forward selection procedure, 2 new models were built – one each for students qualifying for free/reduced price lunch and those who pay full price for school lunch. Parameter estimates for the stratified models are presented in Tables 5 (regular price) and 6 (free/reduced price) below. When the analysis is stratified by lunch paying status, gender (OR = 2.8; CI = 2.19-3.60) and grade (OR = 0.81; CI = 0.73 – 0.89) remain significantly associated with school lunch participation only for those students who pay regular price for lunch, but not for students who qualify for free/reduced price lunch.

Table 13. Parameter estimates for factors associated with school lunch participation among students paying regular price for school lunch*

Covariate	Levels of Covariate (Values)	Referent	OR	95% CI	p value
School	2 (1/2)	School 1	1.01	0.80, 1.29	0.90
Grade Level	4 (9-12)	n/a	0.81	0.73, 0.89	0.00
Gender	2 (0/1)	Female	2.80	2.19, 3.60	0.00
School week	20 (1-20)	n/a	0.99	0.99 1.00	0.06

*Using events-of-trials logistic regression, adjusting for clustered residuals (by subject); Outcome = (# of lunches bought per week / # of school days per week); Federally reimbursable meals only during the baseline period (20 wks) of 2014-15 school year at both School 1 and School 2. n (total observations) = 32,600

For students who qualify for free or reduced price lunch, only the school week variable was significantly associated with lunch participation in a manner that would indicate the participation increased slightly as school week increased, but the estimated effect size is small and close to the null (OR = 1.02; CI = 1.01 – 1.03) such that we do not consider this an important finding.

Table 14. Factors associated with school lunch participation among students receiving free or reduced price school lunch*

Covariate	Levels of Covariate (Values)	Referent	OR	95% CI	p value
School	2 (1/2)	School 1	0.86	0.56, 1.33	0.50
Grade Level	4 (9-12)	n/a	1.05	0.86, 1.28	0.62
Gender	2 (0/1)	Female	1.16	0.77, 1.76	0.47
School week	20 (1-20)	n/a	1.02	1.01, 1.03	0.00

*Using events-of-trials logistic regression, adjusting for clustered residuals (by subject); Outcome = (# of lunches bought per week / # of school days per week); Federally reimbursable meals only; during the baseline period (20 wks) of 2014-15 school year at both School 1 and School 2.

**n (total observations) = 1000

5.4. Discussion

Nationally, school lunch food is healthier than ever, but school lunch participation is declining to record lows. Since lunch participation is particularly low at the high school level, it is important to understand the student-level characteristics that may be associated with lunch participation among high school students.

Following the school lunch participation of approximately 2300 high school students for most of an entire school year in two public high schools, we found that the strongest predictor of school lunch participation in this population is whether or not a student qualifies for free or reduced price lunch. In this sample, the high school students who qualify for free or reduced price lunch ate school lunch with 2.5 times the frequency of school lunch participators who pay regular price for school lunch. While students paying regular price for lunch exhibit lunch participation patterns that differ based on gender and grade level, students who qualify for free or reduced price lunch are much more likely to participate in school lunch, regardless of other demographic factors. The finding that school lunch participation depends so heavily on lunch paying status is consistent the findings of similar studies conducted with younger students.³³

Importantly, the observed lunch participation patterns in this study were very similar for both schools, even though one of the schools is almost twice the size of the other. This may be due to the fact that these two schools share the same corporate school food vendor and have identical lunch menus. Indeed, our formative work in this population found that the acceptability of the school lunch food is what students in these schools consider most when deciding whether or not to eat school lunch. What the finding of this particular aim suggests is that school lunch food is indeed the single largest school-level factor that affects participation such that the same food elicits remarkably similar overall lunch participation patterns, even in different schools.

For students who pay regular price for lunch, the finding that grade level is associated with lunch participation, such that those students in lower grades are more likely to participate than older students is also consistent with the findings of our formative work in this population for this project.⁵² This phenomenon is likely influenced by the open campus policy at both schools which allows 12th grade students to travel off campus during lunch. However, the finding that male students were significantly more likely than female students to eat school lunch was an unexpected finding. A potential explanation for this finding is that females in this age group may be more likely than males to sufficiently plan ahead to bring a lunch from home, as other studies

have demonstrated that female students of high school age and even younger are much more likely to plan ahead than their male counterparts⁵³. Still other research has suggested that adolescent girls are more likely to skip lunch than boys,⁴⁴ which may also help explain this finding. It is also possible that there may be gender differences in the stigma associated with school lunch participation, such that female students might be less likely to eat school lunch if they feel that the food is unhealthy, or otherwise socially unacceptable. Further research is needed to determine whether there are gender-based differences in the perception and acceptability of school lunch, and whether including some lunch options which appeal more to female students might be a strategy for improving school lunch participation. The fact that school week was not significantly associated with lunch participation suggests that overall lunch participation does not change over the school year.

5.4.1. Strengths, limitations, and implications for future research

To our knowledge, this is the first study that uses longitudinal, electronic school cafeteria transaction data to investigate the associations between student-level demographic variables and school lunch participation at the high school level. The use of this type of data to observe student-level school lunch behavior is novel and mitigates the biases that are inherent in self- or parent-reported school lunch paying status or lunch participation.

This study has a few limitations. First, the analysis assumes that each student's school assignment remains constant throughout the year, though students who moved out of one of the schools would likely be filtered due to high yearly absences recorded in one school or the other. Additionally, only the total yearly absences for each student is known, not the actual dates on which a student was absent. As such, it is possible that some students were excluded from analysis whose absences did not occur during the baseline period measured in this study. Additionally, since zeros were imported for unobserved reimbursable lunch purchases when the student did not appear in the cafeteria transaction dataset, it could be that the student was

actually absent on some of those days on which a non-participation was recorded, such that we are actually assuming a decision on the student's part when the student is not actually present at school. However, we think that this is unlikely to affect the results and that excluding students based on total yearly absences mitigates this limitation. Lastly, this analysis considers only the purchase of federally reimbursable meals. However, there are other ways in which a student can interact with the school lunch program at their school by purchasing entrees or side items ala carte, and it could be that students who appear to be non-participants in school lunch in this study actually do consume school lunch products without buying federally reimbursable meals. Lastly, this study shares the same limitation as each of the Taste Texting studies in that it was conducted in a relatively wealthy district as discussed above such that the findings may not translate to less-wealthy school districts. More research is needed to determine whether the participation patterns observed here exist in other contexts.

Though this is a relatively small pilot study, these findings may have implications for future research. For instance, the finding that school lunch participation does not change as the school year progresses may suggest that any interventions which aim to increase school lunch participation may need to begin early in the school year, since this study suggests that school lunch participation patterns are established early and do not vary with time.

CHAPTER 6: TASTE TEXTING IMPACT ON SCHOOL LUNCH PARTICIPATION

6.1. Introduction

Long lunch lines during short lunch periods make school lunch participation inconvenient, and one national study suggests that “time spent waiting in line” is a substantial barrier to school lunch participation at the high school level.^{14,15} To encourage overall high school lunch participation, we developed Taste Texting, a behavioral economics informed, web-based program that encourages school lunch participation by allowing students to pre-order school lunch and retrieve pre-ordered lunches from kiosks without having to wait in line. The current study is a pilot test of the Taste Texting program in two public high schools in North Carolina (n ~ 2300 students) and uses a multiple baselines study design and student-ID linked electronic cafeteria transaction data to determine whether usage of the Taste Texting program is associated with increased participation in school lunch.

6.2. Background

6.2.1. Summary of Formative Research Findings

As discussed in Chapter 4 above, the students in this study population emphasized that the taste of the food offered in school lunches was most important to them when deciding whether or not to buy school lunch (rather than the inconvenience of having to wait in line, or other factors) and students’ perceptions of school lunch food were overwhelmingly negative. Likewise, students initial reactions to the concept of a web-based school lunch pre-ordering program were largely negative. Ultimately, students expressed a disinterest in engaging with a school lunch pre-ordering program unless the food that is offered in school lunches was dramatically improved. However, when survey respondents were asked whether they would be

more willing to eat school lunch more often if they could pre-order their lunch and retrieve it without having to wait in line, 60% (across both schools) answered affirmatively. Focus group findings did not differ by school, but survey results differed by school in important ways. For instance, when asked to rate how important “Time spent waiting in line” was to their decision whether to eat school lunch, the students in School 1 rated this aspect as significantly more important on a 5-point Likert scale than the students at School 2 (Wilcoxon rank sum test comparing mean responses at each school; $p = 0.001$). Likewise, when asked to rate the current performance of their school lunch program on a variety of aspects, the survey respondents at School 1 rated the current “time spent waiting in line” aspect of their lunch experience significantly lower than did the survey respondents at School 2 ($p = 0.004$).

6.3. Methods

6.3.1. Study overview

The Taste Texting program was implemented in two public high schools in North Carolina in the Spring of 2015. These two schools share the same school district, the same corporate food vendor, have identical menus, and had similar baseline lunch participation rates.⁵⁰ The combined student population of both schools is approximately 2300 students. At each of these schools, the entire student body eats during a single 50-minute lunch period, which is thought to contribute to long cafeteria lines. Before implementing the Taste Texting program, we conducted formative research in the form of a series of focus groups in each of these schools to identify social norms, attitudes, and behaviors surrounding school lunch. The findings from these focus groups were then used to develop a pen-and-paper survey that was distributed during the lunch hour and completed by approximately 20% of the total student body at each school ($n \sim 440$). The full methods and results of this formative research may be found in Smith, et al (2016).⁵² Here, we briefly restate the most salient findings from that work.

6.3.2. Multiple baselines study design

This study employed a multiple baselines across subjects study design whereby each student in each of the schools was assigned to one of four groups. The 4 groups were as follows: Group 1 consisted of 11th and 12th grade students at School 1, Group 2 consisted of 9th and 10th grade students at School 1, Group 3 consisted of 11th and 12th grade students at School 2, and Group 4 consisted of 9th and 10th grade students at School 2. Program initiation was staggered by group, with an average of 2 weeks between group-specific program launches. Though the program began at different times for each group, the program ended on the same date for all groups, such that the total program duration was 12 weeks at School 1 and 10 weeks at School 2.

6.3.3. Program Registration

Taste Texting is a web-based program that students can use to preorder school lunch. Before using the Taste Texting program, each participant had to register for a free account using an email address and a password. To advertise the upcoming program launch and to incentivize program registration, two program registration drives were held at each school during the lunch hour before the program started. During these registration drives, school lunch personnel established a temporary kiosk in the school cafeteria with wifi-connected laptops and iPads and a smoothie bar. Students who registered for a free Taste Texting account during the registration drive were given a free 4oz fruit smoothie. All of the registration drives were held during the baseline period, advertised via each school's announcement system, and open to all students regardless of when the program would start for them. On the Taste Texting registration webpage, the student ID, email, and password fields were required, while optional data fields included grade, gender, and cell phone number.

6.3.4. How the program works

The Taste Texting program is a web-based program that requires an internet connection. Both schools have free wireless networks that are regularly used by all students while at school, and over 90% of the survey respondents at both schools indicated that they own web-enabled smartphones that they use to access the internet while at school on a daily basis.⁵² To use the Taste Texting program to pre-order lunch, a participant would sign into their Taste Texting account. Once signed in, they would select one entrée and fruit or vegetable side items. Lunch orders could only be placed one day at a time, and pre-orders were allowed between the hours of 4pm the previous day and 10am of the day the meal would be served. At each school, the full lunch menu was available for pre-order each day, and the lunch menu that was offered online via Taste Texting did not differ in any way from the lunches served in the cafeteria (i.e. no secret or special menus were involved). However, only federally reimbursable lunches were available for pre-order via the Taste Texting program, such that each pre-ordered lunch must consist of an entrée and at least fruit or vegetable side item. The program did allow a student to add various ala carte items such as drinks, chips, granola bars, cookies, etc for an additional fee per item – the same items were offered at the same price online as they were on the lunch line. Students were not charged via the Taste Texting website when they placed their order. Rather, they were charged when they retrieved their lunch from the kiosk. At both schools, preordered lunches were retrieved at a kiosk that was located just outside of the cafeteria to avoid long cafeteria lines

6.3.5. Program advertisements, prompts and incentives

When students registered for the Taste Texting program, they agreed to receive regular email updates from the program at the email address that they provided, but they could choose whether or not to submit their cell phone number. Students who did submit a cell phone number were required to check a box to opt-in to receiving regular text messages. Daily email and text

messages were sent to registered participants to prompt them to preorder lunch. The content of messages changed very little over the course of the program and explained how the program worked, identified the location(s) of the Taste Texting pick-up kiosk, and explained what the free-food incentive was for preordered lunches, if any (described below). Each message also included clickable links that directed the user to the program website to place their order. Generally, email messages were sent in the evening and text messages were sent in the morning after the school day had begun, but before the 10am deadline for pre-ordering lunch. Each email and text message included instructions for how to opt out of future messages should a participant wish to no longer receive program notifications.

The school lunch vendor incentivized program usage by offering free additional food items such as free chips, cookies, and drinks to users who pre-ordered lunches. The vendor also initiated a short-term promotion whereby students could earn 1 free lunch by referring 3 other students to the program. Advertising the program to non-registrants occurred through email blasts and announcements on the school intercom. Additionally, school lunch staff handed out small fliers advertising the preordering program to students who were buying school lunch in the usual manner. However, advertising the program to the entire student body using the main channels did not occur until the pre-ordering program was available for all students to use. No additional print media were created to advertise the program, nor was the program advertised on either school's social media outlets. This was due to formative research findings, which suggested that the students in these schools were averse to interacting with school officials on social media.⁵²

6.3.6. Analytical methods

In both of the schools included in this study, a student must either type in their student ID number or swipe their ID card any time they complete a purchase (including those receiving a free or reduced price meal) from the school cafeteria, such that a student ID number is

associated with each reimbursable lunch purchase. The result of these transactions is a student-ID linked cafeteria transaction data set that includes all of the transactions for each day of the entire 2014-15 school year. Because the cafeteria transaction dataset included only those students who ever purchased lunch from the school cafeteria, an additional dataset containing student ID numbers, grade, gender, lunch paying status, and total yearly absences for each student in both schools was furnished by the school district. This second, demographic dataset was merged with the cafeteria transaction dataset using student ID number as the unique identifier.

The goal of the Taste Texting program was to increase participation in school lunch as measured by purchases of federally reimbursable lunches which include an entrée, mandatory fruit and vegetable side items, and milk. As such, this analysis focuses solely on sales of reimbursable lunches to either full paying students or those qualifying for free or reduced-price meals. The student-ID linked cafeteria transaction dataset records a “1” for each school day that a student bought a reimbursable lunch. If a student appeared in the demographic dataset, but not in the transaction dataset for a given school day, then a zero was imported for that student’s reimbursable lunch purchase on that day. To construct the outcome variable for this study, the number of reimbursable lunches that each student bought in any given school week was divided by the number of days in the week. This yields a weekly lunch participation proportion, ranging from 0 to 1, that quantifies the percentage of the week that each student bought school lunch. For instance if a student ate school lunch on 3 days of a school week that contained 5 days, then their school lunch participation portion for that week would be $3/5$ or 0.6. To determine whether Taste Texting program participation was associated with an increase in school lunch participation among registered users, we measured each user’s weekly lunch participation proportion for 8 weeks before each Taste Texting user placed their first order with the program. We then calculated their lunch participation proportion for 4, 6, and 8 weeks after their first order. Using Wilcoxon sign rank tests, we compared each user’s school lunch

participation at 4, 6, and 8-weeks after they began using the Taste Texting program to their 8 week average school lunch participation before they began using their program. These comparisons were stratified according to levels of program usage as determined by the number of total Taste Texting lunch orders placed during the program period. For Taste Texting users who registered for but never used the program, we calculated their mean school lunch participation for the 8 weeks prior to the school week in which the program started for their group. Wilcoxon sign rank tests were used to examine the 4-, 6-, and 8-week changes in lunch participation, and any observed changes were deemed statistically significant at an alpha equal to or less than 0.05.

All research methods used in this study were approved by the Institutional Review Board at UNC Chapel Hill and by the participating school district.

6.4. Results

6.4.1. Taste Texting Program Overview

Consistent with a multiple baselines across subjects study design, the Taste Texting program launch dates differed for each of the 4 groups (2 groups/school). Since the program end date was the same for all groups, each group experienced a different number of total program days. At School 1, Group 1 experienced a total of 63 program days, while Group 2 experienced 55 total program days. At School 2, Group 3 experienced a total of 53 program days while Group 4 experienced 38 program days.

6.4.2. Program Registration

A total of 99 students registered for a Taste Texting account at each school, which represents 7% of the total student body at School 1 and 11% of the total student body at School 2. At School 1, 44% of program registrants signed up during the baseline phase, and 41% of all program registrants signed up on a smoothie registration day. At School 2, 70% of all users signed up during the baseline period, mainly on a smoothie registration day. Table 1

summarizes the demographic characteristics of all program registrants. At both schools, the majority of the program registrants were 11th and 12th grade students and program registrants were relatively equally split between genders, though School 2 had a slightly more female registrants (57% female). At both schools, 64% the students who signed up to use the Taste Texting program were students who pay regular price for school lunch. At School 1, 55% of the students who signed up to use the program gave a cell phone number and agreed to receive regular text messages from the program, compared to 37% at School 2.

To determine whether the program registrants were students who were already eating school lunch, we analyzed the lunch purchasing activity of program registrants during 4 weeks before each user registered a Taste Texting account (see Table 3). At School 1, 21 of the 99 program registrants had not eaten school lunch at all during the 4 weeks prior to establishing a Taste Texting account. Of those School 1 students who did buy lunch in the 4 weeks prior to registering for Taste Texting, 37% ate lunch less than 3 days per week, while 41% ate lunch 3-5 days per week. At School 2, 36 of the 99 program registrants did not buy lunch at all during the 4 weeks prior to their program registration, 35/99 bought lunch fewer than 3 days per week, and 28/99 bought lunch 3-5 days per week.

Table 15. Demographic characteristics and baseline lunch participation* of program registrants.

DEMOGRAPHIC VARIABLE	SCHOOL 1	SCHOOL 2
Gender	N (%)	N (%)
Female	49	57
Male	50	42
Grade		
9	18	21
10	15	23
11	28	32
12	38	23
Lunch Paying Status		
Free/Reduced	32	34
Full Price	64	64
Missing	3	1
Mean lunch participation prior to program registration*		
Never	21	36
Less than 1 day/week	11	18
1 to <2 days per week	12	7
2 to <3 days per week	14	10
3 to <4 days per week	14	10
4-5 days per week	27	18
TOTAL	99	99

*Lunch participation = (number of reimbursable lunches bought in a week / number of school days in that week)

**Calculated from student ID linked cafeteria transaction data for the 4-week period prior to program registration

Once the program was open to all students at a school, announcements about the program were made over the intercom and email messages, which included a clickable link to register an account with the program, were sent to the entire student body at each school multiple times. Fifty-six percent of the program registrants at School 1 and 28% of the users at School 2 registered after the program began at their school.

6.4.3. Program Usage

During the 63 days of program operation at School 1, a total of 462 Taste Texting lunches were sold, averaging 7.3 orders per program day (range 0-17) and 2 program days with

zero orders. The maximum number of Taste Texting orders at School 1 in a single day was 17, which represents 6.4% of the total average daily lunches sold at School 1 during the program period. At School 2, the program operated for 53 days, during which 72 Taste Texting orders were sold, averaging of 1.4 Taste Texting orders per day (range: 0-9). At School 2, there were 25 program days with zero Taste Texting orders (47% of program days). The largest number of Taste Texting orders sold in a single day was 9, which represents 5.8% of the total daily lunches at School 2.

At both schools, a large proportion of the students who registered an account with Taste Texting never used the program to pre-order lunch during the program period, though this was significantly more pronounced at School 2 (see Table 2). At School 1, 51% of registered Taste Texting users never used the program to pre-order lunch, and another 11% of the registered users utilized the program just once. At School 2, 82% of the registered users never used the program, and another 5% used the program to pre-order lunch just once. Though a majority of the program registrants at both schools were upperclassmen, these upperclassmen were least likely to use the program at School 1, where 54% of the juniors and 63% of the seniors who signed up for the program did not use it. At School 1, the total number of pre-ordered lunches bought by an individual during the program period ranged from 0 to 53; At School 2, it ranged from 0 to 11. At School 1, the 49 users who used the program 1 or more times placed an average of 9.5 Taste Texting orders each (sd = 11, median = 6). At School 2, the 17 users who used the program 1 or more times placed an average of 4 Taste Texting orders each (SD = 3.3, median = 3)

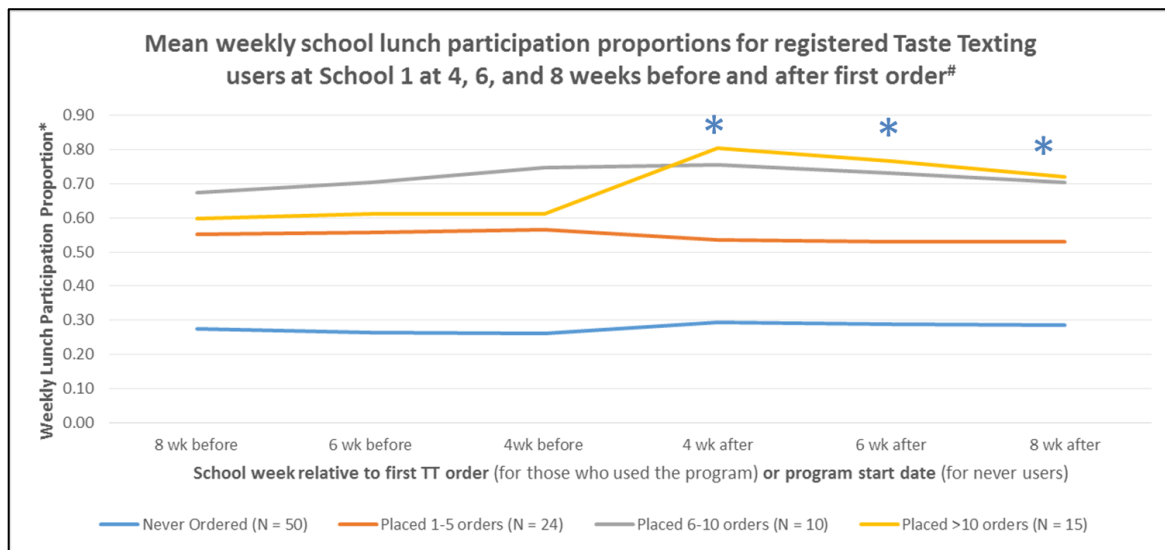
6.4.4. Program impact

Though there were a very small number of program users who used the program to pre-order lunch when they had not previously been eating school lunch, the vast majority of program users were students who had been eating school lunch before the program launched. In School

1, the students who used the Taste Texting program to order lunch at least once during the program period had been eating school lunch an average of 60% of the time (or 3 days/week) in the 4 weeks before the program launched. Likewise, in School 2, the registered users who actually used the program at least once had been eating school lunch an average of 54% of the time before (2-3 days/week) before the program launched in their school.

Figures 1 and 2 below present the 4-, 6-, and 8-week changes in lunch participation proportion for users in each usage category at School 1 and School 2, respectively.

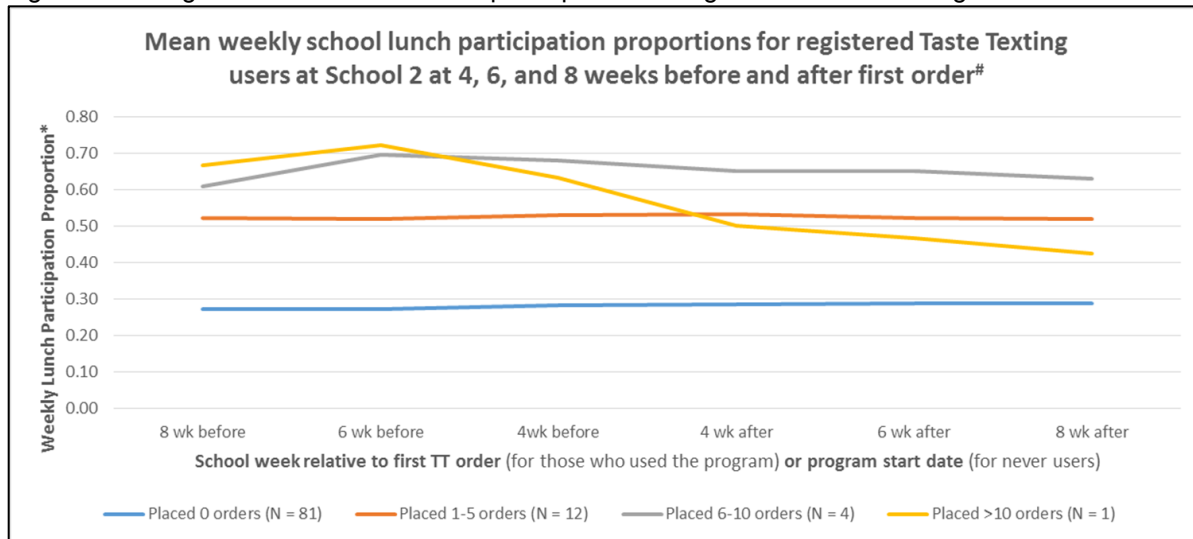
Figure 1. Changes in mean school lunch participation for registered Taste Texting users at School 1.



*Lunch participation = (number of reimbursable lunches bought in a week / number of school days in that week) **For users who registered for the Taste Texting program but never used it, this graph compares mean lunch participation relative to the school week in which the program started for their group in their school.

The observed changes in lunch participation proportion were non-significant for users in the first 3 usage categories. However, the students at School 1 who used the program the most (placing >10 Taste Texting orders) significantly increased their lunch participation proportion by 12% once they began using the program ($p = 0.04$).

Figure 2. Changes in mean school lunch participation for registered Taste Texting users at School 2.



*Lunch participation = (number of reimbursable lunches bought in a week / number of school days in that week)

**For users who registered for the Taste Texting program but never used it, this graph compares mean lunch participation relative to the school week in which the program started for their group in their school.

The heaviest program users in School 2 (n = 5) exhibited slightly decreased lunch participation during the program period, but no statistically significant changes in pre/post school lunch participation were observed for program users at School 2.

6.4.4.1 Characteristics of heavy users at School 1

Participation in Taste Texting was associated with significantly increased school lunch participation at 4-, 6-, and 8-weeks post initial order for the heaviest users at School 1, which represent 15% of the registered Taste Texting users at School 1. These heavy users were entirely female, 33% of them were sophomores, 33% were seniors, and 60% of them (N = 9) are those who pay regular price for lunch. The majority of them (73%) registered for the program during the program period and as a whole, these heavy users exhibited the shortest time lapse between registration and first order with a mean of 2.1 weeks. Lastly, as can be seen in Figure 1, the heaviest users at School 1 were not those who were exhibiting the highest

school lunch participation prior to program implementation, relative to students who used the program less often.

6.4.4.2 Average percentage of pre-ordered lunches

Students who used the Taste Texting program to order lunch were not mandated to use the pre-ordering program for every lunch purchase that they made. On any day during the program period, it was possible for a student to either pre-order lunch and skip the line or stand in line to order lunch. Therefore, we examined the total number of reimbursable lunches that all registered users ordered, and quantified the percentage of those that were placed with Taste Texting. The 50 program users in School 1 bought an average of 36% of their reimbursable lunches with Taste Texting during the program period (sd = 31%, range: 1-100%). The 17 users in School 2 who used the program bought 31% of their school lunches using the program (sd = 33%; range: 3-100%) during the program period. The percentage of reimbursable lunches that a user bought with Taste Texting increased as the users who placed the highest total number of Taste Texting orders increased (see Table 16).

Table 16. Mean percentage of lunches* pre-ordered during the program period.

PROGRAM USAGE	SCHOOL 1			SCHOOL 2		
	N	Percentage of lunches that were pre-ordered	sd	N	Percentage of lunches that were pre-ordered	sd
Placed 1-5 orders	24	25%	33%	12	28%	35%
Placed 6-10 orders	10	27%	18%	4	36%	34%
Placed >10 orders	15	61%	21%	1	43%	.

*Calculated as follows: (number of lunches bought with Taste Texting / total number of reimbursable lunches bought during the program period)

Since 51% of the program registrants at School 1 and 83% of the registered users at School 2 did not use the program to order lunch at all during the program period, we examined whether these students were still eating school lunch even though they were not using the Taste Texting program to order school lunch. We found that at School 1, 36% of these registered non-users did not buy a reimbursable lunch during the program period, but 64% of them did buy reimbursable lunches an average of 43% of the time during the program period. Similarly, at School 2, 35% of the 82 people who never used the program did not buy lunch at all during the program period, but 65% of them did buy lunch an average of 43% of the time during the program period, or about 2 days per week.

6.5. Discussion

Some research has suggested that the time that students spend waiting in cafeteria lines is a major barrier to school lunch participation, especially at the high school level. The Taste Texting program was designed to increase overall participation in school lunch by allowing students to skip lunch lines entirely if they preordered lunch. What we found by implementing this program for 8-12 weeks in two public high schools with approximately 2300 students is that interest in the program was tepid. Only a small percentage of the student body signed up for the program, and a majority of the students who registered either never used the program or only used it one time. Though program usage was associated with an increase in lunch participation for the heaviest users in School 1, this result is qualified by the fact that even those

heavy users of the program did not use the program to buy 100% of their school lunches during the program period. Instead, those heavy users pre-ordered an average of 60% of their school lunches – the remaining 40% of the time, they bought their lunch the conventional way. Indeed, students across all usage categories – from the students who signed up for the program but never used it to the students who used the program the most – were still buying school lunch with some regularity, but not using the Taste Texting program to do it.

There are a number of potential explanations for these results. The most likely explanation is that the convenience of pre-ordering lunch and skipping lunch lines was likely insufficient to overcome the greatest barrier to school lunch participation, which is the students' negative perceptions of school lunch food. Indeed, as discussed in Chapter 4, our formative research demonstrated that students in these high schools view the food offered in school lunches to be unappetizing and undesirable. Though 60% of the ~440 students (across both schools) who completed our formative research survey answered that they would eat school lunch more often if they could pre-order it and retrieve it without having to wait in line, many of the focus group participants indicated that a lunch pre-ordering program would not encourage school lunch participation unless there was a dramatic improvement in school lunch food.⁵²

Though the schools included in this study differed significantly by size, their baseline lunch participation patterns were remarkably similar, as noted in Chapter 5 above.⁵⁰ Nonetheless, Taste Texting program uptake in School 2 was significantly less than it was in School 1. In School 2, almost 9 out of every 10 students who registered for the program either never used the program or only used it once. One potential explanation for this observed disparity could be that, according to our formative research, time spent waiting in line was more of a perceived barrier to school lunch participation for students at School 1 relative to School 2.⁵²

6.5.1. Strengths, limitations, and implications for future research

This study does have a few limitations. This analysis does not consider absences, and assumes that school assignment remained constant throughout the school year. As such, it is possible that some of the observed low program usage could be attributed to absences or students who moved schools after registering for the program. Additionally, we did not conduct any message testing for program advertisements (either via text or email), nor did we conduct any advertising via print. It may be that some carefully tested messages in electronic and paper form may help improve program uptake. Furthermore, during informal post-program discussions about the program, some students indicated that they do not mind standing in lunch lines, as time spent waiting in line offers a chance to socialize with friends, to see what is being offered for lunch (the Taste Texting program website presented the menu in text with no pictures) and to change their mind about what to have for lunch right up until the time at which they take their food from the line. Additionally, some students suggested that by the time the program launched (mid-Spring semester), students had already established their school lunch ordering patterns and were less likely to change them so late in the school year. This feedback is supported by our AIM 2 results in Chapter 5 above which indicate that both school-wide and individual level lunch participation patterns did not vary over time during the baseline period. Perhaps beginning the program at the start of the school year would allow students to incorporate the pre-ordering program into their daily routine.

This study provides some limited evidence that the Taste Texting program may modestly improve overall lunch participation for those students who use the program the most. Furthermore, the findings from this aim suggest that those whose lunch participation was significantly improved by participation in the program are those who, according to our AIM 2 findings presented in Chapter 5 above, are least likely to participate in school lunch: female, older than 9th grade, and mostly paying regular price for lunch. However, the number of heavy users is small, and their program usage is still relatively tepid, such that further research is

needed to determine whether the benefits of the Taste Texting program justify its costs. In particular, it would be beneficial to pilot test the program in a school(s) with higher overall participation rates than either of these schools, to begin the program sooner in the school year, and perhaps test different incentives for program usage. Additionally, further research with high school students may be needed to help determine what aspects of the program could be modified to encourage participation.

CHAPTER 7: SUMMARY OF FINDINGS

In summary, we believe that this study makes the following observations about school lunch participation among high school students, and we offer the following lessons learned:

7.1. Student perception of school lunch food the largest barrier to participation

In AIM 1 (Chapter 4), our focus group and survey results indicate that student perception of school food is the most important barrier to school lunch participation, and that this finding is irrespective of school. This finding is further supported by results from AIM 2 in which we found that both schools, though they differ importantly in size and culture, exhibit remarkably similar school-wide lunch participation patterns as indicated by both the findings from the exploratory data analysis offered and the regression analyses in AIM 2 which found that school assignment was not a significant predictor of school lunch participation over time. We think that the remarkably similar school-wide participation rates at both schools is attributable to the fact that both schools have identical daily lunch menus, such that the same food elicits the same overall school lunch participation, even among different schools – this just further underscores the importance of student perception of school food quality in school lunch participation.

Secondarily, we found some evidence suggesting that students primarily encounter school lunch visually, and hypothesize that some of the tepid Taste Texting uptake noticed in AIM 3 was due to the fact that if a student stands in line to receive lunch s/he is able to visually encounter the food and/or watch the food be assembled, both of which may be important influences on school lunch participation. Lastly, in AIM 1 we found that high school students, without prompting, naturally compare the food that is offered in school lunch to the food which

they access at restaurants, and that their favorite restaurants are national, heavily-branded chains such as Subway, Chipotle, and Chick-Fil-A.

As much as they are able, future interventions that seek to improve school lunch participation should measure and seek to affect student perception of school lunch food, either by changing menu items, presenting the menu in appealing ways (with appetizing photos or descriptions) or by preparing as much of the food “on the line” as possible. This last recommendation to assemble as much of the food on the line as possible may accomplish a few desirable objectives: 1) It may encourage the use of fresh ingredients, and 2) It may replicate the restaurant experience for high school students whose preference for national restaurant chains like Subway and Chipotle may be due in part to the experience of having one’s food assembled immediately and to exact specifications, and 3) It may combat the common perception (as described in AIM 1) that school lunch food is “mysterious” and “not fresh”

However, in schools with high overall lunch participation at baseline, preparing additional food on the line may exacerbate time spent waiting in line.

7.2. School lunch paying status is most important predictor.

In AIM 1, we found that high school students in this sample view lunches brought from home as the preferred lunch option, and school lunch as sad alternative to the default that one chooses only as a “last resort”. This finding is underscored by AIM 2 results, which indicate that receiving free or reduced price lunch is very strongly associated with school lunch participation, and that the mean school lunch participation among students who receive free or reduced price lunch is over 2x as frequent as school lunch participation among students who pay regular price for lunch. These results suggest that school lunch is chosen most often by students who need it most, and largely left by students who can afford to not eat it, a finding which agrees with a recent report by the Government Accountability Office (GAO) which found that overall school lunch participation is declining at the high school level, and that this decline is

Secondarily, we found that among students who pay full price for lunch, males and those in lower grades are more likely to participate. We hypothesize that the finding that school lunch participation is related to grade level may be due in part to the open campus policy that exists in this district, which allows seniors to travel off campus for lunch.

As stated many times previously, our findings were observed in a local school district that is wealthy relative to both the rest of the state and the nation. As such, additional, more nationally representative, research is necessary to determine whether these findings are true in other contexts. If so, we recommend additional research that focuses on high school girls, particularly those who pay regular price for school lunch, and their perceptions and concerns about school lunch in an effort to identify intervention targets for programs that may encourage them to participate in school lunch. Additionally, in order to increase overall school lunch participation, we recommend revoking open campus policies. Furthermore, since our findings suggest that a stigma surrounding school lunch is operative at a high school level, we strongly recommend that school lunch programs install electronic point-of-sale (POS) systems that allow students who receive free and reduced price lunch to purchase lunch in a similar manner to students who pay regular price for lunch.

Lastly, we echo the growing body of investigators who suggest that school lunch programs consider offering school lunch to all students free of charge, perhaps by taking advantage of the Community Eligibility standard made possible by the Healthy Hunger Free kids Act. Free lunch for all likely eliminates social stigma associated with receiving free or reduced price lunch and would likely have an immediate and substantial impact on school lunch participation.

7.3. Participation patterns are stable throughout the school year.

Our regression analyses in AIM 2, we found that lunch participation did not vary over time, suggesting that lunch participation patterns that are established early and maintained

throughout the school year. This finding was underscored by some of the post-program feedback that we received from students in which it was mentioned that the pre-ordering program may have been more successful if it had launched earlier in the school year, as students may have been more inclined to make it part of their routine.

School lunch interventions should consider implementing their programs at the start of the school year when new routines are likely forming. In this way, school lunch interventions may be more readily incorporated into students' daily lunch routines and thus become part of the collective normal practice.

7.4. Time spent waiting a poor intervention target.

As mentioned previously, the largest factors affecting school lunch participation at the high school level are school lunch paying status and student perception of school lunch food. Though this study does provide some evidence that a pre-ordering program does increase school lunch participation for the heaviest users, it may be that time spent waiting in line is not a significant enough issue to serve as an intervention target in this or other contexts. Our findings from AIM 1 hint at this. In AIM 1, we found that time spent waiting in line was more of a perceived problem for students in the larger school (School 1) than for students in the smaller school, a fact which we think explains the lack of program adoption in the smaller school. This may be due to a) time spent waiting in line at baseline is not inconvenient enough to encourage the adoption of a new system for accomplishing the same behavior (i.e. ordering lunch) or b) the adoption of a new system for ordering lunch does not produce a measurable improvement on time spent waiting in line, or c) both may be true. In this study, our process evaluation suggests that both the time spent waiting in line was insufficient enough to be sufficiently inconvenient (ha!) and that use of the Taste Texting resulted in minimal time savings relative to standing in line to order school lunch.

As mentioned previously, the context for this study is two schools with very low percentages of the student body qualifying for free or reduced price lunch (relative to the state and the nation) and correspondingly low baseline lunch participation overall. Consequently, it is possible that time spent waiting in line is not a significant issue in this context, but it still may be a significant issue in other contexts, especially schools with higher percentage of students who qualify for free or reduced price lunch and higher overall. For future studies, we recommend that if time spent waiting in line is chosen as the primary intervention target, investigators should measure the percentage of the student body at the study sites that receive free and reduced price lunch, the overall school lunch participation rate at baseline, and should time the lines before beginning formative research and study design.

7.5. Preordering program may increase school lunch participation for some

In AIM 3, we found that Taste Texting program engagement did significantly increase overall school lunch participation for the heaviest users at School 1, and that those heavy users are those who, according to our AIM 2 findings, are precisely the types of students who are less likely to buy lunch: females, non-freshman, and many who pay regular price for lunch). Since the Taste Texting program changed nothing about the school lunch experience except for time spent waiting in line (students were offered the same food) this suggests that affecting time spent waiting in line is sufficient to improve the school lunch participation among the unlikeliest participants. This finding suggests that the concept of a pre-ordering program may still have merit, especially if it can be inexpensively implemented.

7.6. Study Strengths and Limitations

In its use of rigorous mixed methods, student ID linked cafeteria transaction data, behavioral economics and mobile health, this study is unique and innovative. The sum of these studies is, to our knowledge, the most comprehensive investigation into perceptions of school

lunch and perceived barriers to participation among high school students to date and the first intervention to increase overall school lunch participation at the high school level.

However, this study has a few key limitations. First, the intervention described in AIM 3 (Chapter 6) was not designed to address what we found in AIM 1 to be the largest barrier to school lunch participation in this population: student perception of school lunch food. Additionally, this study does not assess the usual lunch choices of non-school lunch participants, such that we are unable to determine whether school lunch is truly healthier than any lunch alternatives chosen by this population. Lastly, all of this research was conducted in a uniquely wealthy school district, such that these findings may not translate to other contexts.

7.7. Conclusion

Low high school lunch participation is a challenge that affects both students and school food operators. Low high school lunch participation means that students are missing an important contribution to a healthy diet, school lunch is further stigmatized, and that school food operators are struggling to comply with federal nutrition mandates that are expensive to implement, especially amid declining participation. This pilot study, including its findings, lessons learned, and recommendations for future research, is an important step in identifying a scalable solution that could benefit both school food operators and the students they serve.

APPENDIX 1: FOCUS GROUP DISCUSSION GUIDE

Introduction/Purpose statement

Thanks for being here today! My name is Tosha and this is (introduce the helpers) and we're from UNC Chapel Hill. We are here to discuss school lunch here at (insert name of high school). We want to hear from you how school lunch can be improved and how we can encourage more students to participate in school lunch.

We will be taking notes and tape recording today's session. We are recording the group discussion today because we don't want to miss any of your comments. At the end of today's session, we can turn off the recorder if you want to share some comments off the record.

This discussion is confidential, which means that no one outside of this room knows who is participating in these focus groups, and we won't share any of your answers or thoughts with anyone outside of the research team at UNC. We are conducting several of these types of discussions at your school and at other schools. Later, when the other researchers and I examine the responses to each of the questions that we ask today, we will group all of your comments together so that no one will be able to tell who said what. We also ask you not to share what other participants said after this sessions is over.

When I ask questions, you all are welcome to respond however you like, but please speak one at a time so that we can make sure we get all of your comments. If you could state your number whenever you speak up (give example) that would help. There are no right or wrong answers – we really want to know what you think! If you disagree with what others are saying, please speak up – we really like to hear all points of view.

The discussion will last approximately one hour today. Any questions before we get started?

With your permission, I will now start the recorders.

I'd like to begin with a warm up question, so I'll go around the room and ask each of you to say your first name (it can be real or fake) and tell us what your absolute favorite food is.

Great! Thanks! Let's get started with some questions about school lunch.

Focus Group Questions

1. When you think of school lunch here, what words come to mind?
2. Let's say there is a new student who you are taking to the cafeteria for the first time. What would the person see when she gets to the cafeteria for lunch?
What would you need to explain to her so she can understand how lunch at this school works?
3. What do you think are some of the reasons why students might or might not buy school lunch?

4. If the students here don't eat school lunch, what do they eat instead?
 - a. Probes:
 - i. Are there other ways to get food at school besides buying school lunch? What are those and why might a student use them?
 - ii. Why might some students leave campus for lunch rather than buy lunch at school?
 - iii. Why might some students bring lunch from home rather than buy lunch at school?
5. If I understand correctly, your lunch period here is about 45 minutes long. How do you think most kids at your school use that lunch period?
 - a. Probe(s)
 - i. Besides eating lunch, what are other things you might do during the lunch period?
6. What is one thing that you would do to improve school lunch?
7. If you had designed a new and improved school lunch program, how would you convince your fellow students to try it?
 - a. How would you incentivize them to try it for the first time?
 - b. How would you incentivize them to continue to try it?
 - c. How could you communicate with all the students in your school at once?
Which social media sites or groups would you use to advertise your school lunch improvement project?

APPENDIX 2: BASELINE SURVEY (AIM 1)

Researchers from UNC Chapel Hill are collaborating with Chartwells, Inc, the company that provides school lunch here on campus to learn what students think about school lunch. This research is supported by the University of North Carolina at Chapel Hill. Researchers at UNC Chapel Hill and Research Triangle International (RTI) have partnered with Chartwells for the evaluation of a school lunch pre-ordering system. The partnership between UNC Chapel Hill, Chartwells, and RTI does not affect your participation in the study.

Completing this survey is voluntary and you may skip any question. There are no right or wrong answers to these questions; we want to know what you really think. This survey should take 5-7 minutes to complete. By filling out this survey, you give us permission to use your answers for research purposes. However, your answers will be confidential – your individual answers will not be shared with anyone.

By completing this survey, you will be entered into a drawing to win one of ten \$25 Amazon gift cards. Your contact information will not be shared with anyone – it will only be used to contact you in case you win one of the Amazon gift cards.

If you have any questions, feel free to contact the Tosha Smith at UNC Chapel Hill by emailing tosha@unc.edu or calling 980-320-0655 or the Institutional Review Board (IRB) at UNC Chapel Hill by calling 919-966-3113 and ask about research study number 14-1727.

1. With which gender do you most identify? (please check one)

- Male
- Female

2. Which of the following represents your racial or ethnic heritage? (check all that apply)

- African American or Black
- Asian
- Latina/Latino American or Hispanic
- Middle Eastern
- Native American or Alaskan Native
- White
- Other: _____

3. What grade are you in this year?

- 9th
- 10th
- 11th
- 12th

4. During the current school year, how many times per week do you normally eat school

lunch?

- Everyday
- 3-4 days/week
- 1-2 days/week
- Never

5. If you DO normally eat school lunch (1-5 times per week), what is the #1 reason why you eat school lunch?

6. If you DO NOT normally eat school lunch, what is the #1 reason why you do not eat school lunch?

7. When you think about school lunch, how important are each of the following aspects to you?

7a. Healthfulness of the food

(5 = Very important; 4 = Somewhat important; 3 = Neither important nor unimportant, 2 = Somewhat unimportant; 1 = Not important at all)

1 2 3 4 5

7b. Taste of the food

(5 = Very important; 4 = Somewhat important; 3 = Neither important nor unimportant, 2 = Somewhat unimportant; 1 = Not important at all)

1 2 3 4 5

7c. Appearance of the food

(5 = Very important; 4 = Somewhat important; 3 = Neither important nor unimportant, 2 = Somewhat unimportant; 1 = Not important at all)

1 2 3 4 5

7d. Variety of the food

(5 = Very important; 4 = Somewhat important; 3 = Neither important nor unimportant, 2 = Somewhat unimportant; 1 = Not important at all)

1 2 3 4 5

7e. Time spent waiting in line

(5 = Very important; 4 = Somewhat important; 3 = Neither important nor unimportant, 2 = Somewhat unimportant; 1 = Not important at all)

1 2 3 4 5

7f. Price of the food

(5 = Very important; 4 = Somewhat important; 3 = Neither important nor unimportant, 2 = Somewhat unimportant; 1 = Not important at all)

1 2 3 4 5

7g. Friendliness of school lunch staff

(5 = Very important; 4 = Somewhat important; 3 = Neither important nor unimportant, 2 = Somewhat unimportant; 1 = Not important at all)

1 2 3 4 5

7h. Atmosphere in the cafeteria

(5 = Very important; 4 = Somewhat important; 3 = Neither important nor unimportant, 2 = Somewhat unimportant; 1 = Not important at all)

1 2 3 4 5

8. Please rate the CURRENT STATE OF SCHOOL LUNCH at your school in each of the following areas:

8a. Healthfulness of the food

(5 = Excellent; 4= Good; 3= Average; 2= Below Average; 1= Poor)

1 2 3 4 5

8b. Taste of the food

(5 = Excellent; 4= Good; 3= Average; 2= Below Average; 1= Poor)

1 2 3 4 5

8c. Appearance of the food

(5 = Excellent; 4= Good; 3= Average; 2= Below Average; 1= Poor)

1 2 3 4 5

8d. Variety of the food (please circle your response)

(5 = Excellent; 4= Good; 3= Average; 2= Below Average; 1= Poor)

1 2 3 4

11d. I bring lunch from home

(1 = Often; 2 = Sometimes; 3 = Rarely; 4 = Never)

1 2 3 4

11e. My parents drop lunch off to me at school

(1 = Often; 2 = Sometimes; 3 = Rarely; 4 = Never)

1 2 3 4

11f. Seniors bring me food from off campus

(1 = Often; 2 = Sometimes; 3 = Rarely; 4 = Never)

1 2 3 4

11g. I don't eat lunch

(1 = Often; 2 = Sometimes; 3 = Rarely; 4 = Never)

1 2 3 4

11h. I snack during classes rather than eating lunch

(1 = Often; 2 = Sometimes; 3 = Rarely; 4 = Never)

1 2 3 4

12. Do you know who to go to with your suggestions and complaints about school lunch?

Yes

No

15. How do you normally hear about events that are happening at school? (please check all that apply)

- Announcements read over the intercom
- Announcements on the website
- Flyers and posters posted around school
- The school's official social media accounts (Facebook, Twitter, etc)
- Your parents tell you
- Other: _____

16. What is the PRIMARY way that you hear about events that are happening at school? (please check just one)

- Announcements read over the intercom
- Announcements on the website
- Flyers
- The school's official social media accounts (Facebook, Twitter, etc)
- Your parents tell you
- Other: _____

17. Which of the following social media networks do you currently use? (please check all that apply):

- Facebook
- Twitter
- Instagram
- Tumblr
- Google+
- Vine
- Reddit
- Other: _____
- Other: _____

18. Which social network do you use the most often?

19. What most catches your attention on social media networks?

- Photos
- Videos
- Advertisements
- Buzzfeed/links to articles

20. How often do you interact with East Chapel Hill High School or school clubs on social media networks?

(1 = Often; 2 = Sometimes; 3 = Rarely; 4 = Never)

1

2

3

4

21. Would you be interested in following East Chapel Hill High School or Chartwells (the school lunch company) on either Facebook or Twitter if you received coupons and/or menu information on from their Facebook or Twitter accounts?

- YES
- NO

22. Are there any other thoughts about school lunch at your school that you'd like to share with us? If so, please write them below:

23. Do you have a cell phone?

YES

NO

24. If the answer to Question 00 above is "YES" If you use your cell phone to access the internet, what kind of data plan do you have on your phone?

YES

NO

Doesn't apply (I don't have a cell phone)

25. How often do you use your cell phone at school?

Everyday

3-5 days per week

1-2 days per week

Never

26. What is the best way to contact you if you win one of the \$25 Amazon gift cards (please write legibly). Remember, we will not share this information with anyone. It will only be used to contact you if you win.

Email address: _____

Cell phone number: _____

APPENDIX 3: SAMPLE STATA CODE FOR AIM 2 ANALYSES

```
****STATA CODE FOR REGRESSION MODELING OF STUDENT-LEVEL SOCIOECONOMIC FACTORS ON SCHOOL LUNCH PARTICIPATION****

*OUTCOME = reimburse_wk_prop (the proportion of the school week that each student bought reimbursable school lunch)
*each subject id has a subject-specific value

*COVARIATES = add these variables in this order (each of these is subject specific)
*eds ("economically disadvantaged student; =0 if pays regular price for lunch, =1 if free OR reduced lunch)
*school (value of 1 or 2)
*grade (9-12)
*gender (=0 if female, =1 if male)
*sch_wk (weeks 1-20 as this is baseline only)

*If you use the "logit" command, it reports log odds
*If you use "logistic" it reports odds ratios

*vce(cluster id) adjusts for repeated observations on the same subjects (telling Stata that the residuals cluster by id, which is the subject indicator)

*We're only going to include observations in which sch_wk <= 20 & ab_censor == 0
*ab_censor is the variable that we constructed to filter out the kids who missed too much school

*Coding interaction terms for regression:
**Put a pound sign in between the variables that you want to interact
***Must tell Stata if they are continuous or categorical with a prefix just before the variable

logistic reimburse_wk_prop if sch_wk <= 20 & ab_censor == 0, vce(cluster id)

logistic reimburse_wk_prop eds if sch_wk <= 20 & ab_censor == 0, vce(cluster id)


logistic reimburse_wk_prop eds school if sch_wk <= 20 & ab_censor == 0, vce(cluster id)

logistic reimburse_wk_prop eds grade if sch_wk <= 20 & ab_censor == 0, vce(cluster id)

logistic reimburse_wk_prop eds grade gender i.eds#i.school if sch_wk <= 20 & ab_censor == 0, vce(cluster id)
```

APPENDIX 4: EXAMPLE TASTE TEXTING* USER INTERFACES

Figure 3. Example daily email announcement



Order lunch now and pick up with no waiting!

Pre-order lunch now and pick up at the station by the stairs - skip the cafeteria entirely!

Your lunch is made to order, and the entire menu is available for pre-order, except hot deli sandwiches.

Here's how it works:

1. Go to carrboro.101lunch.com to place your order for tomorrow.
2. Pick it up at the station near the stairs at the time that you choose.



That's it! Order all the way up to 10am for that day's lunch.

If you have any questions, suggestions or experience any difficulty ordering, please email us at k12support@area101.com, or you can talk to Lakeshia or Lashunda in the Cafe.

[Click Here to Order Now!](#)

*In each of these schools, the Taste Texting program was branded as "Lunch101"

Figure 4. Post login landing page (entrée selection)



Step 1:

Choose meal period for Thursday - May 21,2015 until 10:00 AM

Meal Period: 12:20 PM ▾

Step 2:

Choose your lunch

Entree

Teriyaki Chicken with Brown Rice	Turkey Hotdog on Bun	Toasted Cheese & Bacon Sandwich	Hawaiian Pizza
Chicken Fajita Salad	Grilled Chicken Caesar Salad	Cheese Pizza	Turkey & Cheese Sub



Figure 5. Fruit/vegetable side item, beverage, and add on selection page

iPad 4:03 PM 99%

east.101lunch.com

Online Survey Software | Qualtrics Survey Solutions ViewItem

Welcome, [Jermaine Chance](#) | [Logout](#)



Step 3:

Choose your lunch preferences

Teriyaki Chicken with Brown Rice

Choose At Least 1 Fruit Or Veggie Thursday

- Seasoned Northern Beans
- Baked Sweet Potato
- Fresh Steamed Broccoli
- Caesar Side Salad
- Sweet Potato Salad
- Potato Wedges
- Apple
- Chilled Pears

Milk

- 1% White
- Skim White
- Skim Chocolate

Snack Add-Ons

- Goldfish \$0.75
- Assorted Cereal Bars \$1.00
- Rice Krispie Bar \$1.00
- Baked Chips \$1.00

Beverage Add-Ons

- Natures Twist Orangeade \$1.50
- Natures Twist Lemonade \$1.50
- Glacier Fruit Water \$1.50
- SOBE Life Water \$1.50
- Lipton Diet Green Tea \$1.50
- Powerade Zero 20 oz. \$1.50
- Minute Maid Juice 10 oz. \$1.25
- Aquafina Water \$1.50
- Vitamin Water ZERO \$1.50

[Place Order](#)

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